

**NBER RECESSION DATES:
STRENGTHS, WEAKNESSES, AND A MODERN UPGRADE**

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ABSTRACT

This paper examines the strengths and weaknesses of the NBER recession dates. We argue that the most important strength of the recession chronology is that it captures a fundamental feature of the macroeconomy: long periods of relatively stable growth are periodically interrupted by relatively rapid and substantial declines in economic activity. One weakness is that the definition and criteria used by the NBER in dating recessions have evolved substantially over time, leading to inconsistencies in the chronology. More significantly, the NBER's focus on the behavior of the level of economic activity, rather than on the deviation of activity from normal, is at odds with virtually all modern models of macroeconomic fluctuations. For this reason, we propose that the NBER modify its definition of a recession to emphasize rapid increases in the shortfall from normal rather than declines in economic activity. We also discuss ways of making the dating of recessions more mechanical and less judgmental. Applying these modern upgrades to NBER procedures yields a new quarterly business cycle chronology for 1929 to 2019 that is slightly different from the existing NBER dates, more consistent over time, and on a sounder theoretical basis.

In the mid-twentieth century, the National Bureau of Economic Research's (NBER) dates of business cycle peaks and troughs were a crucial tool of macroeconomic analysis. Such classic works as Milton Friedman and Anna Schwartz's *A Monetary History of the United States* (1963), Simon Kuznets's *National Income and Its Composition* (1941), Moses Abramovitz's *Inventories and Business Cycles* (1950), and Thor Hultgren's *Costs, Prices, and Profits* (1965) examined macroeconomic data through the lens of the business cycle dates. This research used the NBER dates to establish crucial facts about how the money stock, the distribution of income by industry and type, inventories, and productivity varied with economic activity.

Modern macroeconomic research has obviously evolved greatly since those classic works. Most modern empirical studies focus on continuous time series rather than correlations with a set of business cycle peaks and troughs. Yet even modern studies frequently talk about "recessions," and use recession episodes identified by the NBER to motivate and illustrate their points. The NBER recession dates also generate considerable interest from policymakers and the news media, and the declaration of a peak or trough is often front-page news. And even today, most data graphing programs have the option of showing NBER recessions with the ubiquitous gray bars.

2020 marks the National Bureau's hundredth anniversary. As such, it seems a natural time to consider whether the NBER recession dates remain a useful contribution worth continuing—and if so, whether they have weaknesses that should be corrected in the Bureau's second century. That is what we do in this paper.

In Section I of the paper, we argue strongly that the recession dates capture a fundamental feature of the American economy over the past century that may be missed by simple time series analysis. Periods of normal growth or expansion are periodically interrupted by abrupt and relatively rapid declines in overall economic activity that last for more than a few months. Building on the work of Hamilton (1989), we show that such recession periods emerge clearly from a Markov-switching model estimated using conventional postwar macroeconomic indicators, such

as the growth rate of real GDP or the change in the unemployment rate. Because recessions are a genuine and important feature of the economy, it makes sense to identify when they occur rigorously and free of bias.

Though the NBER recession dates remain a valuable resource for researchers and the public, in Section II we argue that there are significant flaws in the existing NBER recession chronology. A review of the dating procedures shows that the early recession dates were derived using methods very different from those used in later periods. Even in the post-World War II period, there is enough evolution in the economic indicators considered in the dating of cycles that important inconsistencies may have crept into the chronology.

More fundamentally, the NBER bases its chronology on series that are seasonally adjusted, but not otherwise transformed. As a result, the procedures for identifying recessions do not distinguish between movements in normal or potential levels of economic activity and deviations from normal. This is at odds with virtually all major models of short-run fluctuations, from the traditional Keynesian framework to modern DSGE models, which assign a central role to a distinction between the economy's normal, flexible-price level of activity and temporary departures from that level. The focus on levels of aggregate variables rather than deviations from normal may have had little effect in the United States over the past century, when normal growth was moderate and relatively stable. But, it is an important shortcoming for considering settings when normal growth is more extreme.

In Section III, we propose revisions to the NBER recession dating procedures. First, we argue that data limitations for the period before 1929 are severe enough that it is probably best to focus revision efforts on the period since 1929. Second, we urge a definition of recessions based firmly on measures of deviations from normal economic activity, such as the change in the output gap or the deviation of unemployment from the natural rate. Third, we suggest greater reliance on an algorithmic approach to help discipline the dating of cycles. The Markov-switching model, in particular, has the desirable feature that it focuses on relatively abrupt and rapid changes in

the series considered. While it is unlikely that judgment can or should be eliminated entirely, it should be more constrained. We therefore discuss how guided judgment can be used to adjudicate cases where the algorithm is quite uncertain.

