

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 2012, BLS adjusted the series listed below using intervention analysis seasonal adjustment techniques. BLS examined these series using the 8-year span from January 2004 through December 2011.

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

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.

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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	None
	7/08-2/09	Return to normal pricing	
	8/09-12/09	Reduction in airplane capacity led to less availability, fewer discounts, and higher prices.	
Beverage materials including coffee and tea	11/04-4/05	Smaller Brazilian coffee crop, rising Brazilian Currency	2/08
	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	
	12/10-8/11	Bad weather conditions in Brazil and Colombia and increased supply hoarding	
Cable and satellite television and radio service	None	None	6/05, 7/05
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, 12/10
Cheese and related products	5/04	Very low spring stocks of cheese and butter, plus lower production of raw milk	4/06, 6/06
	9/05	Response to tight cheese and dairy market	
	6/07-10/07	Cheese prices increased due to volatile spot trading, strong demand and higher Class III Milk prices	
	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 3/11-9/11	Increased milk output and ample cheese stocks Higher feed prices, rising energy prices, and strong international demand for dairy products	
Coffee	11/04-4/05	Smaller Brazilian coffee crop, rising Brazilian currency	None
	4/08	Speculation of a smaller Brazilian crop, and a weak U.S. dollar	
	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	1/06	Larger than normal increase due to recovery from Hurricane Katrina	11/05, 2/10

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Gasoline, all types	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	9/08-12/08	Response in crude oil markets to world-wide economic downturn	
	6/09	Return to normal pricing	
Gasoline, unleaded midgrade	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	9/08-12/08	Response in crude oil markets to world-wide economic downturn	
	6/09	Return to normal pricing	
Gasoline, unleaded premium	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	9/08-12/08	Response in crude oil markets to world-wide economic downturn	
	6/09	Return to normal pricing	
Gasoline, unleaded regular	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	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	3/05, 6/05, 8/06
	11/10-2/11	Strong foreign demand for whey, butter fat and other ingredients used in ice cream	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Juices and nonalcoholic drinks	2/05-4/05	Orange juice futures increased due to cuts in projected citrus production of Florida, related to the previous hurricane season	3/07, 12/07, 4/08, 3/09, 12/10
	8/08-10/08	Higher commodity costs combined with a declining demand for soft drinks	
Leased cars and trucks	7/05-9/05	Effect of interest rates rising to a four year high, which impacted the money factor included in leases	None
	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	
	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	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	9/08-12/08	Response in crude oil markets to world-wide economic downturn	
	6/09	Return to normal pricing	
New cars	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	7/08, 8/08, 9/08
	8/09	"Car Allowance Rebate System" program temporarily depressed prices	
	8/09-11/09	Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories	
	1/11-6/11	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
New cars and trucks	7/08-9/08	Record discounting on vehicles in response to weaker sales and declining economic conditions	None
	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	
	8/09	“Car Allowance Rebate System” program temporarily depressed prices	
	8/09-11/09	Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories	
	1/11-6/11	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	7/08-9/08	Record discounting on vehicles in response to weaker sales and declining economic conditions	None
	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	
	9/09-11/09	Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories	
	1/11-6/11	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 vehicles	7/08-9/08	Record discounting on vehicles in response to weaker sales and declining economic conditions	None
	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	
	8/09	“Car Allowance Rebate System” program temporarily depressed prices	
	8/09-11/09	Production cuts by manufacturers in spring 2009 resulting in all-time low levels of inventories	
	1/11-6/11	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	2/05-4/05	Orange juice futures increased due to cuts in projected citrus production of Florida, related to the previous hurricane season, combined with a small Brazilian coffee crop	3/07, 4/08, 3/09, 12/10
	8/08-10/08	Higher commodity costs combined with a declining demand for soft drinks	
Nondurables	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	9/08-12/08	Response in crude oil markets to world-wide economic downturn	
	6/09	Return to normal pricing	
Nondurables less food	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	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	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	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	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	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
Nondurables less food, beverages, and apparel	6/05-9/05	Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria	None
	10/05-11/05	Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices	
	8/06-10/06	Collapse in profit margins for oil refineries	
	9/08-12/08	Response in crude oil markets to world-wide economic downturn	
	6/09	Return to normal pricing	
Other lodging away from home including hotels and motels	None	None	9/05
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	None
Public transportation	2/08-7/08	Higher fuel surcharges implemented by airlines due to increased fuel costs	None
	7/08-2/09	Return to normal pricing	
	8/09-12/09	Reduction in airplane capacity led to less availability, fewer discounts, and higher prices.	
Used Cars and Trucks	9/08-3/09	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
	7/09-12/09	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	
	2/11-8/11	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	8/05-10/05	Supply disruptions due to Hurricane Katrina	None
	1/06	Larger than normal increase due to recovery from Hurricane Katrina	
	2/08-7/08	Effect of a widening storage deficit, combined with strong summer demand	
	7/08-11/08	Introduction of lower winter gas rates, and recovery of storage inventories	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Utility (piped) gas service	8/05-10/05	Supply disruptions due to Hurricane Katrina	10/06
	3/08-7/08	Effect of a widening storage deficit, combined with strong summer demand	
	8/08-11/08	Introduction of lower winter gas rates, and recovery of storage inventories	
	3/09-5/09	Increased inventories compared to 12 months ago, weak demand and reduced spot market prices	