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Measuring consumer price change during economic downturns: a review of assumptions about consumer spending

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The Bureau of Labor Statistics (BLS) publishes a wide variety of measures of consumer price change, each with different market baskets that are used to calculate average price change across items and cities. A Consumer Price Index (CPI) is a weighted average of price change for a market basket of consumer goods and services. One measure of price change is the CPI All Urban Consumers (CPI-U). This measure is what most media outlets refer to as consumer inflation. The CPI-U is published in a timely manner, less than 2 weeks after the reference month,

but the market basket is based on consumer spending from 2017–2018 for January 2020 to December 2021 indexes.

An alternative measure of price change, the Chained CPI-U (C-CPI-U), is published as a final version about 1 year after the CPI-U. The delay is due to processing a market basket of consumer spending for the corresponding index month. By reflecting consumer spending in the month that it occurred, the final C-CPI-U more closely measures the change in the cost of living than the CPI-U.[1] BLS also publishes a preliminary version of the C-CPI-U with the same timeliness and market basket as the CPI-U. This preliminary version assumes consumers shift spending in response to price change.[2] These assumptions are reasonable during stable economic periods, generally making the preliminary C-CPI-U a good approximation of the final C-CPI-U.

During economic downturns, how do these measures help in analyzing price change, and what can we assume about consumption? This **Beyond the Numbers** article explores the final C-CPI-U during the Great Recession and the recession that occurred as a result of the COVID-19 pandemic.[3] Additionally, the article evaluates consumer spending assumptions of the CPI-U and preliminary C-CPI-U during these recessionary periods to highlight challenges of lagged consumer spending data.

Calculating the CPI-U and C-CPI-U

BLS calculates the CPI-U by using a market basket of goods and services with fixed quantity weights that are updated every 2 years. The market basket weights were recently updated in January 2020, and reflect consumer spending patterns of 2017 and 2018. These weights were used throughout 2020 and 2021.

The CPI-U uses fixed quantity weights, meaning that we assume that consumers purchase the same mix of goods and services and in the same quantities in every period. In reality, consumers tend to change their consumption patterns in response to relative price change by substituting goods whose prices are rising with goods whose prices are falling relative to the average. Because the method for calculating the CPI-U does not account for consumer substitution within a biennial index period, the CPI-U is often considered on the highest end among price indexes of consumer inflation.[4]

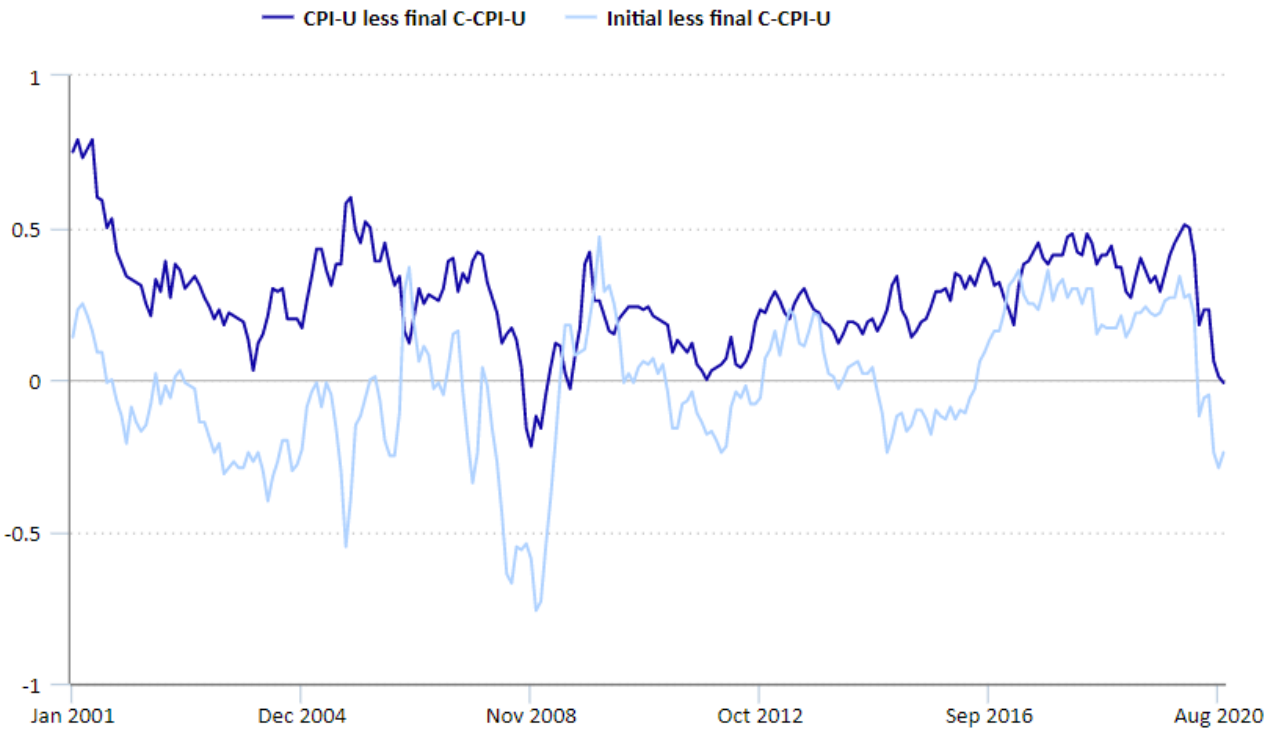
The C-CPI-U is another measure of price change that uses contemporaneous consumer spending data to reflect how consumers change their buying habits. For example, consumer inflation in May 2020, as measured by the C-CPI-U, reflects consumer spending in April and May 2020, whereas the May 2020 CPI-U reflects consumer spending as fixed quantities from 2017 to 2018. By reflecting actual consumer behavior (no assumptions needed), the C-CPI-U more closely approximates consumer price change than the CPI-U. The drawback is consumer spending estimates for May 2020 are not available until May 2021, so a preliminary version is published before final estimates are available.

