

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-13ARIMA-SEATS software to calculate factors for seasonal adjustment of both historical and current series.

Seasonal adjustment for some CPI series uses a technique called intervention analysis that is included in the Census X-13 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-13ARIMA-SEATS is used to perform intervention analysis seasonal adjustment, unusual events are modeled as part of the seasonal adjustment process. X-13ARIMA-SEATS'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 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 2014, BLS adjusted the series listed below using intervention analysis seasonal adjustment techniques. BLS examined these series using the 8-year span from January 2006 through December 2013.

| | | |
|---|---|---|
| Airline fare | Gasoline, unleaded regular | Nondurables less food |
| Bakery products | Ice cream and related products | Nondurables less food and apparel |
| Beverage materials including coffee and tea | Juices and nonalcoholic drinks | Nondurables less food and beverages |
| Carbonated drinks | Leased cars and trucks | Nondurables less food, beverages, and apparel |
| Cereals and bakery products | Motor fuel | Prescription drugs |
| Cheese and related products | New cars | Public transportation |
| Coffee | New cars and trucks | Used cars and trucks |
| Electricity | New trucks | Utilities and public transportation |
| Gasoline, all types | New vehicles | Utility (piped) gas service |
| Gasoline, unleaded midgrade | Nonalcoholic beverages and beverage materials | |
| Gasoline, unleaded premium | Nondurables | |

For each series that was adjusted using X-13ARIMA-SEATS 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.

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Consumer Price Index series – intervention analysis seasonal adjustment

| Series | Level shift period(s) | Event | Outliers |
|---|-----------------------|---|---------------------------------------|
| Airline fare | 2/08-7/08 | Higher fuel surcharges implemented by airlines due to increased fuel costs | 3/13 |
| | 8/08-1/09 | Return to normal pricing | |
| | 8/09-12/09 | Reduction in airplane capacity led to less availability, fewer discounts, and higher prices | |
| Bakery products | 1/08-5/08 | World grain shortage, rising ingredient costs, and rising fuel costs led to higher prices | None |
| Beverage materials including coffee and tea | 9/10 | Bad weather conditions in Brazil and Colombia, planned supply hoarding by exporters in Brazil and Vietnam, and a general manufacturer's price increase | 2/08 |
| | 12/10-8/11 | Bad weather conditions in Brazil and Colombia and increased supply hoarding | |
| Carbonated drinks | 8/08-10/08 | Higher commodity costs combined with a declining demand for soft drinks | 3/07, 12/07, 4/08, 3/09, 10/10, 12/10 |
| Cereals and bakery products | 1/08-5/08 | World grain shortage, rising ingredient costs, and rising fuel costs led to higher prices | None |
| Cheese and related products | 6/07-10/07 | Cheese prices increased due to volatile spot trading, strong demand and higher Class III milk prices | 4/06, 6/06 |
| | 4/08-8/08 | Significantly greater demand for corn used in ethanol led to higher feed prices; higher energy and milk prices | |
| | 12/08-05/09 | Decline in domestic demand and softer export sales due to exchange rates; increased milk production led to larger cheese stocks | |
| | 1/11 | Increased milk output and ample cheese stocks | |
| | 3/11-9/11 | Higher feed prices, rising energy prices, and strong international demand for dairy products | |
| | 4/12 | Higher milk output in April resulted in lower cheese prices | |
| Coffee | 4/08 | Speculation of a smaller Brazilian crop, and a weak U.S. dollar | None |
| | 7/10-9/10 | Bad weather conditions in Brazil and Colombia, planned supply hoarding by exporters Brazil and Vietnam, and a general manufacturer's price increase during the modeled period | |
| | 12/10-8/11 | Bad weather conditions in Brazil and Colombia and increased supply hoarding | |
| Electricity | 7/12 | A new sample, more reflective of the electricity market, was selected | 2/10 |

CPI series – intervention analysis seasonal adjustment-continued

| Series | Level shift period(s) | Event | Outliers |
|--------------------------------|-----------------------|--|--------------------------------|
| Gasoline, all types | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |
| Gasoline, unleaded midgrade | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |
| Gasoline, unleaded premium | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |
| Gasoline, unleaded regular | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |
| Ice cream and related products | 6/09 | Large decrease in ingredient prices during May | None |
| | 11/10-2/11 | Strong foreign demand for whey, butter fat and other ingredients used in ice cream | |
| | 4/12-8/12 | Higher milk output in April and higher production of frozen dairy products | |
| Juices and nonalcoholic drinks | 8/08-10/08 | Higher commodity costs combined with a declining demand for soft drinks | 3/07, 12/07, 4/08, 3/09, 12/10 |
| Leased cars and trucks | 7/08-10/08 | Decreased demand for SUV's and light trucks due to higher gasoline prices, leading to lower residual prices and higher lease prices | None |
| | 12/08-2/09 | Decreased demand for SUV's and light trucks due to higher gasoline prices, leading to lower residual prices and higher lease prices | |
| | 6/09 | "Car Allowance Rebate System" initiative led to a lower supply of used cars and an increase in used car prices, allowing manufacturers to decrease leased car prices as the residual prices returned to normal | |
| | 2/10 | Recalls put downward pressure on residual values for used cars, resulting in higher lease prices | |
| Motor fuel | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |

