# COVID-induced Recession Began in March 2020*

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**Abstract**

The COVID-induced recession began in March 2020 for the United States. We identify this turning point by applying a sequential quickest detection method to a real-time index of economic activity. Supporting evidence is also found from macroeconomic data releases and stock markets.

**Keywords**: Big Data, COVID-19; Coronavirus, Turning Points

**Disclaimer**: The opinions expressed in this article are those of the authors and do not reflect the view of Freddie Mac.

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# 1 Introduction

The U.S. entered 2020 experiencing the longest period of uninterrupted growth in its history (Marotta, 2020). But as a novel coronavirus disease, identified in February as COVID-19, began to spread around the world, uncertainty over its health and economic effects quickly began to escalate. By March 11th, the World Health Organization declared the outbreak had become a global pandemic. A mere ten days later, the media was already reporting on fears of "the biggest quarterly contraction on record" as a result of the virus and the measures used to combat it (Schwartz, 2020).

The Business Cycle Dating Committee of the National Bureau of Economic Research (NBER), who determines the chronology of the U.S. business cycle, patiently waits for sufficient evidence to accumulate before making a decision. For example, the beginning of Global Recession was announced by the NBER after a year of due diligence. Exceptional accuracy comes at the cost of timeliness. Given the widespread uncertainty over the duration and effects of COVID-19, calling a recession in real time is critical such that appropriate policy actions can be taken.

We answer this call by performing a real-time analysis of the health of the U.S. economy induced by the coronavirus. To this end, we take advantage of the Bayesian sequential quickest detection (Bsquid) method of Li et al. (2020) and a new "big data" index of economic activity proposed by Brave et al. (2019). The Bsquid method accurately identifies business cycle peaks and troughs for the five most recent recessions, but within a much faster time frame than official announcements by the NBER. This superior performance comes from the appealing feature of the Bsquid method that depends on a state-dependent threshold, rather than a fixed threshold, to identify changes in business cycle. Furthermore, the new index uses a much broader array of data to measure the overall health of the U.S. economy than the NBER does in its process. Using this method, we find that a recession began at the same time as the pandemic response accelerated in Europe and the U.S. – March

2020.[1]

Our paper builds on a large literature on nowcasting and forecasting business cycle turning points. Among many others, Estrella and Mishkin (1998), Rudebusch and Williams (2009) and Berge (2015) consider predicting turning points using leading economic and financial variables; Berge and Jorda (2011) and Stock and Watson (2014) focus on establishing in-sample chronologies of business cycles; and Chauvet and Piger (2008) and Hamilton (2011) identify a turning point soon after it has occurred.

Our paper is also related to the growing literature trying to understand and measure the pandemic effects on a range of economic factors. COVID-19 market volatility took off in the last weeks of February 2020 making it the first infectious disease outbreak to have a significant effect on U.S. stock market volatility (Baker et al., 2020). Gormsen and Koijen (2020) estimate that while one year growth estimates have fallen by 3.8 percent since January, the stock market decline has been greater than that warranted by the slowed growth, instead reflecting an increased discount rate that may be driven by new risk aversion or uncertainty.

The pandemic has also had more direct effects on business ability to operate and their supply chains. Ramelli and Wagner (2020) show firms' stock prices were adversely affected when they were more dependent on international trade, global supply chains, and financial markets, with these effects becoming more pronounced by March. Alfaro et al. (2020) and Fahlenbrach et al. (2020) find similar results. Barrero et al. (2020) show that equity returns across U.S. listed firms fall sharply in March 2020 reaching levels similar to the Great Recession of 2008. Bartik et al. (2020) find similar operating and liquidity concerns for small businesses who have been especially affected by enforced lockdowns yet employ nearly fifty percent of American workers. Dingel and Neiman (2020) also show the effects may be heterogeneous as the

[1]The Fed did its first emergency rate cut in early March and another in mid-March, again pointing to concerns about recession starting in March.

proportion of jobs that can still be done under lockdown measures varies by industry.