In Section IV, we take a first step at implementing these proposed revisions to the dating procedures. We discuss the results of the Markov-switching model estimated on changes in the deviation from normal for the postwar and interwar eras. For observations where the verdict of the model is not clear-cut, we supplement the statistical analysis with additional data and reasoning. A comparison of the new tentative dates with the NBER recession chronology shows that the revisions we propose to the dating methodology leave the post-1929 chronology fundamentally intact. Many turning points move slightly and some more substantially, but no recessions are eliminated and none are added. Nevertheless, we believe the revised procedures yield recession dates that capture past downturns more accurately and will likely identify future recessions more reliably.

I. THE IMPORTANT CONCEPT OF A RECESSION

Macroeconomic fluctuations are complicated. Downturns vary in speed, size, length, and periodicity, in the relation between different variables during the downturn, and more. Periods of growth exhibit similar variation. Given this, it is natural to wonder if a simple recession chronology like that of the NBER is useful. Perhaps macroeconomists should just embrace the full time series of key series in all their complexity, and not try to reduce aggregate behavior to a simple two-state classification.

The strongest argument in favor of a chronology like the NBER recession dates is that it captures an essential feature of the macroeconomy. The idea of distinct phases of the business cycle, particularly recessions and expansions, is not an arbitrary division of a smooth distribution of macroeconomic outcomes into discrete categories. Rather, it captures a fundamental feature of short-run fluctuations: normal economic activity is periodically interrupted by distinct periods

when the negative deviation of activity from normal increases rapidly. Following such interruptions, the economy typically returns only gradually to normal.

The easiest way to see this is just to look at the plot of the unemployment rate in the United States since 1948 shown in Figure 1. (The sources for all data used in the paper are given in the data appendix.) The fact that there are repeated episodes of rapid, substantial increases in unemployment simply jumps out of the figure. The increases occur at irregular intervals, start from different levels, last different lengths of time, and involve different overall changes in unemployment. But these periods, which together account for a relatively small fraction of the postwar era, differ sharply from the rest of the era: the past 70 years are characterized by brief bursts of rapidly rising unemployment followed by gradual declines that are always less rapid than the increases.

A. A Markov-Switching Approach

A more formal demonstration that recessions are a genuine phenomenon rather than an arbitrary classification comes from the important work of Hamilton (1989). Hamilton posits a two-regime model of quarterly GDP growth. In its simplest form, growth in each regime is i.i.d. across quarters, and the only difference between the two regimes is in mean growth. Switches between the regimes follow a Markov process. That is, if the economy is in regime r in a period, it switches to the other regime the next period with probability p_r and remains in the current regime with probability $1 - p_r$. Importantly, Hamilton imposes no other constraints on the two regimes. For example, one could feature mean growth that is slightly above the overall average and the other mean growth slightly below the overall average, with the economy spending about half the time in each regime and switching between them frequently; or the higher growth regime could be less common than the lower growth regime and transitions between the regimes rare; and so on.

When we reestimate Hamilton's Markov-switching model using quarterly GDP growth for the full postwar period (1948Q2–2019Q4), we obtain two key results (both of which are present

in Hamilton's original paper).¹ First, the two regimes look a great deal like "recessions" and "normal times" (or "expansions"). Mean growth in the low growth regime is estimated to be not just low, but negative (-1.7 percent at an annual rate, with a standard error of 1.2; estimated mean growth in the high growth regime is 3.9 percent, with a standard error of 0.3). And the transition probabilities imply that on average the economy spends just 14 percent of its time in the low growth regime, and that when it enters that regime, it stays there on average only 3.2 quarters. That is, the sharpest distinction in the data on postwar GDP growth is between a norm of somewhat above-average growth and occasional periods of substantial decline.²

The estimation yields not just values of the model's parameters, but estimated probabilities by quarter that the economy was in the low growth regime. The NBER focuses on peaks and troughs in the level of economic activity, while the model considers changes in GDP. Thus if the two approaches identify similar episodes, the model will find high probabilities of being in the low growth regime from the first quarter *after* the NBER peak through the NBER trough. Panel (a) of Figure 2 therefore highlights these quarters using gray bars on a plot of the estimated probability the economy was in the low growth regime. The estimated probability is typically close to either 0 or 1, and the periods when it is high correspond closely to NBER recessions. This is the second key result of the model.³

In other words, if a modern time-series econometrician with no knowledge of the history of business cycle dating or the concept of a recession were handed the time series for postwar U.S. GDP growth, they would conclude that the data pointed to a division of short-run fluctuations into two types of periods that correspond closely to the recessions and expansions identified by NBER

¹ We measure GDP growth as the change in the log of GDP (multiplied by 400, so that it corresponds to percent growth at an annual rate).