CPI series – intervention analysis seasonal adjustment-continued

| Series | Level shift period(s) | Event | Outliers |
|---------------------|-----------------------|--|----------|
| New cars | 4/09-7/09 | Return to regular pricing was more pronounced due to heavy losses from deep discounting in the summer and fall of 2008; dramatic production cuts spurred by high inventories | None |
| | 9/09-11/09 | Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories | |
| | 3/11-6/11 | Pent-up demand from earlier delayed purchases due to declining economic conditions resulting in higher current demand; significantly fewer discounts and incentives; shortages in supply due to earthquake and tsunami in Japan leading to below average inventories | |
| New cars and trucks | 2/09-7/09 | Return to regular pricing was more pronounced due to heavy losses from deep discounting in the summer and fall of 2008; dramatic production cuts spurred by high inventories | None |
| | 9/09-11/09 | Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories | |
| | 3/11-6/11 | Pent-up demand from earlier delayed purchases due to declining economic conditions resulting in higher current demand; significantly fewer discounts and incentives; shortages in supply due to earthquake and tsunami in Japan leading to below average inventories | |
| New trucks | 1/09-7/09 | Return to regular pricing was more pronounced due to heavy losses from deep discounting in the summer and fall of 2008; dramatic production cuts spurred by high inventories | None |
| | 9/09-11/09 | Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories | |
| | 1/11-5/11 | Pent-up demand from earlier delayed purchases due to declining economic conditions resulting in higher current demand; significantly fewer discounts and incentives; shortages in supply due to earthquake and tsunami in Japan leading to below average inventories | |
| New vehicles | 2/09-7/09 | Return to regular pricing was more pronounced due to heavy losses from deep discounting in the summer and fall of 2008; dramatic production cuts spurred by high inventories | None |
| | 9/09-11/09 | Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories | |
| | 3/11-6/11 | Pent-up demand from earlier delayed purchases due to declining economic conditions resulting in higher current demand; significantly fewer discounts and incentives; shortages in supply due to earthquake and tsunami in Japan leading to below average inventories | |

CPI series – intervention analysis seasonal adjustment-continued

| Series | Level shift period(s) | Event | Outliers |
|---|-----------------------|---|--------------------------------|
| Nonalcoholic beverages and beverage materials | 8/08-10/08 | Higher commodity costs combined with a declining demand for soft drinks | 3/07, 12/07, 4/08, 3/09, 12/10 |
| Nondurables | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |
| Nondurables less food | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |
| Nondurables less food and apparel | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |
| Nondurables less food and beverages | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |
| Nondurables less food, beverages, and apparel | 8/06-10/06 | Collapse in profit margins for oil refineries | None |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| | 6/09 | Return to normal pricing | |
| Prescription drugs | 1/07-3/07 | Significantly lower prices for some generic drugs due to patent loss and new generic drug discount program implementations at several major retailers | 5/13, 12/13 |
| | 10/12-12/12 | Expiration of patents resulted in increased availability of generic alternatives | |
| Public transportation | 2/08-7/08 | Higher fuel surcharges implemented by airlines due to increased fuel costs | 3/13 |
| | 8/08-1/09 | Return to normal pricing | |
| | 8/09-12/09 | Reduction in airplane capacity led to less availability, fewer discounts, and higher prices | |

CPI series – intervention analysis seasonal adjustment-continued

| Series | Level shift period(s) | Event | Outliers |
|-------------------------------------|-----------------------|--|----------|
| Used Cars and Trucks | 12/08-3/09 | Decrease in demand due to the recession and large increases in gas prices, and consumers experiencing difficulty in getting loans due to the global credit crunch | None |
| | 9/09-12/09 | Decrease in supply due to “Car Allowance Rebate System” program, and increase in demand due to record low inventory of new cars. Fewer cars coming off lease at this time | |
| | 3/11-6/11 | Reduced supply of new cars in 2009 and 2010 due to the recession led to lower supply of used cars in 2011; shortages caused by the earthquake in Japan affected parts and supplies resulting in increased new car prices and higher demand for used cars | |
| Utilities and public transportation | 2/08-7/08 | Effect of a widening storage deficit, combined with strong summer demand | None |
| | 8/08-1/09 | Introduction of lower winter gas rates, and recovery of storage inventories | |
| Utility (piped) gas service | 3/08-7/08 | Effect of a widening storage deficit, combined with strong summer demand | 10/06 |