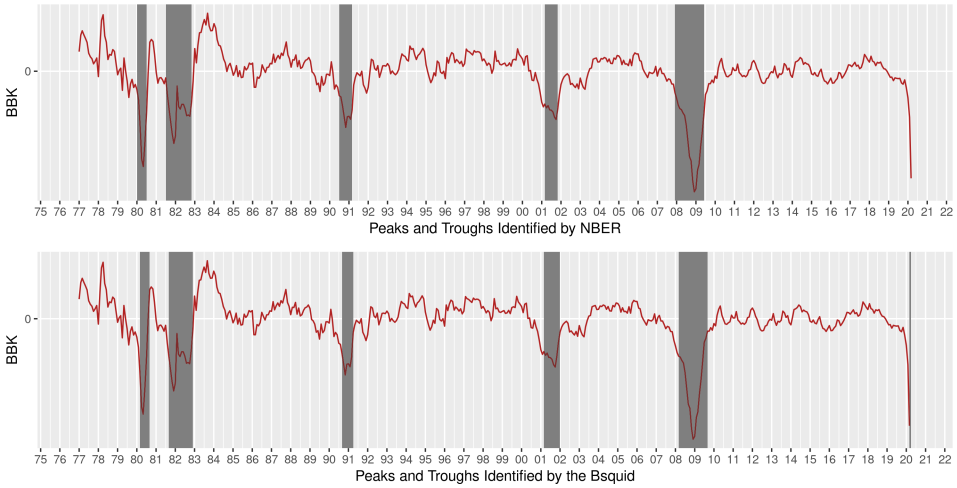
Lastly, other authors have considered the effects on the labor market due to shelter in place orders and the drastic consumption decline in mid March and April (Baker et al., 2020). For instance, Gregory et al. (2020) show that even a three-month lockdown could yield a prolonged recovery as those who lost their jobs from the sudden shock are slowly reabsorbed into the market. Barrero et al. (2020) estimate that around 42 percent of layoffs due to COVID-19 will result in permanent job losses. Cajner et al. (2020) support this by finding employment already fell by 22 percent in March 2020.

# 2 Data

We use a real-time "big data" index of U.S. economic activity, developed by Brave et al. (2019). The Brave-Butters-Kelley (BBK) index builds on the well-known Chicago Fed National Activity Index (CFNAI) and extends it in two important ways. First, the CFNAI is constructed from a panel of 85 macroeconomic time series. By contrast, the BBK index summarizes the information in a much larger panel of 500 U.S. time series, broadly reflecting the set of real economic activity indicators commonly used to forecast U.S. GDP. Second, the CFNAI is estimated as the first principal component of its constituent time series that ignores dynamic correlations present in large panels. By contrast, the BBK index uses collapsed dynamic factor analysis techniques that make use of both the static and dynamic correlations.

Figure 1 plots the BBK index. The shaded areas denote the recessions identified by the NBER (upper panel) and the Bsquid method (lower panel), which are discussed in greater detail in the next section. As Figure 1 shows, the BBK index movements track closely with both methods' identified recessions. While it normally trends around zero, it drops quickly around the onset of a recession before returning to near-zero, or to higher values in the

case of the 1980s recessions, by the end of the downturn.




Note: The BBK index is developed by Brave et al. (2019) and plotted using the data vintage released on May 1, 2020 from `https://www.chicagofed.org/publications/bbki/index`. The NBER dates of business cycle are downloaded from `https://www.nber.org/cycles/cyclesmain.html`. The business cycle dates based on the Bsquid method come from the authors' own calculation.

Figure 1: Monitoring Recessions with the BBK Index

# 3 Identifying Turning Points – In Sample Analysis

We apply Li et al. (2020)'s Bsquid method to date the past five recessions. Li et al. (2020) explicitly model a decision maker's dual requirements of timeliness and accuracy and frame the problem of monitoring business cycles as a sequential stopping time. The Bayesian sequential quickest detection framework is objective, transparent and repeatable. We focus on the recessions occurred after 1978, since the NBER made no formal announcements when it determined the dates of turning points before 1978.

Table 1 summarizes the results in dating peaks. The first column includes

the peaks defined by the NBER. The second column includes the peaks identified by the Bsquid method. Comparing the NBER dates to those identified by the Bsquid method illustrates the accuracy of the newly established dates. The Bsquid method identifies the beginning of five recessions with reasonable accuracy, all within three months of the NBER date. Furthermore, our method produces no false positive signals over the sample period. The third and fourth columns show the dates announced by the NBER and the Bsquid method, respectively. On average, the Bsquid method announces the peak faster than the NBER and the average lead time for the five peaks in the sample is about 6 months.