² Of course, we are not the first authors to reestimate Hamilton's model. See Chauvet and Hamilton (2006), for example. Hamilton's model differs from ours by including an autoregressive component in GDP growth. Including autoregressive terms does not have a large impact on the results, so we omit them to present the two-regime model as simply as possible.

³ The estimates shown in Figure 2 use the full sample to estimate the probability for each date, rather than only observations up to that date. Hamilton refers to the full sample estimates as the "full sample smoother."

researchers over the past century.

This analysis considers just one variable. Panel (b) of Figure 2 shows the estimated recession probabilities averaged across two-regime models for each of the three variables that arguably receive the most attention in both academic and popular discussions of short-run fluctuations—real GDP growth, employment growth, and the change in the unemployment rate.⁴ The models using either employment or the unemployment rate yield the same two key results as the model using GDP: the two regimes look like recessions and expansions, and the periods the model assigns high recession probabilities to overlap closely with NBER recessions. Indeed, the correspondence to the NBER recession dates from averaging the three sets of estimates is even closer than that using GDP alone. Of course there are differences (an issue we discuss below), but the overall fit is remarkable.

B. Evidence from 1929 to 1947

The decades immediately before the start of our postwar sample include two of the most notable periods in U.S. macroeconomic history: the Great Depression and World War II. Thus, it is valuable to see if fluctuations in this period also appear to fall naturally into periods of recession and normal growth.

The absence of official data on quarterly real GDP, payroll employment, and the unemployment rate extending back to the 1930s precludes using the exact approach we employ for the postwar period. However, reasonably good proxies for the series exist. In particular, the index of industrial production prepared by the Federal Reserve, the number of production workers in manufacturing published by the Bureau of Labor Statistics, and the survey-based

⁴ The employment series that enters our estimation is the change in the log (as with real GDP, multiplied by 400), and the unemployment series is the simple change in the unemployment rate (multiplied by 4 so it is at an annual rate).

A natural alternative to estimating separate models for each variable is to estimate a single model for all three jointly, with the variables required to have the same distribution in the two regimes except for differences in their means. However, because GDP growth is more volatile than the other series, the resulting estimates place essentially no weight on the behavior of GDP. We therefore prefer averaging the estimates from the three single-variable models. See Hamilton (2011) for another approach to extending his approach to multiple series.

unemployment rate series constructed by the National Industrial Conference Board are high quality series that all extend back to at least 1929Q2. The output and employment series are less broad than GDP and total employment, but they cover a substantial fraction of the interwar economy. We therefore estimate a Markov-switching model on quarterly data for the growth rate (or, in the case of the unemployment rate, the change) of each series.⁵ Again, the sources of the data and any necessary adjustments are described in the data appendix. Because of data limitations, we define the interwar sample as 1929Q3 to 1947Q4.

Remarkably, despite the enormous upheavals of this period, for all three variables the two regimes identified by the Markov-switching approach have the characteristics of recessions and expansions: one regime is infrequent, short-lived, and involves poor economic performance, and the other is common, long-lasting, and involves excellent performance. Thus, the period 1929–1947 provides further evidence that recessions are a fundamental feature of the economy. The main difference from the postwar period is that the two regimes are more extreme in this period than in the later one. For example, the estimates for 1929–1947 imply that unemployment rises on average by 8.5 percentage points per year in the recession regime, and falls on average by 2.4 percentage points per year in the expansion regime.

Figure 3 plots the average estimated recession probabilities from the three models, together with the NBER recessions. Although the agreement is not as striking as for the postwar period, it is still very strong.

C. The Enduring Value of the Concept of a Recession for Studying Business Cycles

The fact that short-run fluctuations fall relatively neatly into recessions and expansions makes the ideas of recession and expansion valuable concepts. They provide a convenient way of referring to different episodes, and looking at how a variable behaves in recessions and expansions is an easy way of summarizing its short-run cyclical properties. In addition, trying to understand

⁵ For all three series, we use the quarterly average of monthly values before computing growth rates (calculated using changes in logarithms) or changes (as always, at annual rates).

why the economy undergoes distinct periods of sharp contraction is a critically important research question. As a result, the concept of a recession continues to play a major role in macroeconomic research.

To obtain some simple evidence about this point, we examine all papers (other than comments, replies, and errata) published in the *American Economic Review* in 2019. Of the 29 papers that include a *Journal of Economic Literature* code for macroeconomics (category E), just over half (15 of the 29) use the term “recession” at some point, with most of those papers using it to refer both to the general idea of a recession and to one or more specific episodes, such as the Great Recession. Nine additional papers that do not list macroeconomics as one of their subject areas also use the term.

Recessions also play an important role in economic discussions among policymakers, the public, financial professionals, and the media. For example, the *Washington Post* published 630 items that featured the term “recession” in 2019, the *New York Times* 818, and the *Wall Street Journal* 1037.⁶ As in economic research, in these other uses the term is employed both as a convenient way of summarizing the idea of a weakening economy and as a shortcut way of referring to important episodes.

