

Technical Report

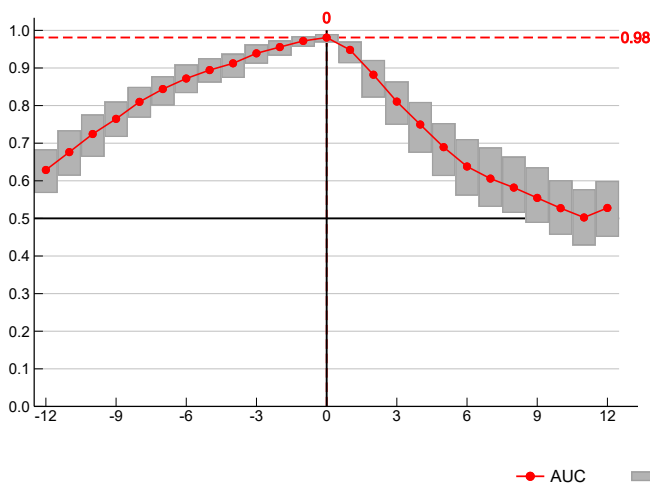
Brave-Butters-Kelley Indexes (BBKI)

by Ross Cole, research analyst
July 5, 2022

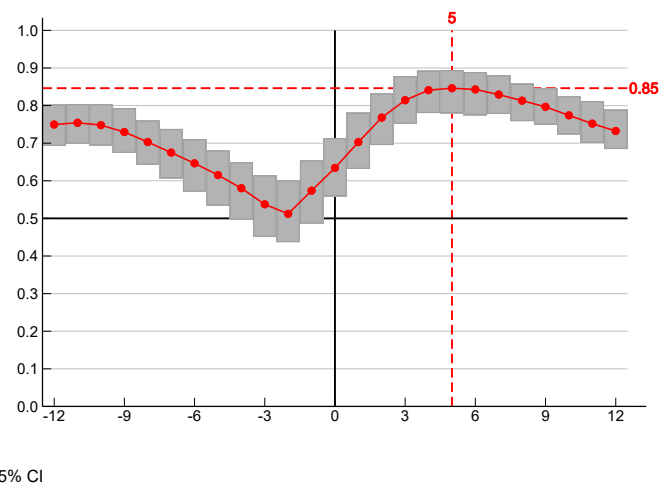
This document outlines recent changes made to the Brave-Butters-Kelley (BBK) Indexes. All future changes will be documented here.

- On July 19, 2021, the National Bureau of Economic Research (NBER) determined that April 2020 marked the end of the recent recession that began in February 2020. Below, we present updated area-under-the-ROC-curve estimates (AUCs) for the BBK Coincident and Leading Indexes for the August 3, 2021, release. In addition, we also summarize recent values of BBK Monthly GDP Growth showing that U.S. real gross domestic product surpassed its February 2020 level in March 2021. See figures 5–7 (on pp. 11–12) for further details.

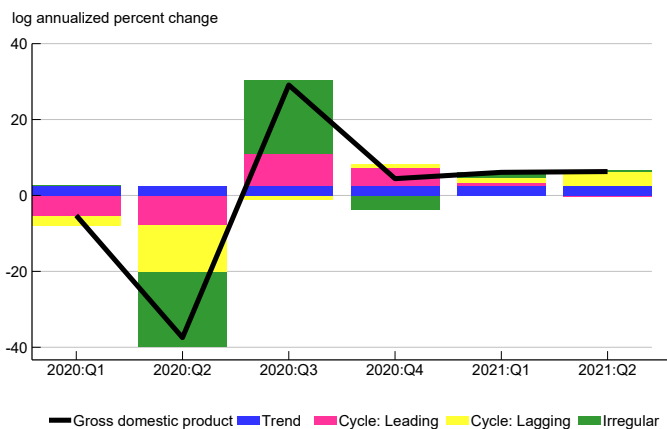
BBK Coincident Index (through June 2021)



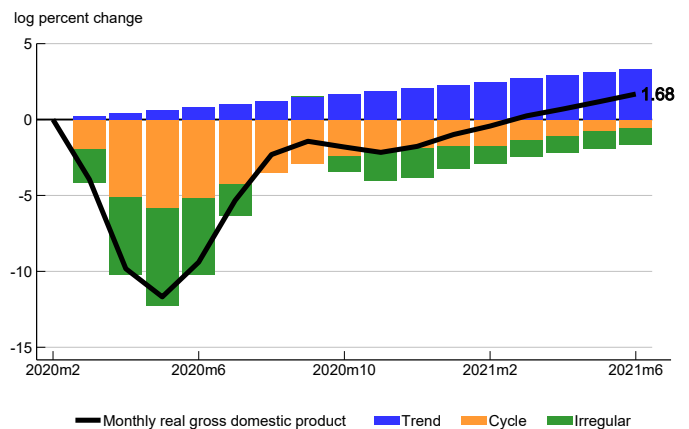
BBK Leading Index (through June 2021)



Decomposition of real gross domestic product

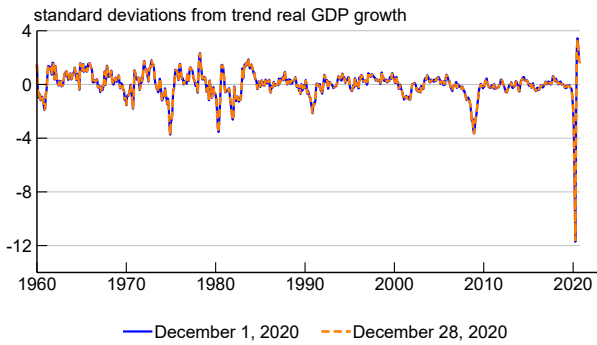


Cumulative change in BBK Monthly GDP

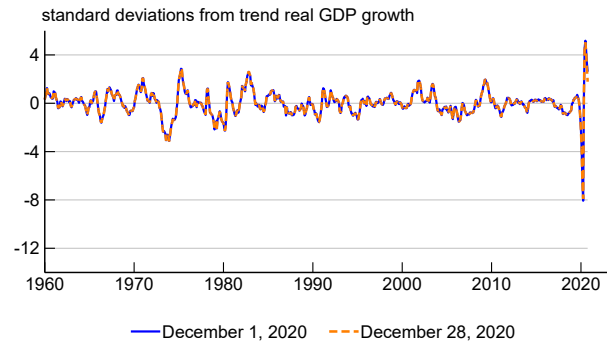


- For the December 28, 2020, release, the BBKI incorporated Pandemic Unemployment Assistance data in the initial and continuing unemployment claims series. This and other incoming data through October 2020 led to minor revisions to the history of the BBKI.