| Peaks identified by | | Peaks announced by | | Months ahead of |
|---|---|---|---|---|
| NBER | Bsquid | NBER | Bsquid | NBER announcement |
| Jan 1980 | Mar 1980 | Jun 1980 | Mar 1980 | 3 months |
| Jul 1981 | Sep 1981 | Jan 1982 | Sep 1981 | 4 months |
| Jul 1990 | Sep 1990 | Apr 1991 | Sep 1990 | 7 months |
| Mar 2001 | Mar 2001 | Nov 2001 | May 2001 | 6 months |
| Dec 2007 | Mar 2008 | Dec 2008 | Mar 2008 | 9 months |

Note: To date peaks, we take the beginning of an expansion identified by the Bsquid method as given and aim at detecting the end of the expansion. The NBER dates of business cycle are downloaded from `https://www.nber.org/cycles/cyclesmain.html`.

Table 1: Identifying Peaks with the BBK Index

To date troughs, we adopt the same method. Table 2 presents the results. The Bsquid method identifies five troughs accurately, all within three months of the NBER date. Most importantly, our method shows systematic improvement over the NBER in the speed with which these troughs are announced. On average, the Bsquid method announces the five business cycle troughs 13 months ahead of the NBER announcement. The maximum lead time is 20 months for the 1991 trough.

To summarize, monitoring business cycles faces two potentially conflicting objectives: accuracy and timeliness. The Bsquid method maintains a careful balance between these two objectives and identifies those turning points with

| Troughs identified by | | Troughs announced by | | Months ahead of |
|---|---|---|---|---|
| NBER | Bsquid | NBER | Bsquid | NBER announcement |
| Jul 1980 | Sep 1980 | Jul 1981 | Sep 1980 | 10 months |
| Nov 1982 | Dec 1982 | Jul 1983 | Dec 1982 | 7 months |
| Mar 1991 | Apr 1991 | Dec 1992 | Apr 1991 | 20 months |
| Nov 2001 | Jan 2002 | Jul 2003 | Jan 2002 | 18 months |
| Jun 2009 | Sep 2009 | Sep 2010 | Sep 2009 | 12 months |

Note: Similar to Table 1, except that we take the beginning of a recession identified by the Bsquid method as given and aim at detecting the end of the recession.

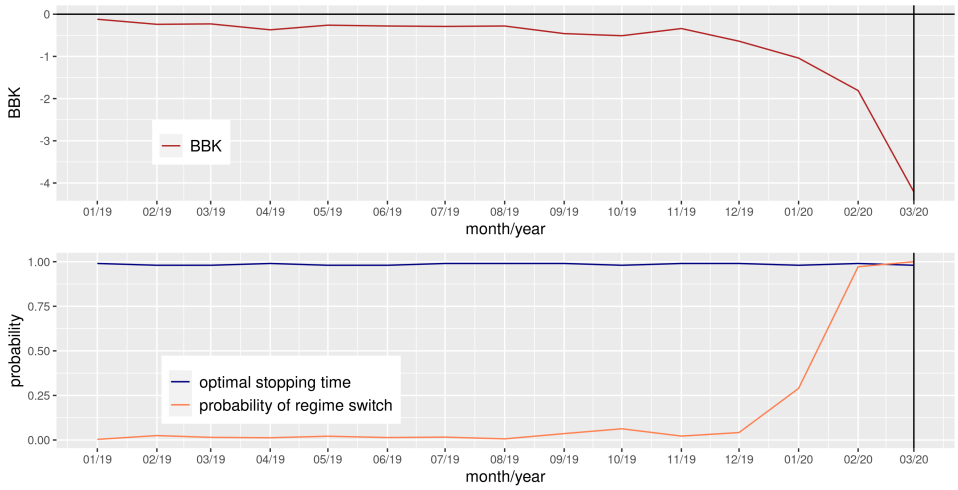
Table 2: Identifying Troughs with the BBK Index

reasonable accuracy as soon as possible. By contrast, the NBER dating committee aims for the accuracy at the cost of timeliness. Another reason why the turning points identified by the Bsquid method differ from those of the NBER is that we use a "big data" index constructed from a panel of 500 U.S. macroeconomic time series. By contrast, the NBER mainly focuses on four monthly coincident indicators, namely, non-farm payroll employment, industrial production, real personal income excluding transfer receipts, and real manufacturing and trade sales. A third reason is that this in-sample analysis uses the most recently available data vintage, rather than real-time data used by the NBER.

