

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	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
Coffee	New cars	Public transportation
Electricity	New cars and trucks	Used cars and trucks
Gasoline, all types	New trucks	Utilities and public transportation
Gasoline, unleaded midgrade	New vehicles	Utility (piped) gas service
Gasoline, unleaded premium	Nonalcoholic beverages and beverage materials	Video and audio
Gasoline, unleaded regular	Nondurables	
	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
	8/08-2/09	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
Cable and satellite television and radio service	None	None	6/05, 7/05
Carbonated drinks	4/02-6/02	Promotions associated with significant new brand introductions	7/03, 3/07, 12/07, 4/08, 3/09
	8/08-10/08	Higher commodity costs combined with a declining demand for soft drinks	
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	
Electricity	1/06	Larger than normal increase due to recovery from Hurricane Katrina	11/05
	6/09	Dramatically decreased electricity generation costs due to lower fuel prices	
Gasoline, all types	3/03-5/03	Oil strike in Venezuela ends, with faster than expected increases in oil supply	None
	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	
	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
Gasoline, unleaded midgrade	3/03-5/03	Oil strike in Venezuela ends, with faster than expected increases in oil supply	None
	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	
	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	3/03-5/03	
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	
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		3/03-5/03	Oil strike in Venezuela ends, with faster than expected increases in oil supply
	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	
	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	3/03-6/03	Sluggish demand for dairy food "treats"
6/09		Large decrease in ingredient prices during May	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Juices and nonalcoholic drinks	4/02-6/02	Promotions associated with significant new brand introductions	7/03, 11/03, 3/07, 4/08, 3/09
	2/05-4/05	Orange juice futures increased due to cuts in projected citrus production of Florida, related to the previous hurricane season	
	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 SUVs and light trucks due to higher gasoline prices, leading to lower residual prices and higher lease prices	
	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	
Motor fuel	3/03-5/03	Oil strike in Venezuela ends, with faster than expected increases in oil supply	None
	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	
	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
New cars	6/04-8/04	Effect of very large cash incentives offered by domestic automakers	8/03, 7/08, 8/08, 9/08
	11/04	Return to normal promotions, combined with the effect of a model changeover	
	6/05-8/05	Employee pricing discounts offered by domestic automakers and corresponding incentives offered by imported makes	
	8/05-10/05	Short supply of fuel-efficient vehicles in light of record gasoline prices, combined with early 2006 model changeovers and a return to normal promotions following employee pricing offers	
	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	
New cars and trucks	7/08-9/08	Record discounting on vehicles in response to weaker sales and declining economic conditions	1/02, 1/03, 2/03
	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	
New trucks	7/08-9/08	Record discounting on vehicles in response to weaker sales and declining economic conditions	1/02
	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	
New vehicles	7/08-9/08	Record discounting on vehicles in response to weaker sales and declining economic conditions	1/02, 1/03, 2/03
	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	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Nonalcoholic beverages and beverage materials	4/02-6/02	Promotions associated with significant new brand introductions in carbonated drinks	7/03, 11/03, 3/07, 4/08, 3/09
	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	
	8/08-10/08	Higher commodity costs combined with a declining demand for soft drinks	
Nondurables	3/03-5/03	Oil strike in Venezuela ends, with faster than expected increases in oil supply	None
	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	
	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	3/03-5/03	Oil strike in Venezuela ends, with faster than expected increases in oil supply	None
	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	
	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	3/03-5/03	Oil strike in Venezuela ends, with faster than expected increases in oil supply	None
	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	
	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 and beverages	3/03-5/03	Oil strike in Venezuela ends, with faster than expected increases in oil supply	None
	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	
	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, beverages, and apparel	3/03-5/03	Oil strike in Venezuela ends, with faster than expected increases in oil supply	None
	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	
	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	5/03	Higher room rates resulting from sustained increases in occupancy	9/05
	3/05	Favorable skiing conditions on the east coast which lengthened the skiing season and extended the applicability of peak rates; increased demand related to conventions	
Public transportation	2/08-7/08	Higher fuel surcharges implemented by airlines due to increased fuel costs	None
	8/08-2/09	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" initiative, and increase in demand due to record low inventory of new cars. Fewer cars coming off lease at this time	

CPI series – intervention analysis seasonal adjustment-continued

Series	Level shift period(s)	Event	Outliers
Utilities and public transportation	1/03-3/03	Supply problems in Venezuela, onset of colder than expected weather, and historically low storage levels	None
	8/05-10/05	Supply disruptions due to Hurricane Katrina	
	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	
	8/08-11/08	Introduction of lower winter gas rates, and recovery of storage inventories	
Utility (piped) gas service	1/03-3/03	Supply problems in Venezuela, onset of colder than expected weather, and historically low storage levels	10/06
	8/05-10/05	Supply disruptions due to Hurricane Katrina	
	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	
Video and audio	None	None	12/02, 6/05, 7/05, 1/09