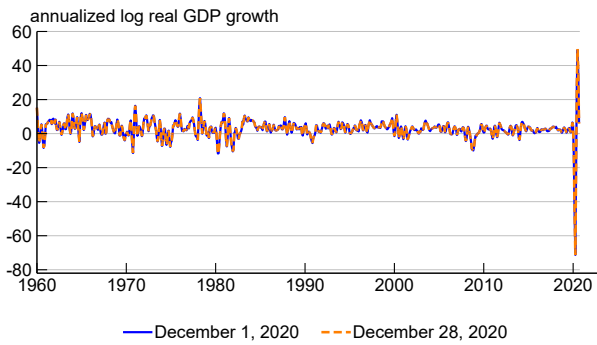
BBK Coincident Index (through October 2020)



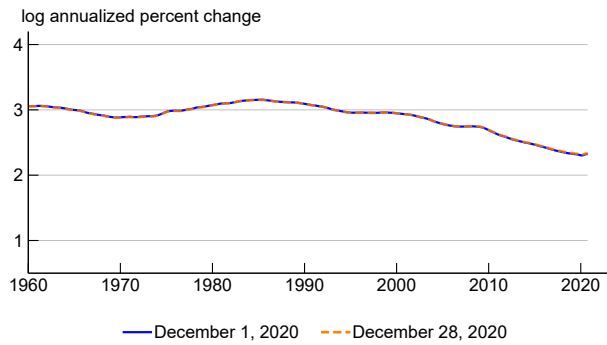
BBK Leading Index (through October 2020)



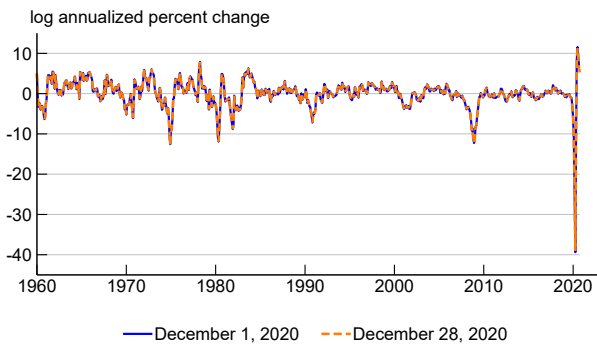
BBK Monthly GDP Growth (through October 2020)



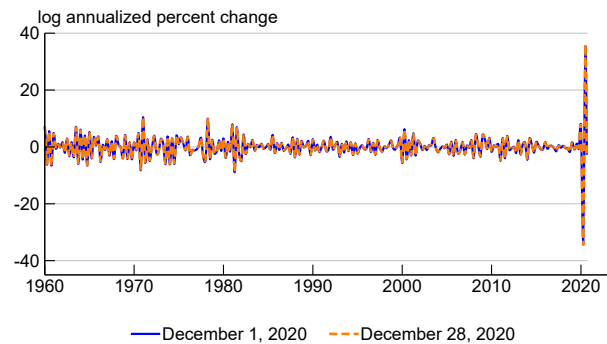
BBK Trend Component (through October 2020)



BBK Cycle Component (through October 2020)

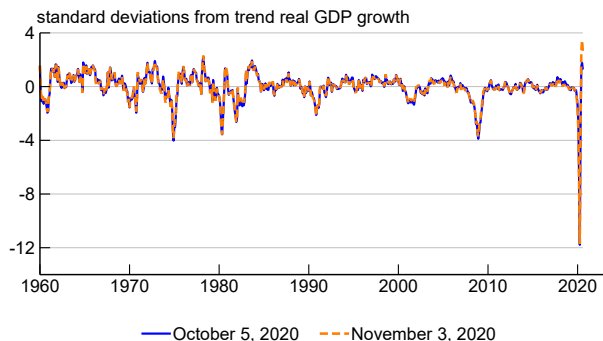


BBK Irregular Component (through October 2020)

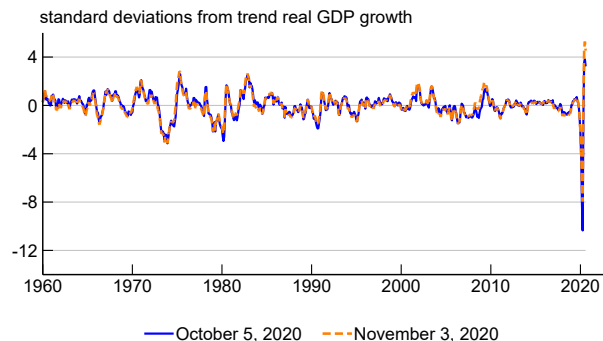


- For the November 3, 2020, release, the BBKI incorporated for the first time U.S. gross domestic product (GDP) data for the third quarter of 2020 (2020:Q3). This and other incoming data through September 2020 led to revisions to the history of the BBKI. Revisions were most pronounced in the recent history of the BBK Leading Index and BBK Monthly GDP Growth. In particular, the recent history of all three components of BBK Monthly GDP Growth (trend, cycle, and irregular) were substantially impacted.

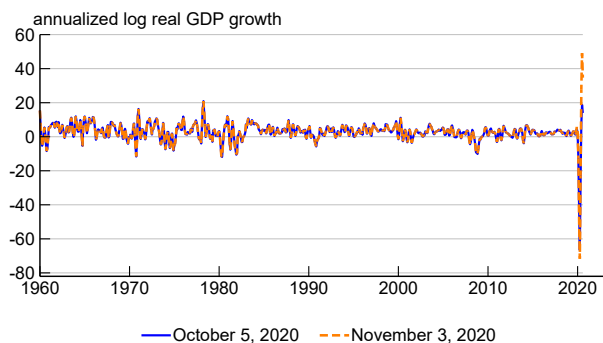
BBK Coincident Index (through August 2020)



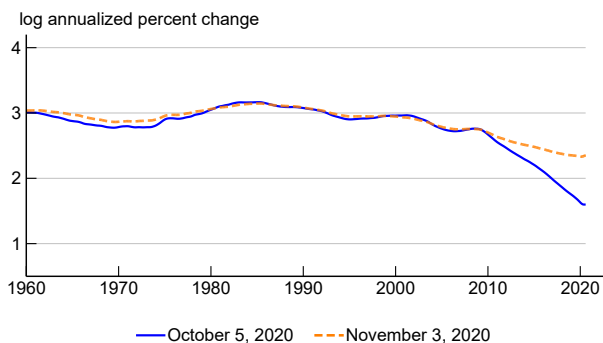
BBK Leading Index (through August 2020)