For all the various purposes recessions are used for, and for all the various users, there is considerable value to having the dates chosen by a single, quasi-official arbiter. Having a single arbiter prevents confusion, eliminates the possibility of individuals selecting dates to advance their own agendas, and allows the dates to be determined by knowledgeable scholars weighing the evidence carefully. Because of the NBER’s long history in the area, it plays this role. Although there are of course expressions of disagreement with particular NBER decisions, we are not aware of any alternative set of dates for peaks and troughs of the modern U.S. business cycle that attract any significant attention.

⁶ Data are from PROQUEST.

II. POSSIBLE WEAKNESSES IN THE NBER RECESSION CHRONOLOGY

That the fundamental concept behind the NBER chronology is sound does not mean that the chronology is without flaws. In this section we describe the NBER dating methodology and highlight three possible weaknesses. One is a shift in the methodology that makes the chronology fundamentally different pre- and post-World War II. The second is a gradual evolution in the series used to date cycles over the postwar era that has likely also introduced inconsistencies and biases over time. The third, and most important, is the fact that the NBER methodology focuses on series in levels rather than deviations from normal. This is at odds with most modern macroeconomic frameworks, and makes the approach of limited value in periods or countries characterized by particularly low, high, or variable normal growth.

A. The NBER Recession Dating Methodology

To describe the possible flaws in the NBER recession chronology, it is useful to describe the Bureau's business cycle dating methodology. *Measuring Business Cycles* by Arthur Burns and Wesley Clair Mitchell (1946) is considered the definitive source on the NBER's approach.⁷ It starts with this definition of business cycles (1946, p. 3):

Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.

Burns and Mitchell argue strongly that it is valuable to try to identify and measure cycles without having a preconceived theory of what causes them. They write: "The way we have chosen is to observe the business cycles of history as closely and systematically as we can before making

⁷ Though there is a voluminous record of the NBER's dating practices (or perhaps *because* it is so voluminous), piecing together exactly how and when the dates of peaks and troughs were set involves a fair amount of detective work. The NBER website (<https://www.nber.org/>) contains electronic versions of all out-of-print NBER books. They can be searched under the Working Papers and Publications tab.

a fresh attempt to explain them” (1946, p. 4). They say that when the opposite “order of inquiry is followed—explanation preceding thorough knowledge of what is to be explained—the results are likely to be unhappy” (1946, p. 8).

Burns and Mitchell draw a distinction between specific cycles, which are the turning points in a particular economic indicator, and reference cycles, which are the dates of overall or economy-wide short-run fluctuations. The reference dates are what economists mean by the NBER chronology.

Burns and Mitchell’s methodology for identifying cycles and turning points in specific series involves several guidelines. First, they argue for using series that have been adjusted for seasonal variation, but not detrended. They then look for “well-defined movements of rise and fall” (1946, p. 57). That is, they seek to identify actual declines in the series. For a rise and fall to be significant enough to classify as a specific cycle, Burns and Mitchell use a combination of a duration rule and a (somewhat circular) minimum amplitude rule. The duration must be “at least 15 months, whether measured from peak to peak or from trough to trough” (1946, p. 58); it must also be less than 10 or 12 years in length. The amplitude must be greater than “the lower limit of the range of amplitudes of all fluctuations that we class confidently as specific cycles” (1946, p. 58).

For some cases the identification of specific turning points, once a given movement is classified as a cycle, is straightforward. If the highs and the lows of the series are unique and obvious, the months in which those extremes occur are taken as the turning points. But in other cases, the identification of turning points is more complicated. For example, if there are multiple peaks or troughs, Burns and Mitchell tend to date the turning point at the latest extreme, provided that there has not been a significant decline before the latest peak or a significant rise before the latest trough. If the series flattens out around the peak or trough, Burns and Mitchell use the rule that the “latest month in the horizontal zone is chosen as the turning date” (1946, p. 58). This “plateau rule” suggests that Burns and Mitchell identify the peak as the period before a rapid fall in the series.

Burns and Mitchell provide only limited guidance for how researchers should go from identifying peaks and troughs in specific series to setting reference dates for recessions. They are explicit that it involves more than looking at averages or central tendencies. They write (1946, p. 77):

It would not do merely to mark off the zone within which a succession of series reached (say) cyclical peaks, then choose the month of their central tendency as the reference peak. (1) Some series ‘indicate’ a decline in business activity when they rise and an increase when they fall; for example, bankruptcies, unemployment, idle equipment. Their peaks and troughs must be inverted before casting up the evidence. (2) Some series regularly reach their peaks and troughs within the intervals marked by concentrations of turning dates. Others behave erratically. In setting reference dates, the evidence of a series that always or usually keeps in step with others is more significant than that of a series that usually ‘walks by itself’. (3) Of the series that fluctuate in unison, some are early to rise and early to fall; others are laggards; a few lead at one turn and lag at the other; many exhibit no consistent timing. These timing characteristics must be taken into account in fixing reference turns.