The CPI-U tends to yield estimates of price change that are larger than the C-CPI-U.[5] Chart 1 displays the difference between the 12-month changes in the CPI-U and the C-CPI-U, often referred to as upper level substitution bias in the CPI-U, from January 2001 to September 2020.[6] The CPI-U tends to be higher than the C-CPI-U because in the CPI-U we do not capture the consumers substituting lower priced goods and services when faced with higher prices. We do capture this type of substitution in the C-CPI-U. The CPI-U measure of price change is greater than the C-CPI-U (i.e., the difference in price change is positive), with the exception of the period between October 2008 and February 2009. During this period, the C-CPI-U was higher than the CPI-U. This is

particularly unusual because the C-CPI-U allows for consumers to adjust the quantities they consume when prices change.

Before final C-CPI-U estimates are available, BLS publishes a preliminary version (initial C-CPI-U) that relies on modeled assumptions of consumer behavior by analyzing how consumers change their spending in response to price change. The performance of the initial C-CPI-U can also be evaluated relative to actual consumer behavior exhibited by the final C-CPI-U. Chart 1 shows the difference between the 12-month percent changes of the initial C-CPI-U minus the final C-CPI-U from January 2001 to September 2020. There were three past recessions over that period, including the most recent February 2020 to April 2020 recession. As an estimate of the final C-CPI-U that more closely measures the change in the cost of living, the initial version is usually a better predictor than the CPI-U. When consumer behavior diverges from expectations (i.e., they don't buy more of relatively less expensive goods), it's possible the CPI-U will be closer to the final C-CPI-U. In fact, for roughly 75 percent of the months (173 out of the 228) the C-CPI-U has been calculated, the initial estimate was closer to the final estimate than the CPI-U. The CPI-U was a better predictor of the final C-CPI-U than its initial version in only 55 months, particularly during the 5 months from October 2008 to February 2009 when the difference between the initial and final C-CPI-U was the largest. Periods where the preliminary C-CPI-U had large divergences from the final C-CPI-U, as well as periods where the CPI-U had small divergences from the final C-CPI-U, are worth further examination.

Chart 1. Impact of consumer substitution (12-month change), January 2001–March 2020