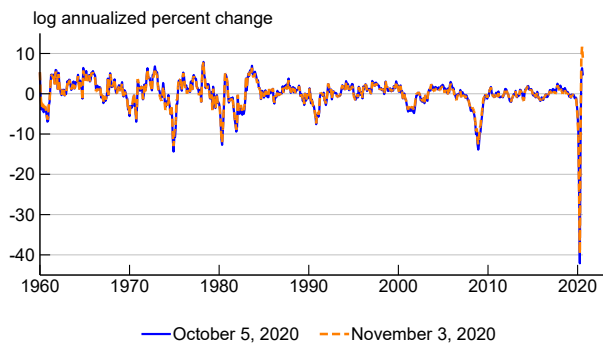
BBK Monthly GDP Growth (through August 2020)



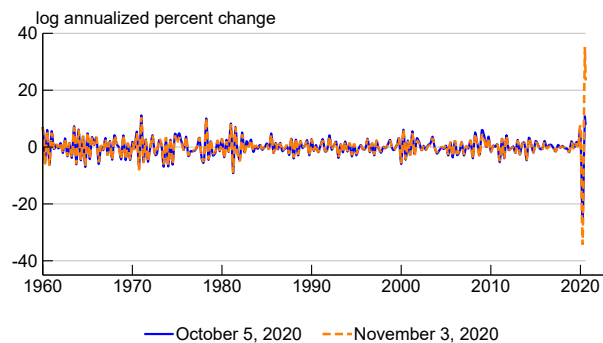
BBK Trend Component (through August 2020)



BBK Cycle Component (through August 2020)

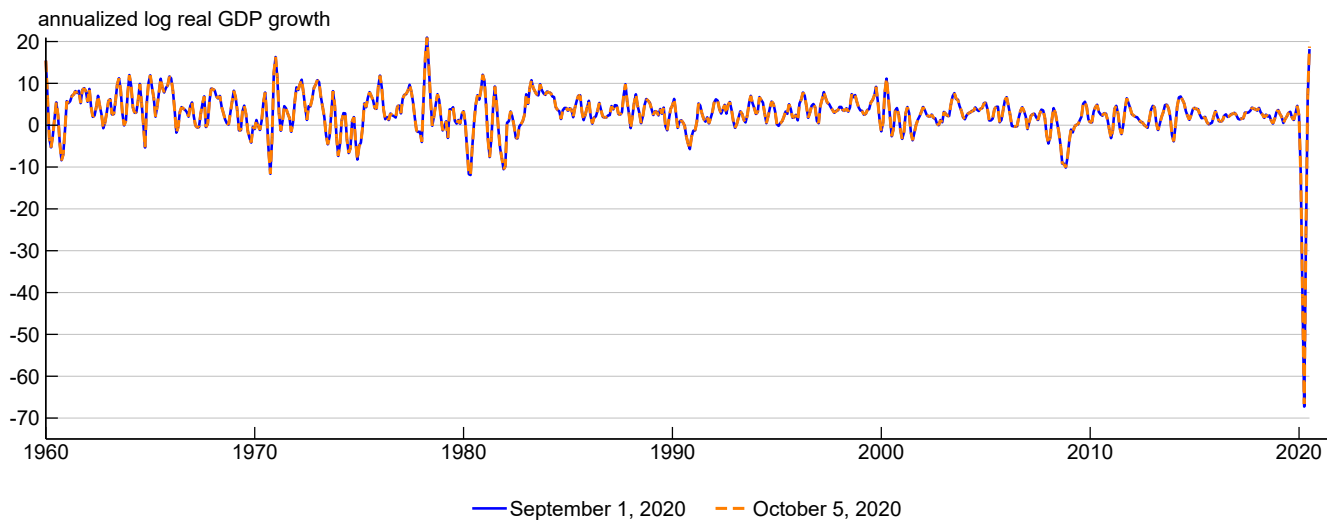


BBK Irregular Component (through August 2020)

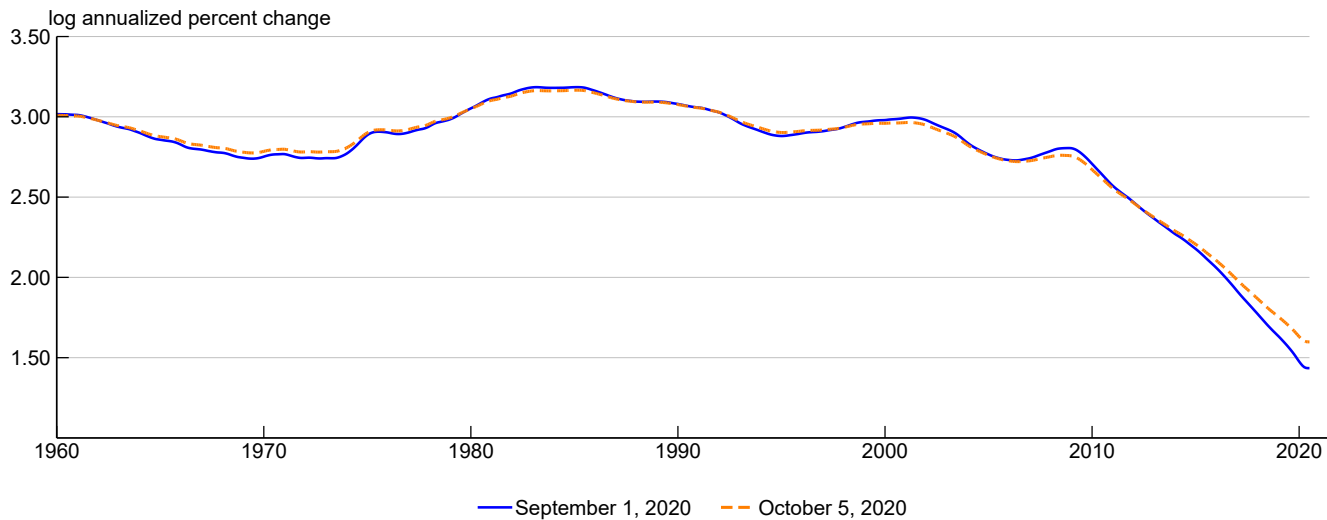


- For the October 5, 2020, release, we updated the median unbiased procedure used to calibrate the variance of the trend component of BBK Monthly GDP Growth. On balance, this change led to minor revisions to the history of BBK Monthly GDP Growth and its trend component.

