

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 interventions removed. 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](#).

BLS examined CPI series using the 8-year span from January 2008 through December 2015 with a few exceptions. *New vehicles, New cars and trucks, New trucks, New Cars, Used cars and trucks, Public transportation, Airline fare, and Other lodging away from home including hotels and motels* were adjusted using a 5-year data span from January 2011 through December 2015.

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 2016, BLS adjusted the series listed below using intervention analysis seasonal adjustment techniques.

Beverage materials including coffee and tea	Gasoline, all types	Nondurables less food
Beef and veal	Gasoline, unleaded midgrade	Nondurables less food and apparel
Carbonated drinks	Gasoline, unleaded premium	Nondurables less food and beverages
Cereals and bakery products	Gasoline, unleaded regular	Nondurables less food, beverages, and apparel
Cheese and related products	Ice cream and related products	Other household fuels
Cigarettes	Juices and nonalcoholic drinks	Other lodging away from home including hotels and motels
Coffee	Leased cars and trucks	Physicians' services
Dairy and related products	Motor fuel	Pork
Domestically produced farm food	New cars	Prescription drugs
Eggs	Nonalcoholic beverages and beverage materials	Public transportation
Fresh milk other than whole	Nondurables	Tobacco and smoking products
Fresh whole milk		Utilities and public transportation
Fuel oil and other fuels		Utility (piped) gas service