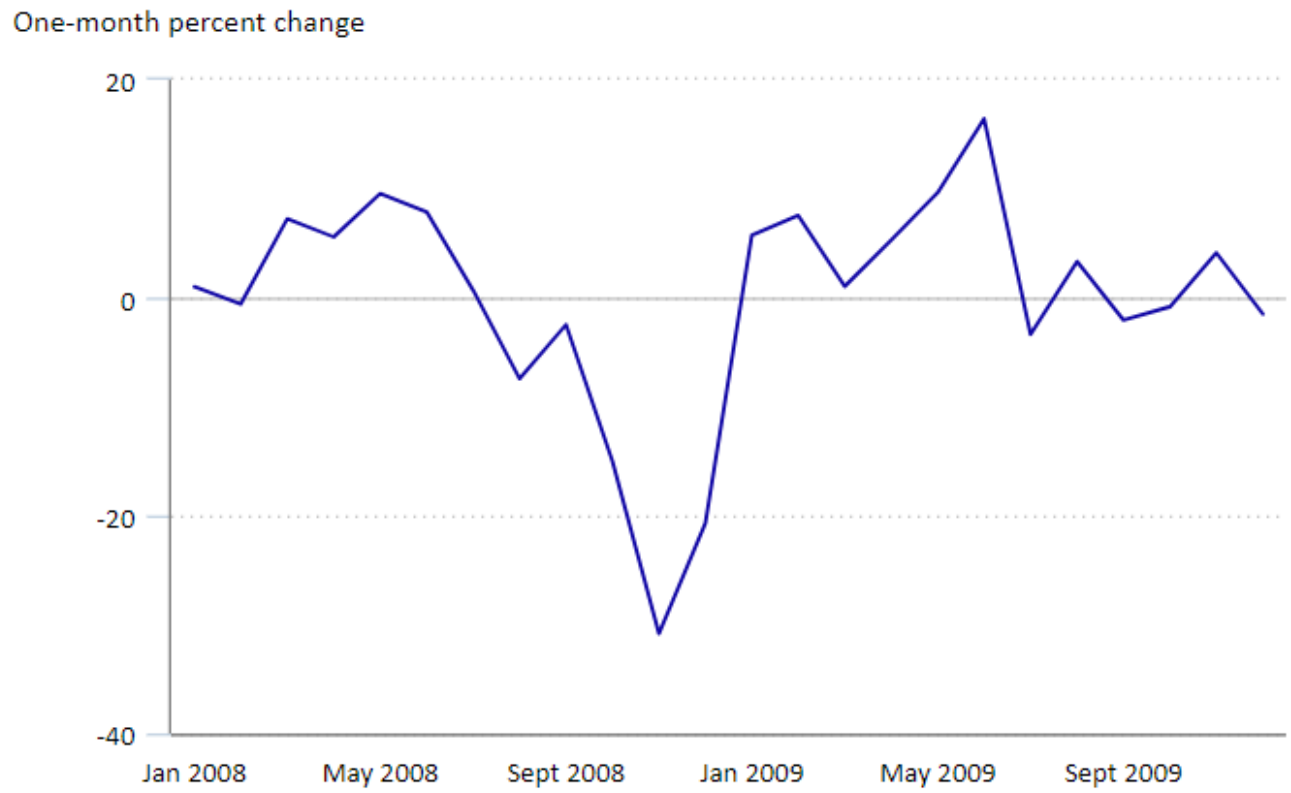


Click legend items to change data display. Hover over chart to view data.
Source: U.S. Bureau of Labor Statistics.

Consumer behavior during the Great Recession

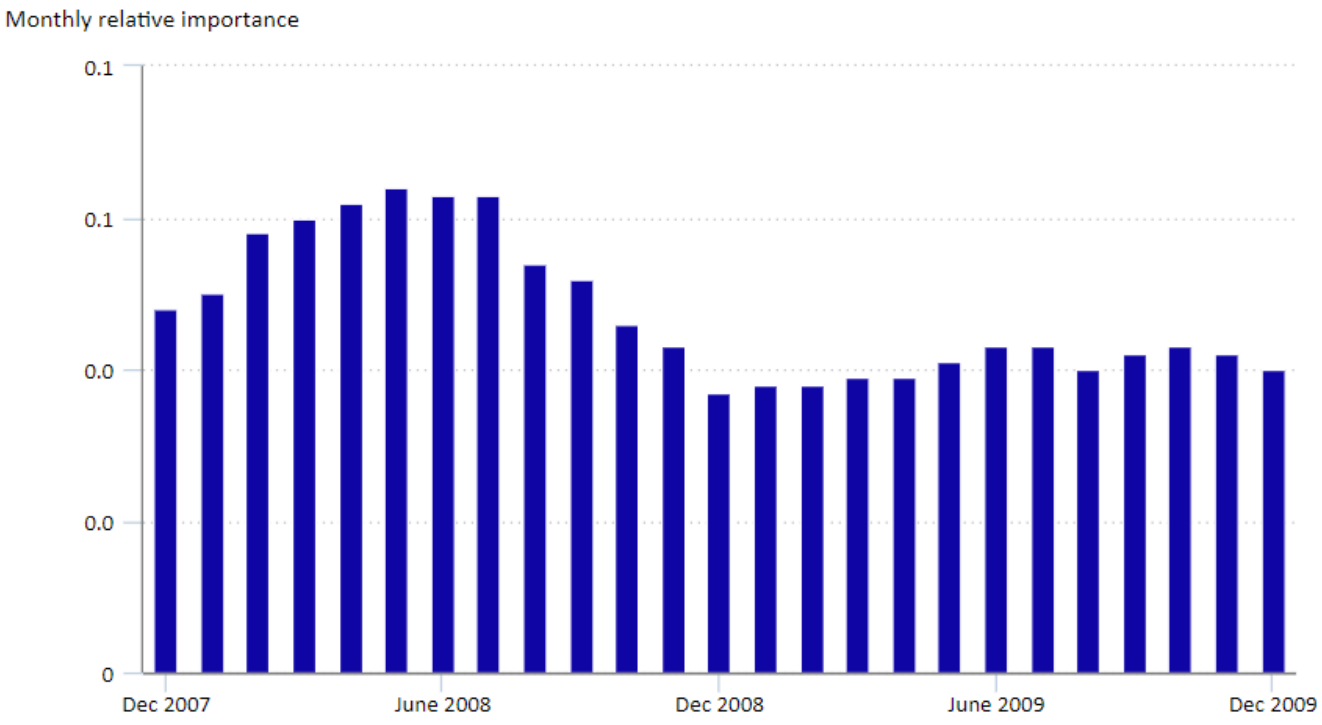
What is so special about the October 2008 to February 2009 period? It is in the middle of the Great Recession, and it includes unusual results of the final C-CPI-U that occurred primarily because of the item category for gasoline. The CPI-U for gasoline decreased 30.8 percentage points as displayed in chart 2. The assumptions underlying the initial C-CPI-U predicts that when prices for a good fall, consumers purchase more of that good. In this case, rather than buying more, consumers spent less on gasoline and expenditure shares relative to the U.S. total expenditures declined by about 2 percentage points as displayed in chart 3. This demonstrates that gasoline demand is driven by many factors in addition to just price.[8] By giving less weight to a good whose price was falling, the C-CPI-U increased faster than the CPI-U for the first time since its publication began. Because consumers did not react as predicted to the large price declines in gasoline, this also resulted in a large difference between the initial C-CPI-U and the final C-CPI-U.