BBK Monthly GDP Growth (through July 2020)



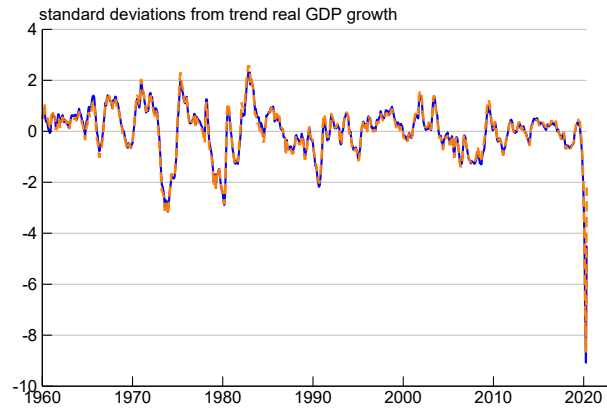
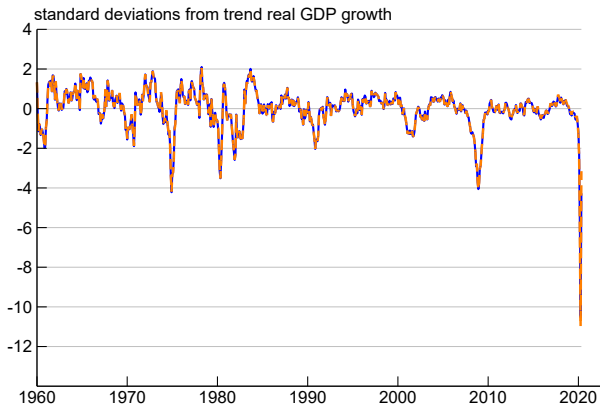
BBK Monthly GDP Growth: Trend component (through July 2020)



- For the August 4, 2020, release, the BBKI incorporated for the first time U.S. gross domestic product (GDP) data for the second quarter of 2020 (2020:Q2). On balance, this and other incoming data through June 2020 led to small revisions to the history of the BBK Coincident and BBK Leading Indexes, but significant revisions to the history of BBK Monthly GDP Growth prior to June 2020. The large revisions to BBK Monthly GDP Growth reflected much larger contributions from the model's irregular component than previously estimated prior to the release of 2020:Q2 GDP data.

BBK Coincident Index (through May 2020)

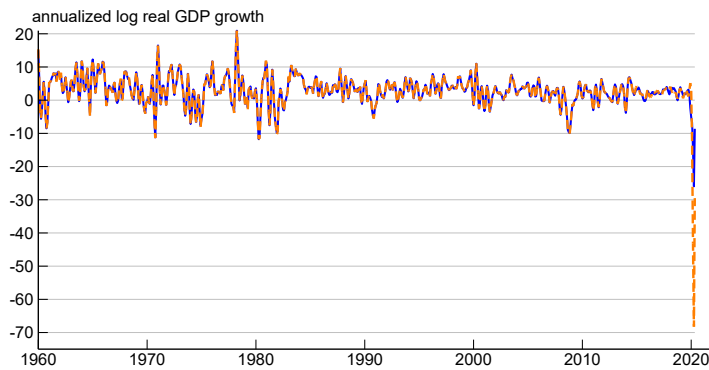
BBK Leading Index (through May 2020)



— July 1, 2020 - - August 4, 2020

— July 1, 2020 - - August 4, 2020

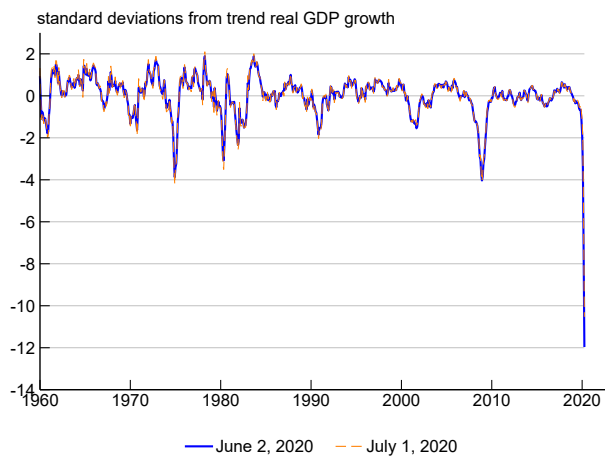
BBK Monthly GDP Growth (through May 2020)



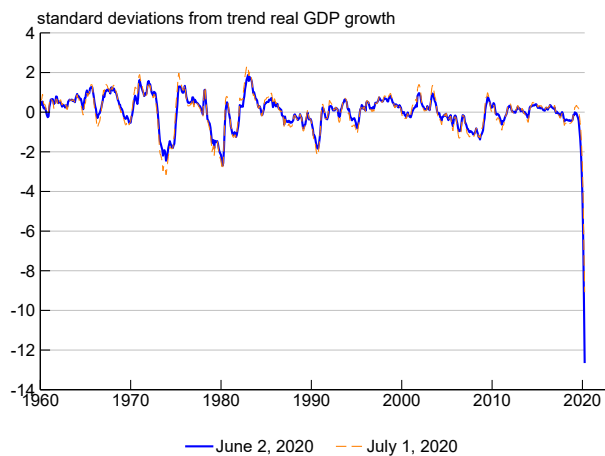
— July 1, 2020 - - August 4, 2020

- 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 \bar{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.

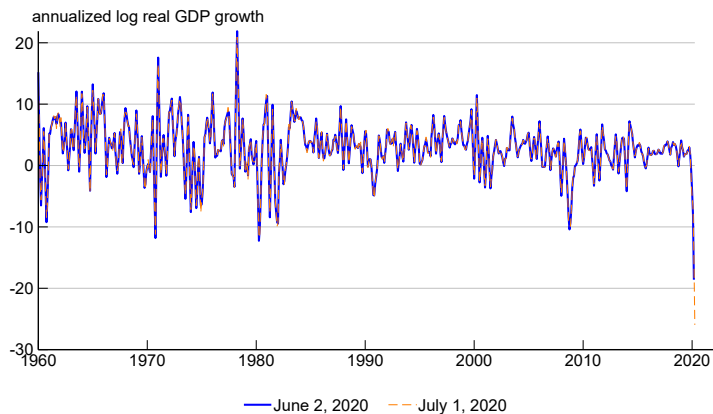
BBK Coincident Index (through April 2020)



BBK Leading Index (through April 2020)