# 4 Dating COVID-induced Recession in Real Time

Having established historical success of the BBK index in dating the past five recessions, we now turn to its real-time performance. We use the BBK data vintage released on May 1, 2020. Follow Li et al. (2020), we calculate the posterior probability of a regime switch (i.e. from an expansion to a recession) and compare this probability to the optimal stopping time. As illustrated in Figure 2 where the probability of a regime switch first exceeds the optimal

stopping time, the Bsquid method identifies a turning point in March 2020. Thus, using the May 2020 data vintage, we conclude that COVID-induced recession began in March 2020.



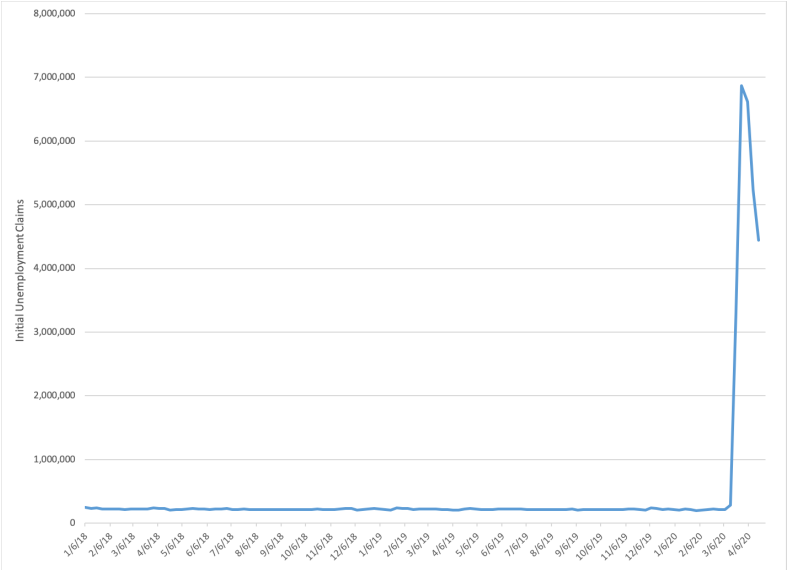

Note: The upper panel plots the BBK index of Brave et al. (2019). The lower panel plots the probability of regime switch from an expansion to a recession, against the optimal stopping time derived under the Bayesian framework developed in Li et al. (2020). When the probability of regime switch exceeds the optimal stopping time, a turning point occurs in March 2020.

Figure 2: Dating the Peak of March 2020

The superior performance of our method is mainly driven by the state-dependent stopping time (i.e. threshold), which is in stark contrast to using a fixed threshold. For example, the document posted on Chicago Fed website suggests using -1 as the recession threshold in practice. The fixed threshold considers only large deviations of the index from the mean of zero but ignores the duration of these deviations. By contrast, the Bsquid method captures both the magnitude and persistence of these deviations.

Next, we discuss other evidence in support of March 2020 as the beginning of COVID-induced recession. For instance, weekly unemployment insurance claims increased by more than a factor of 32 from March 7 to March 28, 2020,

as shown in Figure 3. Weekly initial jobless claims made a great contribution to the sharp decline in the real-time business conditions index proposed by Aruoba et al. (2009).