Here and elsewhere (see, for example, 1946, p. 76), they seem to be arguing for a somewhat judgmental approach that does not assign fixed weights to various series.

At the same time, they appear to be potentially open to using a few aggregate series to set the business cycle reference dates if the data were reliable and the coverage were broad enough. For example, they write (1946, p. 72):

The simplest method of deriving such a scale would be to mark off the months in which the specific cycles of an acceptable measure of aggregate economic activity reached successive peaks and troughs. Aggregate activity can be given a definite meaning and made conceptually measurable by identifying it with gross national product at current prices. ... Unfortunately, no satisfactory series of any of these types is available by months or quarters for periods approximating those we seek to cover. Estimates of the value of the gross or net national product on a monthly or quarterly basis are still in an experimental stage.

The fact that they seem open to using *nominal* GDP as the single indicator confirms how little economic theory entered into their analysis.

B. Inconsistency of the Pre-1939 NBER Recession Dates

The methodology described in *Measuring Business Cycles* is substantially different from that actually used to date recessions before 1939. Burns and Mitchell (1946) state that all of the American reference dates given in the volume were set substantially earlier. For example, a key

footnote says: “Indeed, the monthly (but not the quarterly or annual) American reference dates through 1927 have been allowed to stand as published in 1929 in the National Bureau’s *Recent Economic Changes in the United States*, vol. ii, p. 892” (1946, p. 95n).

Moreover, Burns and Mitchell make clear that the early reference dates were not the result of careful analysis of hundreds of indicators as is often assumed, but rather an input into the study of those series. They write (1946, p. 24):

To learn how different economic processes behave in respect of business cycles, their movements must be observed during the revivals, expansions, recessions, and contractions in general business activity. Before we can begin observing we must mark off these periods. To that end we have made for each of the four countries a table of ‘reference dates’, showing the months and years when business cycles reached troughs and peaks.

They also emphasize that “[m]ost of them were originally fixed in something of a hurry” (1946, p. 95).

The early dates grew out of Mitchell’s pioneering work (Mitchell, 1913, 1927, and 1929). All of Mitchell’s early writings on the reference dates refer to two major sources used to determine the peaks and troughs of business cycles: *Business Annals* and business indexes. *Business Annals* is a compendium of narrative accounts from newspapers and similar sources compiled by Willard Thorp (1926). The *Annals* were supposed to describe contemporaneous perceptions of fluctuations in economic activity. Mitchell had originally planned to just use these narrative accounts to sketch out the reference dates, but found they were not clear enough for this purpose.⁸

The business indexes used to supplement the narrative accounts were not specified. Romer (1994) provides forensic evidence that the ATT Business Index and Snyder’s Clearings Index of Business were likely the most important. These indexes are decidedly different from modern aggregate indicators. They include a wide range of both real and nominal series, such as the output of particular goods, prices, and bank clearings. Another important characteristic of these two indexes is that they were constructed as deviations from trend. As discussed in Romer (1994, p.

⁸ See the preface to *Measuring Business Cycles* (1946, p. vii).

594), when peaks and troughs are relatively smooth, using detrended data tends to systematically move peaks earlier and troughs later.

The methods used to date recessions in the decade 1928–1938 share important similarities with those used for the earlier dates. Like the pre-1927 dates, those for the Depression decade were set well before the publication of *Measuring Business Cycles*. For example, Burns and Mitchell (1946, p. 82) cite an article of theirs in the *National Bureau of Economic Research Bulletin* for November 9, 1936 (Mitchell and Burns 1936) as the source of the dates of the peak and trough of the Great Depression. The fact that Burns and Mitchell (1946, p. 76) refer to a continuation of Thorp’s *Business Annals* through 1932 suggests that narrative accounts played some role in the choice of turning points. And among the forty series that Mitchell and Burns mention in the 1936 article about dating the Depression, several are detrended composite indexes of business conditions. Several others are nominal indicators (such as wholesale prices and bank clearings) or indirect indicators of activity (such as business failures and stock prices). At the same time, Mitchell and Burns appear to have considered more individual series in setting the reference dates for the Depression decade.⁹

This description of how the pre-1939 reference dates suggests that they are not comparable to the modern ones. The dates were sketched down hastily and have been almost unchanged since. More importantly, they were identified using criteria very different from those specified in *Measuring Business Cycles*. Most obviously, they were based substantially on narrative accounts of business conditions—something that is not done at all after 1946. Moreover, to the extent that data were used, detrended composite indicators were central.