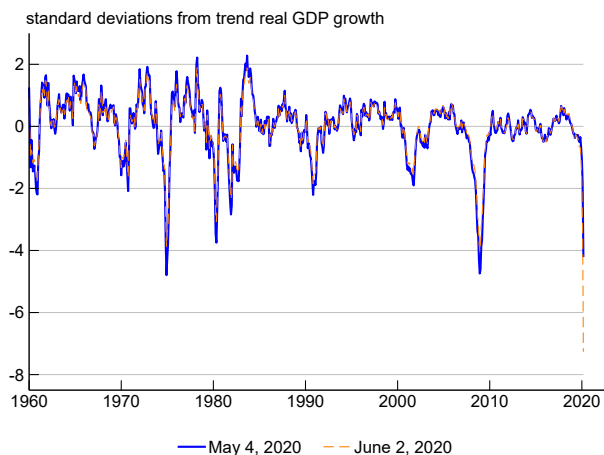
BBK Monthly GDP Growth (through April 2020)



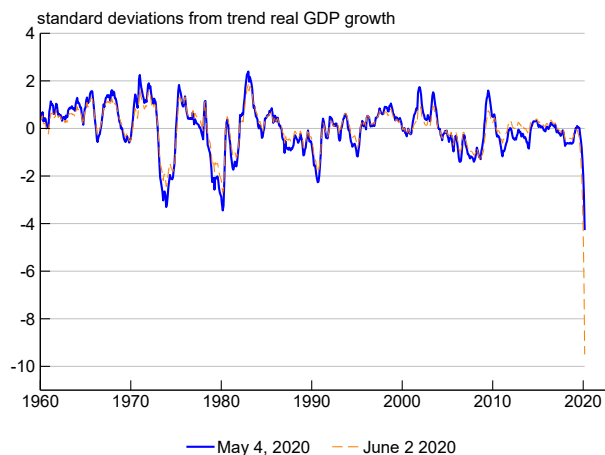
- For the June 2, 2020, release, we further updated data definitions in order to take full advantage of the advance releases for inventories and international trade data. Even with these changes, we still observed only 428 of 500 monthly data series for April 2020. Given the very large changes in many 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.

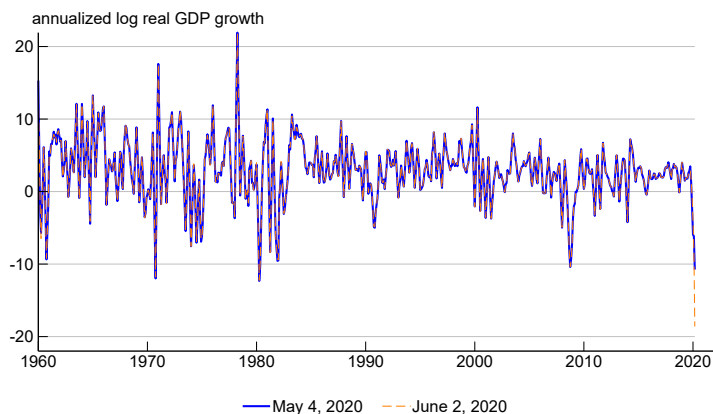
BBK Coincident Index (through March 2020)



BBK Leading Index (through March 2020)

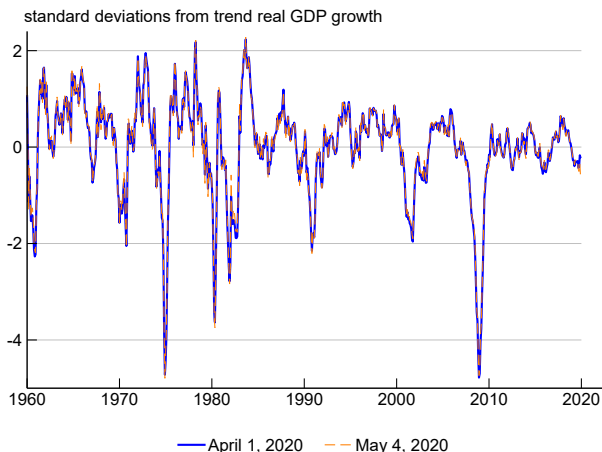


BBK Monthly GDP Growth (through March 2020)

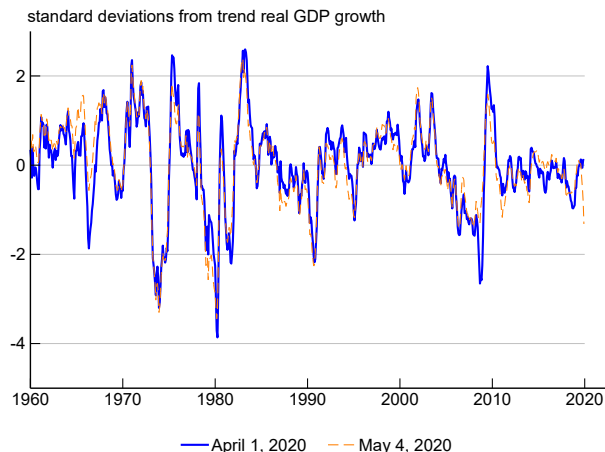


- With the May 4, 2020, release of the BBKI, several improvements were made to the construction of the [500 data series](#) used in the indexes (e.g., imputation of missing values and treatment of outliers).¹ These improvements and incoming data led to small changes in the model's estimated parameters 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.

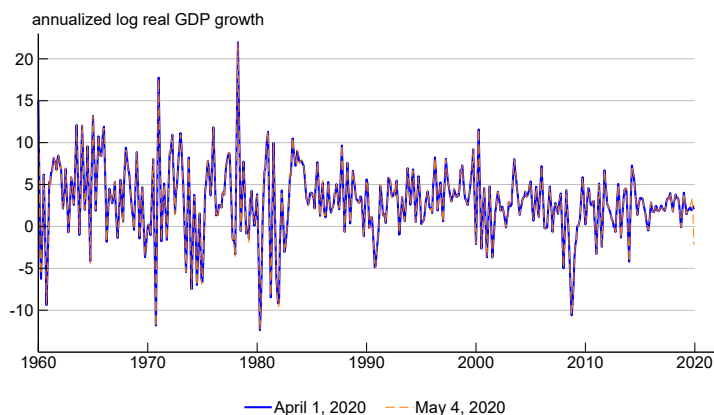
BBK Coincident Index (through December 2019)



BBK Leading Index (through December 2019)