Chart 2. CPI-U one-month change for gasoline (all types)



Hover over chart to view data.
Source: U.S. Bureau of Labor Statistics.

Chart 3. C-CPI-U monthly expenditure weight relative importance for gasoline (all types)



Hover over chart to view data.
Source: U.S. Bureau of Labor Statistics.

Consumer substitution during the COVID-19 pandemic

The October 2008 to February 2009 recessionary period may be relevant to 2020 because it illustrates that during economic shocks, actual consumer behavior can deviate from the assumptions underlying the CPI-U and preliminary C-CPI-U calculations. Even though the weights from 2017–2018 are not likely representative of 2020 consumer behavior due to COVID-19-pandemic store closings and household stay-at-home-orders, consumers are also unlikely to purchase more of many items where prices are decreasing either. Harvard economist Alberto Cavallo conducted research on inflation measures during the pandemic using consumer spending data in the United States compiled from credit card and debit card purchases.[9] His data source shows increased spending on groceries and decreased spending on categories such as healthcare, entertainment and recreation, apparel and general merchandise, transportation, and restaurants and hotels.

Consumer Expenditure (CE) Survey data, the weighting source for BLS CPI products, from April 2020 were released in April 2021 and are consistent with much of the debit and credit card data cited in Cavallo's research. Similar to gasoline spending during the Great Recession, consumers generally bought less of goods and services whose prices fell and more of goods and services whose prices rose. However, there were other categories that followed more typical consumer substitution behavior.

To illustrate 1 month as an example, table 1 shows the 1-month change from March to April 2020 for the CPI-U All Items and select aggregates, as well as the initial C-CPI-U. The effects of the pandemic were first presented in April. From March to April 2020, the final C-CPI-U decreased by 0.5 percent, the CPI-U index decreased by 0.7

percent, and the initial C-CPI-U index decreased at a faster rate of 0.8 percent. One of the primary contributors to the CPI-U (and by extension the C-CPI-U) decline was the Gasoline index, which decreased 16.5 percent in April. Additional contributors to the decline in April include the indexes for Public transportation, Lodging away from home, and Apparel. Spending on all of these categories also declined in April, according to CE data.