C. Changes in the Series Considered in Setting Recession Dates over Time

According to Moore and Zarnowitz (1986), the business cycle dates for the early postwar

⁹ Moore (1961a) presents reference peaks and troughs for the 1950s and indicates five small revisions to the dates for the interwar period, but does not give a reason for the revisions. The recession dates before 1919 were not altered, and those through 1938 have not been altered since 1961.

period were set by researchers at the NBER using the same general methods described by Burns and Mitchell (1946). The early postwar peaks and troughs were not announced with fanfare in real time. Instead, they appeared periodically in NBER volumes with little explanation.

In 1978, the NBER established the Business Cycle Dating Committee (BCDC) to take responsibility for identifying recessions and setting the dates of peaks and troughs. The committee was made up of scholars with particular expertise on the subject, as well as program directors of some of the key macroeconomic programs of the NBER.¹⁰ The modern NBER working definition of what constitutes a recession is similar to that in *Measuring Business Cycles*. A press release from 2001 says: “A recession is a significant decline in activity spread across the economy, lasting more than a few months, visible in industrial production, employment, real income, and wholesale-retail trade. A recession begins just after the economy reaches a peak of activity and ends as the economy reaches its trough” (<https://www.nber.org/cycles/november2001/>). Like the 1946 definition, the modern definition of a recession emphasizes a decline in the level of activity, not just a slowdown in growth.

The broad features of the current process of identifying cycles and turning points are little changed since the days of Burns and Mitchell. The committee looks at the specific series of interest and identifies the absolute peaks and troughs. The behavior of the series is compared with the average behavior in previous modern cycles. There are no fixed weights assigned to the various series. As a result, an important issue the committee faces in choosing turning points is how to balance the various series when there are conflicts.

While the NBER methodology has evolved relatively little since 1946, the economic indicators considered in the dating process have changed substantially. Much of the business cycle research at the NBER in the early postwar period focused on identifying which series were the best cyclical indicators, and classifying them as lagging, leading, or coincident. As of 1961, Moore

¹⁰ The BCDC has put out a statement for each turning point that it has called; these are available (along with other information about its procedures) on the NBER website (<https://admin.nber.org/cycles/main.html>).

(1961b) identified nine key coincident indicators: employment in nonagricultural establishments, the unemployment rate, total industrial production, GNP in current dollars, GNP in constant dollars, bank debits outside NYC, personal income, sales by retail stores, and the wholesale price index. It is reasonable to assume that these were the series receiving the most focus in the dating of peaks and troughs in the early postwar period. Note that five of the nine series were in current dollars.

While business cycle turning points were not announced in press releases in the early postwar period, as the period went on it became common for NBER researchers to write an article explaining why a recession was identified and how the particular turning points were chosen. Solomon Fabricant wrote an article on “The ‘Recession’ of 1969–1970” (1972) that not only discussed the episode, but also offered a thoughtful analysis of the NBER business cycle dating procedures. Fabricant points out that, “How aggregate economic activity is defined for this purpose—particularly, whether it is measured entirely in real terms, or in the mixture of real and pecuniary terms commonly used in the past—[is] a difference of more than negligible importance in a period of rising price levels” (Fabricant 1972, p. 2).

Despite Fabricant’s wise caution, it appears that nominal series continued to be considered in the dating of cycles for several more years. Another review of the quality of cyclical indicators was completed in 1975. This resulted in substantially revised indexes of leading, lagging, and coincident indicators (described in Zarnowitz and Boschan 1975). It appears that as part of that process, the NBER also revisited its existing postwar business cycle dates. In a 1977 article, Zarnowitz and Moore elaborated: “we concentrate attention upon the comprehensive time series on income and expenditures, value of output and sales, volume of production, employment and unemployment. These data were recently used to review and revise the NBER reference chronology of business cycle peaks and troughs during 1948–1970” (1977, p. 472). Thus, it appears that the revisions were likely due to changes in the series considered. What is somewhat surprising

is that of the 19 series that Zarnowitz and Moore present, 12 are real and 7 are nominal.¹¹ The revisions to the NBER business cycle dates discussed by Zarnowitz and Boschan (1975) are the most recent changes, and, to our knowledge, they and the changes described by Moore (1961a) are the only revisions that have been made.