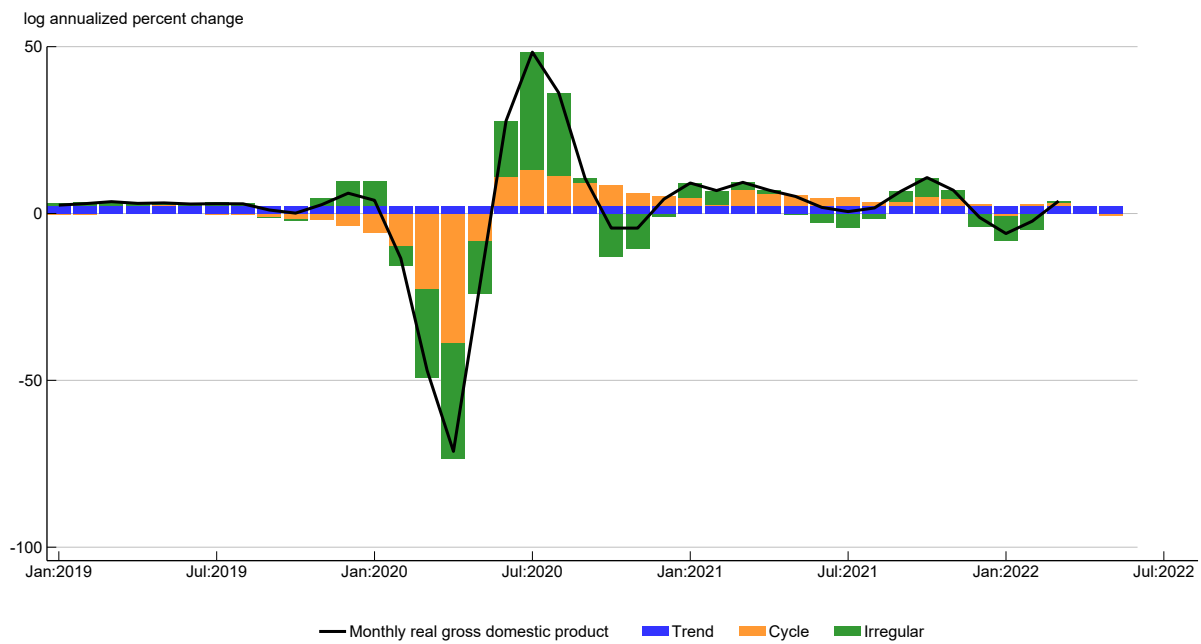
BBK Monthly GDP Growth (through December 2019)



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.

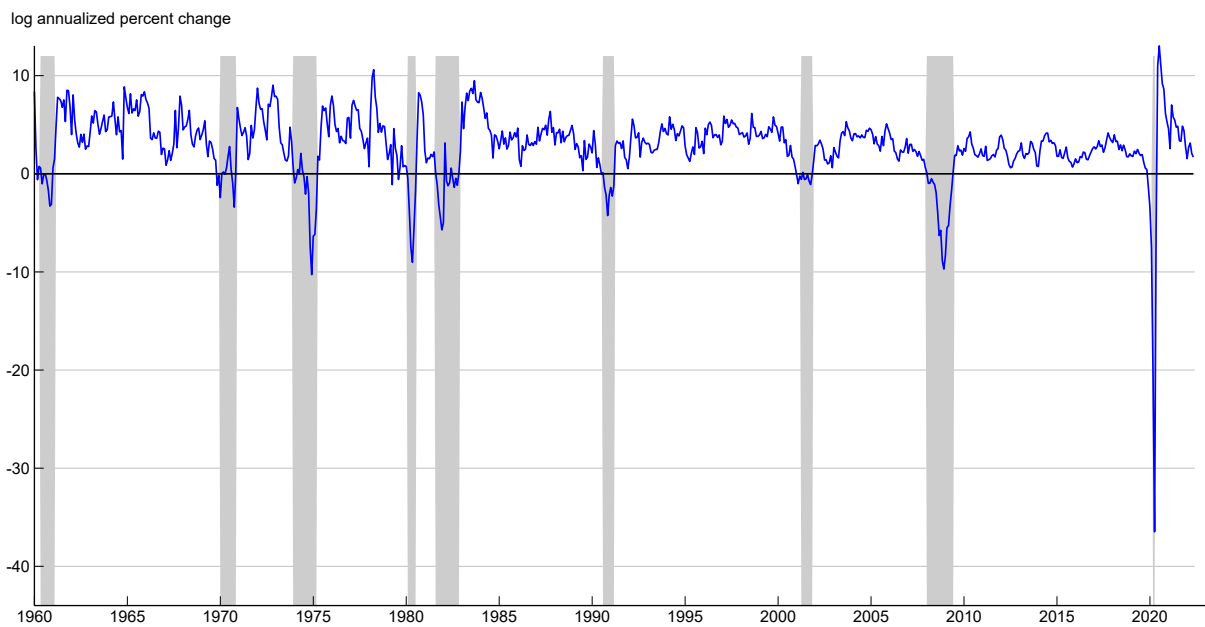
In what follows, we repeat the figures from “A ‘big data’ view of the U.S. economy: Introducing the Brave-Butters-Kelley Indexes” to demonstrate that the major properties of the BBKI were not impacted by these changes.

Figure 1. Decomposition of BBK Monthly GDP Growth, 2019–22



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

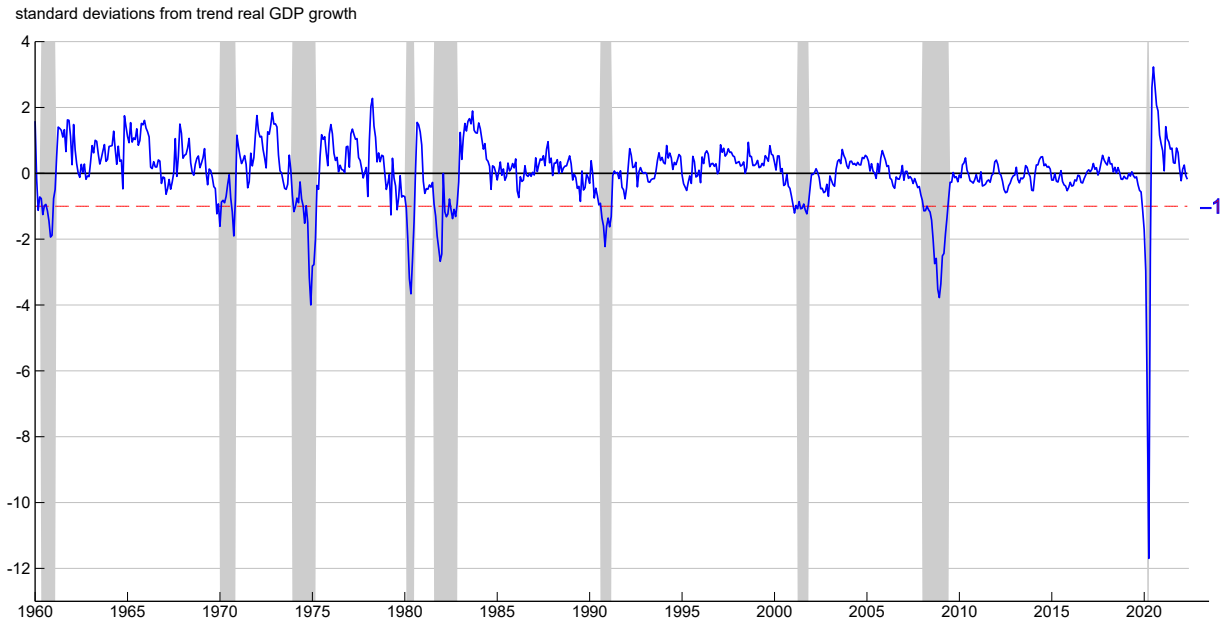
Figure 2. BBK Monthly GDP Growth: Trend and cycle components



