This document outlines recent changes made to the Brave-Butters-Kelley (BBK) Indexes. All future changes will be documented here.

- For the July 1, 2020, release, several improvements were made to the BBKI. First, the list of 500 monthly measures of U.S. real economic activity was updated. Several new series were substituted for others that were found to be redundant or were discontinued. Second, the expectation-maximization (EM) algorithm used in the first stage estimation of the model to obtain the restricted principal components \( \hat{x} \) and \( \hat{F} \) (see box 2 of “A new ‘big data’ index of U.S. economic activity”) was augmented to allow for heteroscedasticity over time in the cross section of idiosyncratic errors. Finally, the state-space model used in the second stage estimation was altered to allow the irregular component of BBK Monthly GDP Growth to follow a second-order autoregressive process. On balance, these changes and incoming data through April 2020 led to small revisions to the history of the BBK Coincident and BBK Leading Indexes, as well as BBK Monthly GDP Growth prior to April 2020, as seen in the figures below.
• For the June 2, 2020, release, we further updated data definitions in order to take full advantage of the advance releases for inventories and international trade data. Even with these changes, we still observed only 428 of 500 monthly data series for April 2020. Given the very large changes in many economic indicators in March and April 2020, we decided not to fully reestimate the model’s parameters until nearly all of the data series were available for April. Instead, we reestimated the model parameters using data through March 2020 (498 of 500 indicators were updated through March). An additional release of the BBKI for April 2020 will be made available with a Chicago Fed Insights blog post to be published on June 15, 2020.

Incoming data through March 2020 led to very small changes in the model’s estimated parameters and, subsequently, revisions to the history of the BBK Coincident and BBK Leading Indexes, as well as BBK Monthly GDP Growth. Of the three, the revisions were largest for the BBK Leading Index, as seen in the figures below.
With the May 4, 2020, release of the BBKI, several improvements were made to the construction of the 500 data series used in the indexes (e.g., imputation of missing values and treatment of outliers). These improvements and incoming data led to small changes in the model’s estimated parameters and, subsequently, revisions to the history of the BBK COINCIDENT and BBK LEADING INDEXES, as well as BBK MONTHLY GDP GROWTH. Of the three, the revisions were largest for the BBK LEADING INDEX, as seen in the figures below.

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1 For more information on what was changed to the imputation of missing values, see p. 7 of the CFNAI background document. Previous iterations of the BBKI used an outlier adjustment to the data that capped large positive and negative values at six times their interquartile range. We are no longer doing so starting with the May 4, 2020, release, as we found that this process had very little effect on past values of the indexes, but severely understated the incoming data during the Covid-19 pandemic.
In what follows, we repeat the figures from “A ‘big data’ view of the U.S. economy: Introducing the Brave-Butters-Kelley Indexes” to demonstrate that the major properties of the BBKI were not impacted by these changes.

**Figure 1. Decomposition of Brave-Butters-Kelley Monthly GDP Growth, 2017–20**

![Figure 1](image)

Source: Authors’ calculations based on data from Haver Analytics.

**Figure 2. Brave-Butters-Kelley Monthly GDP Growth: Trend and cycle components**

![Figure 2](image)

Note: Shaded periods correspond to U.S. recessions as defined by the National Bureau of Economic Research; the vertical line indicates the most recent business cycle peak.

Source: Authors’ calculations based on data from Haver Analytics.
Figure 3. Brave-Butters-Kelley Coincident Index

Notes: GDP refers to gross domestic product. Shaded periods correspond to U.S. recessions as defined by the National Bureau of Economic Research; the vertical line indicates the most recent business cycle peak. The dashed red line shows the historical threshold for U.S. business cycles described in “A ‘big data’ view of the U.S. economy: Introducing the Brave-Butters-Kelley Indexes.” Source: Authors’ calculations based on data from Haver Analytics.

Figure 4. Brave-Butters-Kelley Leading Index

Notes: GDP refers to gross domestic product. Shaded periods correspond to U.S. recessions as defined by the National Bureau of Economic Research; the vertical line indicates the most recent business cycle peak. The dashed red line shows the historical threshold for U.S. business cycles described in “A ‘big data’ view of the U.S. economy: Introducing the Brave-Butters-Kelley Indexes.” Source: Authors’ calculations based on data from Haver Analytics.
Figure 5. AUCs at leads and lags

Notes: Area under the receiver operating characteristic (ROC) curve values (AUCs) correspond to leads (negative horizontal axis values) and lags (positive horizontal axis values) with respect to U.S. recessions as defined by the National Bureau of Economic Research since 1960. The 95% confidence intervals (CIs) are bias-corrected from 500 bootstrap replications. The horizontal and vertical dashed red lines correspond to the peak AUC and associated lead/lag in each panel. For further details, see “A 'big data' view of the U.S. economy: Introducing the Brave-Butters-Kelley Indexes.”
Source: Authors’ calculations based on data from Haver Analytics.

Figure 6. Decomposition of real gross domestic product, 2017–20

Note: The black line is equivalent to the quarterly estimates produced by the U.S. Bureau of Economic Analysis.
Source: Authors’ calculations based on data from Haver Analytics.