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
Beef and veal	4/08	Increase in production	7/09
	12/10-1/11	Higher input costs (wheat and corn) due to drought	
	2/14	Smallest herd size since 1951; result of years of drought and high feed prices	
	8/14	Higher feed prices coupled with increased demand	
Beverage materials including coffee and tea	3/09-4/09	Declining and volatile tea industry prices due to global recession; coffee prices fell on concern that prolonged recession would reduce demand for raw materials	2/08, 10/08, 12/10
	8/10-9/10	Bad weather conditions in Brazil and Colombia, planned supply hoarding by exporters in Brazil and Vietnam, and a general manufacturer's price increase for coffee	
	2/11-7/11	Bad weather conditions in Brazil and Colombia and increased supply hoarding for coffee	
Carbonated drinks	8/08-10/08	Higher commodity costs combined with a declining demand for soft drinks	4/08, 3/09, 6/10, 10/10, 12/10, 4/13
	5/11-8/11	Higher costs of sweeteners, such as corn syrup and other raw materials, were passed to consumers	
Cereals and bakery products	1/08-7/08	World grain shortage, rising ingredient costs, and rising fuel costs led to higher prices	None
	1/11-10/11	Southern U.S. and Mexico drought	
Cheese and related products	4/08-7/08	Significantly greater demand for corn used in ethanol led to higher feed prices; higher energy and milk prices	None
	8/08-8/09	Decline in domestic demand and softer export sales due to exchange rates; increased milk production led to larger cheese stocks	
	2/11-9/11	Higher feed prices, rising energy prices, and strong international demand for dairy products	
	1/14-5/14	Increase in cheese prices due to higher demand and stronger export sales	
Cigarettes	2/09-4/09	Increase in federal excise tax coupled with manufacturer price increases	None
Coffee	2/08-4/08	Speculation of a smaller Brazilian crop and a weak U.S. dollar	12/10
	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	
	2/11-7/11	Bad weather conditions in Brazil and Colombia and increased supply hoarding	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Dairy and related products	3/08-7/08	Significantly greater demand for corn used in ethanol led to higher feed prices; higher energy, milk and cheese prices	None
	1/09-8/09	Decline in domestic demand and softer export sales due to exchange rates; increased milk production led to larger cheese stocks	
	2/11-9/11	Higher feed prices, rising energy prices, and strong international demand for dairy products	
	10/13-5/14	Increase in cheese prices due to higher demand and stronger export sales	
Domestically produced farm food	3/08-9/08	Dry conditions in the Southern Plains and Southeast; world grain shortage; increase in global demand for more resource intensive food and increase in price of fertilizer	None
	2/11-9/11	Southern U.S. and Mexico drought; global demand for biofuel increased demand for feedstock crop (i.e. production of corn-based ethanol)	
	1/14-5/14	Higher beef and veal prices as a result of drought (i.e. Texas and California) and higher feed prices; higher dairy prices	
Eggs	6/15	Shortages caused by the outbreak of the Avian influenza A (H7N9) virus put sharp upward pressure on wholesale and retail prices	None
Fresh milk other than whole	6/08-7/08	Significantly greater demand for corn used in ethanol; higher energy and milk prices	None
	11/08-8/09	Decline in domestic demand and softer export sales due to exchange rates; increased milk production	
	2/11-5/11	Higher feed prices (corn/soybean), rising energy prices, and strong international demand for dairy products	
	11/13-5/14	Slower increase in milk production; strong domestic and foreign demand	
Fresh whole milk	6/08-7/08	Significantly greater demand for corn used in ethanol; higher energy and milk prices	None
	11/08-8/09	Decline in domestic demand and softer export sales due to exchange rates; increased milk production	
	2/11-5/11	Higher feed prices (corn/soybean), rising energy prices, and strong international demand for dairy products	
	11/13-5/14	Slower increase in milk production; strong domestic and foreign demand	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Fuel oil and other fuels	3/08-7/08	Record high crude oil prices	None
	8/08-12/08	Response in crude oil markets to world-wide economic downturn	
	3/14	High propane prices caused by unseasonably low temperatures and high farm demand, driving residential supply down	
	11/14-1/15	Low prices due to increased oil production and reduced non-domestic demand	
Gasoline, all types	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	
Gasoline, unleaded midgrade	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	
Gasoline, unleaded premium	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	
Gasoline, unleaded regular	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	
Ice cream and related products	11/10-2/11	Strong foreign demand for whey, butter fat and other ingredients used in ice cream	5/09, 2/12, 12/14
Juices and nonalcoholic drinks	9/08	Manufacturers raising prices due to higher commodity costs and declining U.S. sales	2/08, 4/08, 3/09, 10/10, 12/10, 9/12, 5/13, 3/15
	10/09	Forecasted increase of orange crop	
	6/11-7/11	Expected smaller than usual crop due to winter freeze, diseases and a drought in Florida	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Leased cars and trucks	7/08-10/08	Decreased demand for SUVs and light trucks due to higher gasoline prices, leading to lower residual prices and higher lease prices	08/09
	12/08-2/09	Decreased demand for SUVs 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	
	10/15-12/15	Lower residual values pushed lease prices higher	
Motor fuel	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	
New cars	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	None
Nonalcoholic beverages and beverage materials	8/08-10/08	Higher commodity costs combined with a declining demand for soft drinks	4/08, 3/09, 12/10
	2/11-7/11	Bad weather conditions in Brazil and Colombia and increased supply hoarding for coffee; higher soft drink prices	
Nondurables	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	
Nondurables less food	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Nondurables less food and apparel	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	
Nondurables less food and beverages	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	
Nondurables less food, beverages, and apparel	9/08-12/08	Response in crude oil markets to world-wide economic downturn	None
	6/09	Return to normal pricing	
	11/14-1/15	Weak global demand along with increased supply from continued growth in North American crude production	
Other households fuels	4/08-7/08	Record high crude oil prices	None
	12/13-2/14	High propane prices caused by unseasonably low temperatures and high farm demand, driving residential supply down	
	2/14-4/14	Return to normal pricing and supply recovery after low temperatures	
Other lodging away from home including hotels and motels	None		6/15
Physicians' services	5/12-9/12	Higher prices mostly due to hospitals buying physician practices	2/15, 11/15
Pork	4/08	Rising corn (feed) prices; higher exports that diverted pork available for domestic consumption	None
	4/14	PED virus led to millions of piglets and slaughter-ready pigs being killed	
Prescription drugs	10/12-12/12	Expiration of patents resulted in increased availability of generic alternatives	2/14
	5/13	Higher concentration than normal of brand to generic conversions due to patent loss for a variety of drugs	
	12/13	Higher concentration than normal of brand to generic conversions due to patent loss for a variety of drugs	
Public transportation	None		3/13
Tobacco and smoking products	2/09-4/09	Increase in federal excise tax coupled with manufacturer price increases	None

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Utilities and public transportation	2/08-7/08	Effect of a widening storage deficit, combined with strong summer demand	4/14
	8/08-11/08	Introduction of lower winter gas rates, and recovery of storage inventories	
	1/09-4/09	Increased inventories compared to 12 months prior, weak demand and reduced spot market prices	
	12/13-3/14	Dramatic increase in demand due to extreme winter in Midwest and Northeast	
Utility (piped) gas service	2/08-7/08	Effect of a widening storage deficit, combined with strong summer demand	None
	8/08-9/08	Introduction of lower winter gas rates and recovery of storage inventories	
	3/09-5/09	Increased inventories compared to 12 months prior; weak demand and reduced spot market prices	
	1/14-3/14	Dramatic increase in demand due to extreme winter in Midwest and Northeast	