Note: Shaded periods correspond to U.S. recessions as defined by the National Bureau of Economic Research.

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

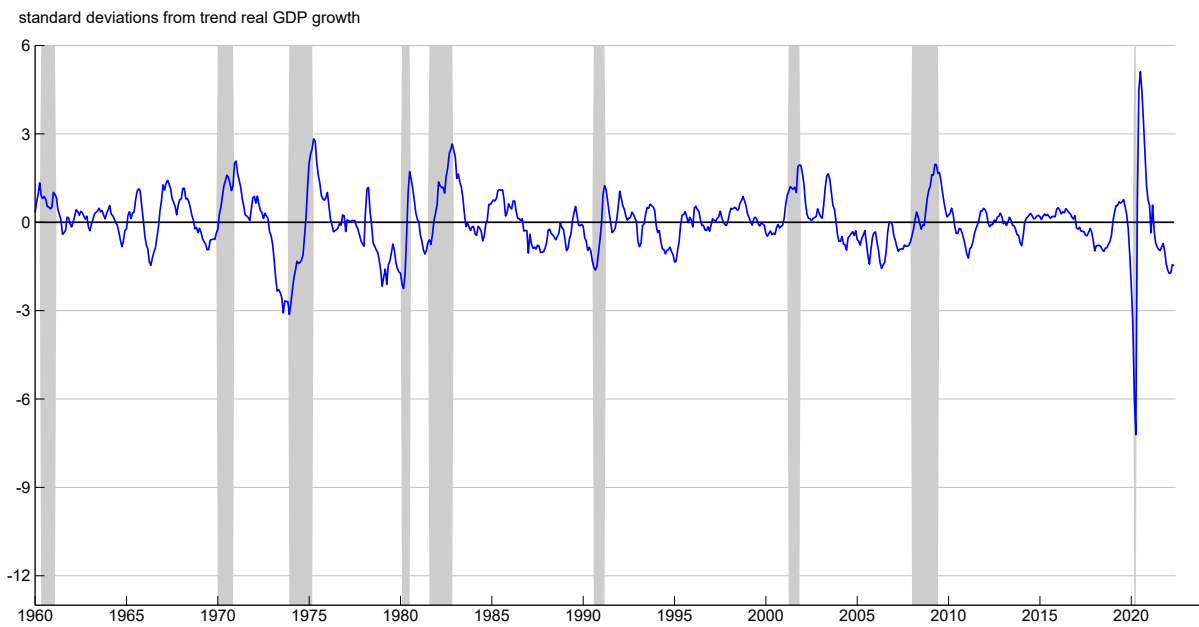
Figure 3. BBK Coincident Index



Notes: GDP refers to gross domestic product. Shaded periods correspond to U.S. recessions as defined by the National Bureau of Economic Research. The 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.