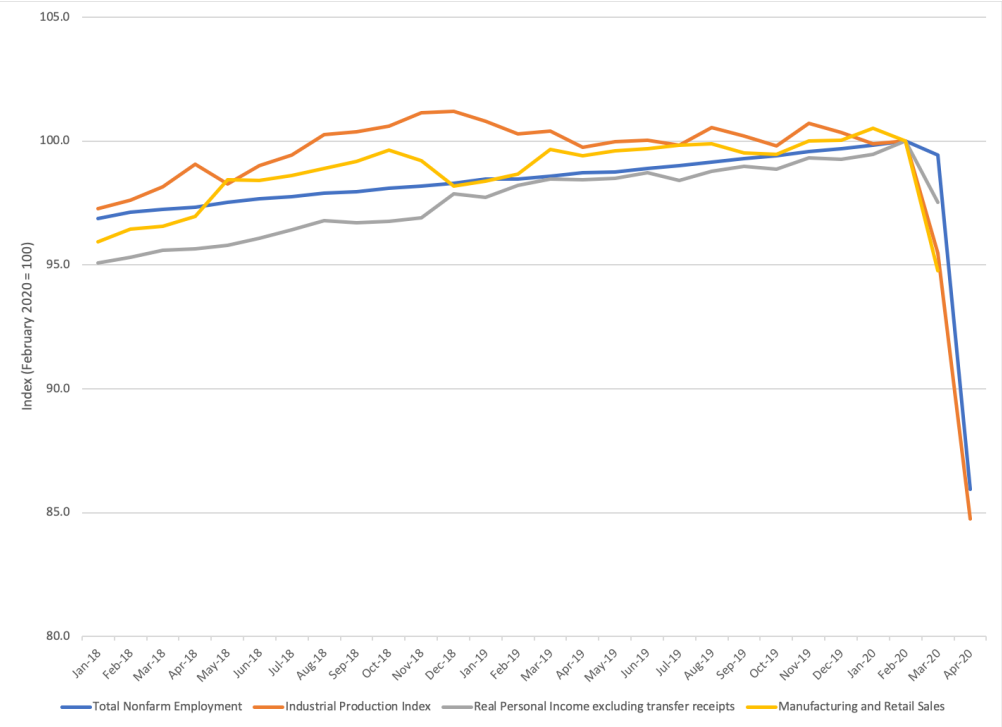



Note: Initial, seasonally-adjusted, unemployment insurance claims rose from 211,000 in the week ending March 7th to 6,867,000 in the week ending March 28th. This rise is compared with historic data to show the unprecedented magnitude. Source: U.S. Department of Labor, Unemployment Insurance Weekly Claims Data. Seasonally Adjusted Initial Claims. Accessed on May 19, 2020 from `https://oui.doleta.gov/unemploy/claims.asp`

Figure 3: Weekly Unemployment Insurance Claims

We also compare the four main indicators monitored by the NBER to see how they have reacted to the crisis. For instance, nonfarm payroll employment had been steadily rising in recent years until it declined by 881,000 in March. The decline accelerated to 20.5 million in preliminary data for April. The industrial production index had also been steady in 2019 before falling by 4.5 percent in March 2020 and even further in April. Likewise, real personal income had a clear upward trend in the past two years until it fell by approximately 2.5 percent in March, although data in April was not yet

available. Lastly, March data on real manufacturing and trade sales was not yet available from the Bureau of Economic Analysis. However, the Census Bureau data on nominal manufacturing and retail sales shows a deep decline in March. Taken together, we can see all four areas began to experience a decline in March after being relatively stable since 2018 (Figure 4).




Note: All indicators are normalized relative to the value of 100 for February 2020. Real Manufacturing and Trade Sales were not available through March 2020, and Nominal Sales from Census data were used as an alternative. Sources: Employment levels from Bureau of Labor Statistics Current Employment Survey, `https://www.bls.gov/ces/data/home.htm`, Industrial Production Index [INDPRO] from Board of Governors of the Federal Reserve System (US), `https://fred.stlouisfed.org/series/INDPRO`, Real personal income excluding current transfer receipts from U.S. Bureau of Economic Analysis, `https://fred.stlouisfed.org/series/W875RX1`, and Manufacturing and Trade Inventories and Sales Report from U.S. Census Bureau, `https://www.census.gov/mtis/index.html`.

Figure 4: Four Monthly Coincident Indicators

Investors began to respond accordingly with the S&P 500 dropping dramatically in March. Its closing price bottomed out at $2,304 on March 20 before slowly beginning to recover as new economic policy was instituted to reduce the effects of the pandemic, as indicated in Figure 5.


Source: Yahoo Finance

Figure 5: S&P 500 Index

We conclude by presenting four other studies of the COVID-19 crisis pointing to a steep decline beginning in March. Cajner et al. (2020) estimated a 22 percent decline in paid employment from February to April 2020, with the decline particularly coming between March 7th and April 11th. Consumption and spending patterns follow a similar trajectory as the decline in paid employment. Baker et al. (2020) and Gelles and Leatherby (2020) analyze different sources of household financial transactions and find similar results of a significant spike in spending in the last week of February and early March as a consequence of grocery stockpiling and spending re-

actions, followed by a drastic drop on general expenditure from mid-March through April. Binder (2020) surveyed households in March about their economic expectations and their knowledge of the Fed's emergency rate cut, finding that households were quite pessimistic in early March.

Given the evidence from key indicators and other studies, it seems clear that there was a rapid deterioration in the health of the U.S. economy in mid-March 2020, which gives us added confidence in our method dating the start of a pandemic-induced recession as occurring in that same month.

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