The statement for the first business cycle peak called by the BCDC (from June 3, 1980) suggests that the committee looked closely at data on industrial production, retail sales in constant dollars, nonfarm employee hours, real personal income, and employment. The most noticeable change in the series considered is that they are all real. Another noticeable change in the series considered is that unemployment ceased to be used to date recessions. The unemployment rate was used extensively in the early postwar period. The explanation for the change can perhaps be seen in the fact that the 1975 review of cyclical indicators changed the unemployment rate from a coincident to a lagging indicator (*Business Conditions Digest* November 1975). The Committee considers the same five series (or close equivalents) in setting peaks and troughs today.¹²

This review of the series used to date recessions in the postwar period suggests there has been an important evolution over time. The two most important changes are the movement away from using nominal series and the dropping of the unemployment rate. Though there have been minor revisions to the NBER chronology as the series considered changed, the revisions have not been systematic or comprehensive. As a result, there are likely inconsistencies in the postwar dates and a careful reconsideration of the postwar chronology would be appropriate.

D. Failure to Distinguish Between Normal Economic Activity and Deviations from Normal

In most approaches to analyzing overall economic activity, the most fundamental

¹¹ See Zarnowitz and Moore (1977, pp. 474–475) for the list of 19 series.

¹² In recent years, the BCDC has focused on real GDP, nonfarm payroll employment, industrial production, real manufacturing and trade sales, and real personal income less transfers. Among monthly indicators, employment and real personal income are considered the broadest and most reliable.

distinction is between the normal level of activity (or its natural, trend, full-employment, potential, or flexible-price level), and departures from the normal level (or the gap or cyclical component). But that distinction plays no role in the NBER's definition of a recession, which focuses on a significant decline in economic activity. With that definition, a recession can result from movements in any combination of the normal and cyclical components—ranging from a normal component that is falling with no change in the cyclical component, to a normal component that is rising rapidly and a shortfall from normal that is rising even faster. As a result, the current definition could lead to the identification of recessions in episodes where the economy is not behaving at all unusually, and to a failure to identify recessions in episodes that have the classic hallmarks of them.

To see how the definition can lead to characterizing episodes where the behavior of the economy is barely different from normal as recessions, consider a country where normal growth is very low and relatively steady. In that situation, it only takes a small increase in the shortfall of economic activity from normal for overall economic activity to decline. Thus, if recessions are defined in terms of falling economic activity, they may be frequent and barely different from other times.

To see how the definition can leave out episodes with many standard features of recessions, consider the opposite case of a country where normal growth is very high. In that setting, a development that leads to a rapid increase in unemployment and idle capacity may not be enough to cause economic activity to actually fall.

Figure 4 shows these possibilities are not just hypothetical. Panel (a) of Figure 4 plots real GDP growth (at a seasonally adjusted annual rate) and the unemployment rate in Japan over the period 2012–2019.¹³ If recessions are defined in terms of absolute declines in economic activity,

¹³ GDP growth is calculated as 400 times the change in the logarithm of GDP measured in billions of chained 2011 yen, series JPNRGDPEXP. The unemployment rate is the quarterly average of monthly figures for all persons aged 15 and over, series LRUNTTTTJPM156S. Both series downloaded from Federal Reserve Economic Data (FRED), <https://fred.stlouisfed.org/>, 8/3/2020.

there are four candidate recessions: 2012Q1–2012Q3 and 2015Q2–2015Q4, when real GDP fell for two consecutive quarters; 2014Q1–2014Q2, when GDP fell sharply for one quarter; and 2017Q4–2018Q3, when GDP fell, rebounded to almost exactly its initial level, then fell again. But with the exception of 2014Q1–2014Q2, none of these episodes are unusual for this period. Because the growth rate of normal output was low, GDP growth was fluctuating around a low level.¹⁴ As a result, growth was occasionally negative. The graph of the unemployment rate reinforces the message that the episodes involving declines in GDP were not at all abnormal. None of them involved any increase in unemployment. Instead, the entire period was characterized by a steady downward drift. Thus, a definition of a recession based on declining economic activity does not appear to be very useful in this setting.

Panel (b) of Figure 4 shows estimates of real GDP growth (at a seasonally adjusted annual rate) in China over the period 2006–2010.¹⁵ Growth never fell below 4 percent, and so a definition of a recession based on a decline in economic activity would presumably not identify any over this period. But during the global financial crisis and its aftermath, growth was well below its usual level for four consecutive quarters—including a remarkable seven percentage points below its average for this period in 2008Q3 and 2008Q4. Analogously to the issues that arise in the case of Japan, a definition of a recession that immediately rules out the possibility of identifying this

¹⁴ The Bank of Japan estimates the growth rate of potential output averaged just 0.8 percent per year over this period (https://www.boj.or.jp/en/research/research_data/gap/index.htm/, accessed 11/27/2019).