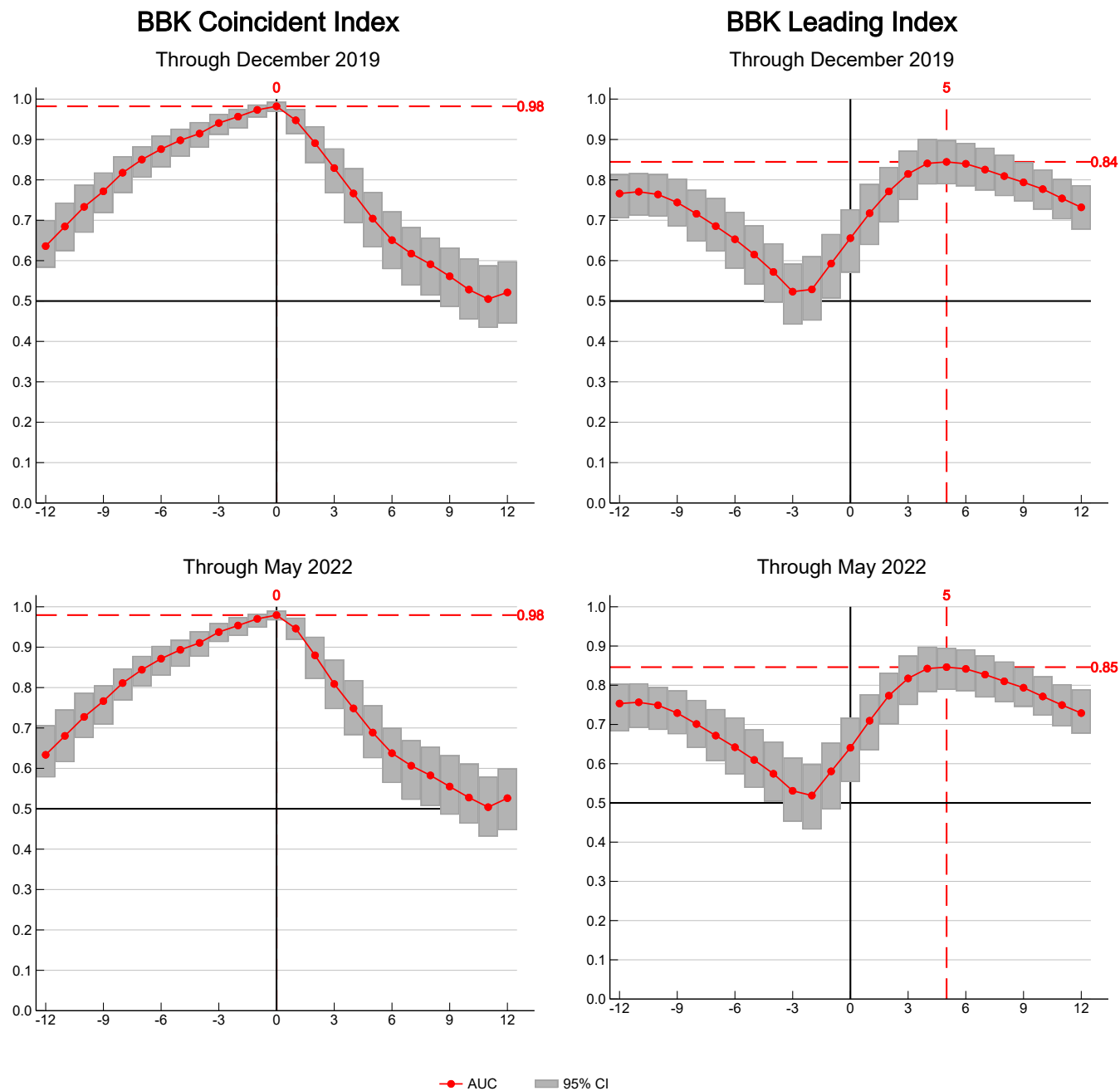
Figure 4. BBK Leading Index



Notes: GDP refers to gross domestic product. Shaded periods correspond to U.S. recessions as defined by the National Bureau of Economic Research.

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

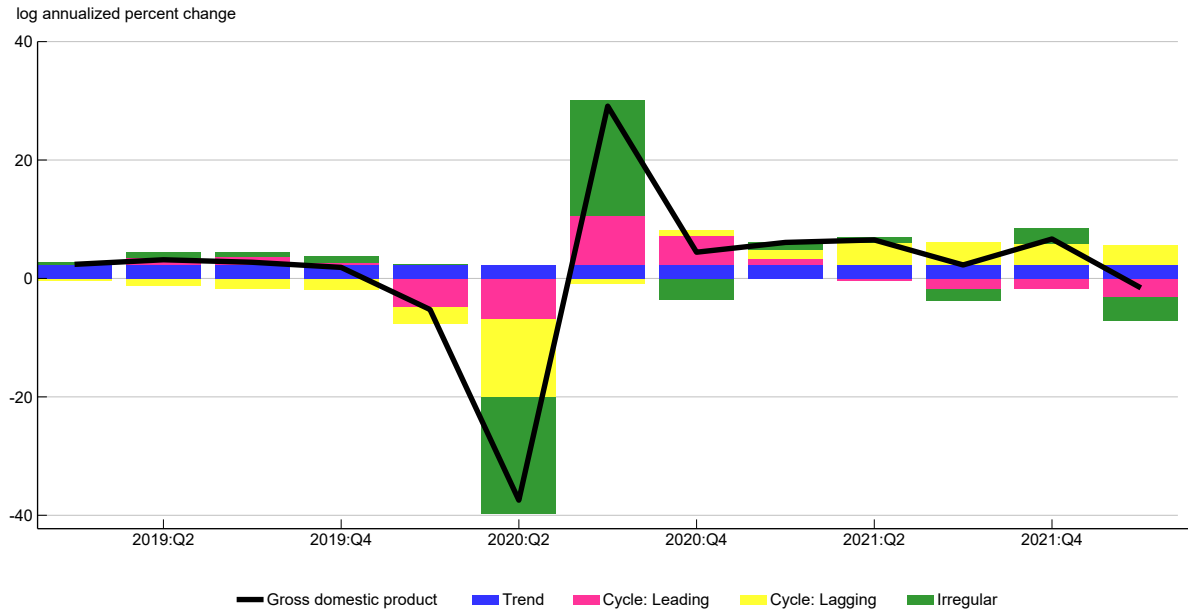
Figure 5. AUCs at leads and lags, through December 2019 and April 2022



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.”](#)

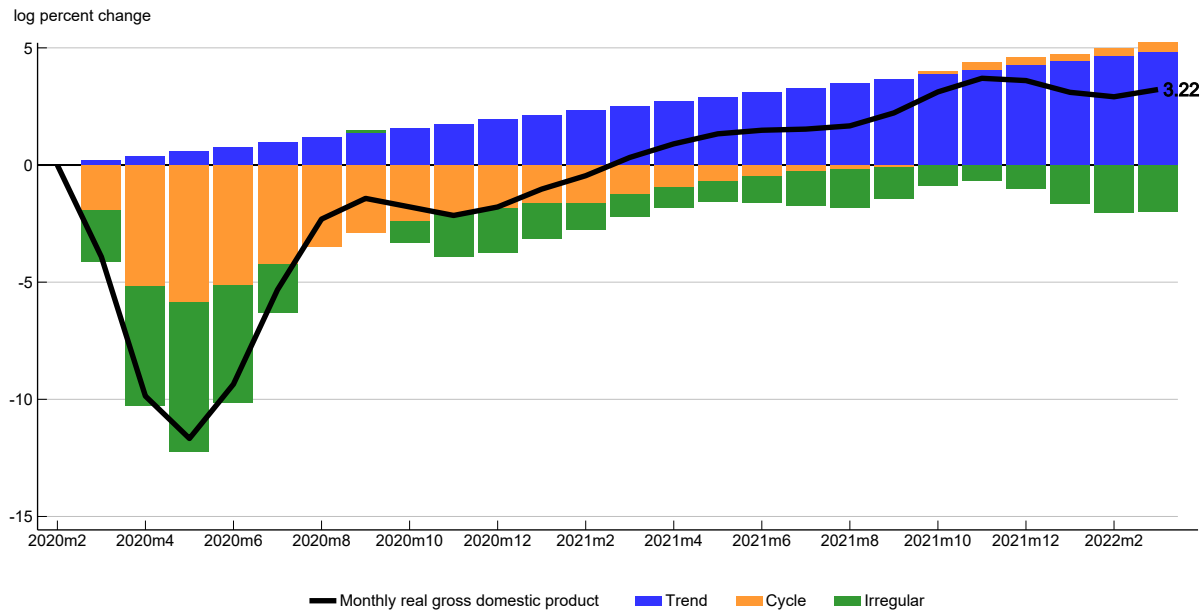
Source: Authors’ calculations based on data from Haver Analytics.

Figure 6. Decomposition of real gross domestic product, 2019–22



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.

Figure 7. Cumulative change in BBK Monthly GDP since February 2020



Note: The running sum of BBK Monthly GDP Growth shows, in percentage terms, the cumulative change in U.S. real gross domestic product (GDP) from February 2020 through March 2022.
 Source: Authors' calculations based on data from Haver Analytics.