Table 1. C-CPI-U and CPI-U 1-month change and relative importances for All Items and select aggregates

Index	March to April 2020 percent change	December 2020 CPI-U relative importance	April 2020 final C-CPI-U relative importance	April 2020 Cavallo COVID relative importance
Final C-CPI-U All Items	-0.50%	[1]	100	[1]
CPI-U All Items	-0.70%	100	[1]	-0.10%
Transportation	-5%	15.2	15.2	6.3
Gasoline	-16.50%	2.8	2.5	[2]
Public transportation	-7.40%	1.1	0.7	[2]
Transportation excluding Gasoline and Public transportation	-1.70%	11.2	12	[2]
Housing	0.00%	42.4	45.3	55.8
Rent of primary residence	0.20%	7.9	7.8	[2]
Lodging away from home	-6.20%	0.8	0.7	[2]
Owners' equivalent rent of residences	0.10%	24.3	27	[2]
Apparel	-4.40%	2.7	1.7	2.2
Food	1.50%	14.1	13.6	14.4
Food at home	2.70%	7.8	9.2	11.3
Food away from home	0.10%	6.3	4.4	3.1

[1] Data not applicable
[2] Estimates not presented
Source: U.S. Bureau of Labor Statistics.

In contrast, Food increased 1.5 percent in April. While prices for Food at home rose more quickly than all other items, spending also increased. Food away from home prices rose at a lower rate (although faster than the average), and spending declined. With the exception of Lodging away from home, the price change for shelter services was more than average, and spending shares increased.

Cavallo estimated that consumer prices fell 0.1 percent in April. In contrast, the CPI-U decreased 0.7 percent, and the C-CPI-U decreased 0.5 percent. The final C-CPI-U index declined more than Cavallo's estimate due in large part to the different weights for Transportation and Food at home. Cavallo's estimates gave less weight to Transportation where prices decreased and more weight to Food at home where prices increase. More analysis is needed to understand the differences in Transportation and Food at home spending.

Conclusion

Consumer decisions to purchase goods are based on many factors, many of which are difficult to model. One consistent factor is the relative price change of goods. This can be described as consumer substitution towards goods whose prices are falling and away from goods whose prices are rising relative to one another. However, as illustrated by the example of gasoline price and spending changes during the Great Recession, sometimes the expected consumer substitution effect does not occur. Similarly, during the early months of the COVID-19

pandemic, the final C-CPI-U reflects actual consumer spending, in which consumers purchased less Gasoline instead of buying more at lower prices. And related, instead of buying less Food at home at higher prices, consumers purchased more. However, unlike during the Great Recession, the aggregation of these lower level changes did produce the expected consumer substitution effect. The October–December 2020 final C-CPI-U will be released in November 2021.

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NOTES

[1] More precisely, the C-CPI-U more closely approximates a cost of living index than the CPI-U, which is the measurement objective of the CPI. See Robert Cage, John Greenlees, and Patrick Jackman, https://www.bls.gov/cpi/additional-resources/chained-cpi-introduction.pdf.

[2] Each of these products use the same elementary price indexes as the measure of price change but differ by index estimation formula and respective weights.

[3] See a list of monthly summaries in "Effects of COVID-19 Pandemic and Response on the Consumer Price Index," https://www.bls.gov/covid19/effects-of-covid-19-pandemic-on-consumer-price-index.htm.

[4] Consumers generally substitute to comparable items in response to changes in relative prices. The modified Laspeyres formula is considered an upper bound measure of price change because of the fixed quantity weights, overstating the change in a cost of living index. See the *International Labour Office CPI Manual*, https://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/presentation/wcms_331153.pdf.

[5] See "Frequently Asked Questions about the Chained Consumer Price Index for All Urban Consumers (C-CPI-U)," https://www.bls.gov/cpi/additional-resources/chained-cpi-questions-and-answers.htm.

[6] The preliminary C-CPI-U 12-month change for January 2015 forward represents the change of the preliminary relative to the final because the final is the base period in common for both versions. The preliminary C-CPI-U 12-month change prior to January 2015

represents the change of initial relative to the interim version because the interim was the base period in common. January 2015 forward, the preliminary C-CPI-U uses a Constant Elasticity of Substitution formula which assumes that when consumers face a price increase for a good, some may substitute it with a comparable good at a lower price, and others will opt not to substitute despite the price increase.

[7] Recession start and end dates are designated by the National Bureau of Economic Research (NBER). The NBER defines a recession as a "significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales." See "U.S. business cycle expansions and contractions" (Cambridge, MA: National Bureau of Economic Research, September 2010), http://www.nber.org/cycles.html.

[8] See *"Short-Term Energy Outlook Supplement:* Motor Gasoline Consumption 2008 Historical Perspective and Short-Term Projections" (Energy Information Administration, April 2008), https://www.eia.gov/outlooks/steo/special/pdf/2008_sp_02.pdf.

[9] Alberto Cavallo, "Inflation with Covid Consumption Baskets," *Working Paper* 27352, National Bureau of Economic Research, https://www.nber.org/papers/w27352.

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