¹⁵ Official quarterly estimates of real GDP growth in China are available only starting in 2011Q1. The figures reported in Panel (b) of Figure 4 are constructed by starting with the official quarterly growth estimates for 2011Q1, 2011Q2, and 2011Q3, and then using the official series for GDP growth from four quarters ago (which begins in 1998Q3) to infer quarterly growth figures, working backward in time. That is, growth in 2010Q4 is computed as the growth rate that when combined with the official estimates of quarterly growth for 2011Q1, 2011Q2, and 2011Q3 yields the official estimate of growth over the four quarters ending in 2011Q3. Growth in 2010Q3 is then computed as the growth rate that yields the official estimate of growth over the four quarters ending in 2011Q2; and so on. These estimates should obviously be treated with caution, particularly as one goes further back in time. The numbers shown in the figure are 400 times the implied changes in the logarithm of real GDP. The official series for quarterly growth and growth from four quarters ago are from OECD.Stat (<https://stats.oecd.org/>, subject B1_GE: Gross domestic product – expenditure approach, measures GPSA: Growth rate compared to previous quarter, seasonally adjusted), and GYSA: Growth rate compared to the same quarter of previous year, seasonally adjusted, downloaded 7/5/2020. Unfortunately, reliable high frequency data for the unemployment rate in China are not available (Feng, and Hu, and Moffitt 2017).

episode as a recession does not appear particularly useful in this setting.

III. SUGGESTED REVISIONS TO THE NBER RECESSION DATING METHODOLOGY

The bottom line of the previous section is that there are good reasons to revisit both the NBER recession dating methodology and the existing dates. This section proposes changes to the methodology, and the next applies these ideas to the selection of specific recession dates.

A. Treat the Early Dates as Different

As Section II shows, the early NBER business cycle reference dates are not comparable to the modern ones. The inconsistencies argue strongly against presenting the NBER's current early business cycle dates as if they represent an unbroken backward extension of the modern dates.

At a general level, there are two possible ways of addressing the inconsistency between the earlier and later dates. The more challenging is to revise the early dates. Two alternative sets of dates that would be useful to consult are the monthly dates starting in 1887 proposed by Romer (1994), based on the monthly industrial production index created by Miron and Romer (1990); and the annual dates for 1790–1915 proposed by Davis (2006), based on his annual industrial production index (Davis 2004). But each set of dates is derived from a single series, and neither covers the full period of interest. Thus these dates could be at most useful references in constructing new dates, not wholesale replacements for the existing ones.

We believe that data limitations, changes in the nature of fluctuations over time, and the lesser interest in early recessions relative to modern ones tilt the balance against undertaking a comprehensive redating of early U.S. business cycles. This leads to the second possible approach to addressing the inconsistency, which is much easier: the NBER could simply present the early dates separately from (and less prominently than) the modern business cycle dates, and accompany them with a clear statement about their lack of comparability with the later dates.

If the NBER were to go this route, the natural dividing line between the earlier and later dates is the Great Depression. The Depression remains of enormous interest, and so it would be

very valuable to have business cycle dates extending back to the Depression that are at least roughly comparable to modern dates. And as described in Section I.B, we have reasonably good proxies for key measures of macroeconomic performance for the 1930s and early 1940s. Moreover, the Markov-switching model shows that this period, like the postwar one, is characterized by episodes that look like recessions and expansions. Thus, for the period beginning with the start of the recession that became the Great Depression (which the NBER currently dates as having occurred in August 1929), it seems both valuable and feasible to make the historical business cycle dates reasonably comparable with the later ones.

B. Focus on Deviations from Normal Economic Activity

Our most fundamental proposal for improving the NBER dating methodology is that in defining a recession, the NBER replace its emphasis on a significant decline in economic activity with a focus on a large and rapid fall in economic activity relative to normal. This change would provide a narrower and more precise definition of a recession. In addition, by emphasizing only the cyclical component of economic activity rather than the trend and cyclical parts together, it would be more firmly grounded in modern understanding of macroeconomic fluctuations. It also appears to correspond more closely to how both economists and the public think of recessions. For example, we doubt that most observers would describe an economy where activity was moving smoothly along a declining trend path (perhaps because of falling population and low productivity growth), with steady unemployment and no large changes in the cyclical component of activity, as being in a protracted recession.

This change would also be in many ways a return to the approach of early NBER researchers. Burns and Mitchell and their early postwar successors, unlike the modern NBER, viewed unemployment—which is to a considerable extent a measure of the shortfall of economic activity from normal—as a valuable indicator of the business cycle. In addition, the early business cycle dates are based in part on detrended series; a focus on the cyclical component of economic activity would mean the NBER was again emphasizing measures that do not have a trend. Finally, one

prominent NBER researcher, Solomon Fabricant, explicitly raised the idea of changing the definition of a recession to one based on the shortfall of economic activity from normal. He wrote: “Why would it not be better to define a recession as a decline in the proportion of available resources employed in production, or as a widening of the gap between potential and actual output” (1972, p. 127).¹⁶

Importantly, our proposed definition focuses not just on increases in the shortfall of economic activity from normal, but on *rapid* increases in the shortfall. A key message of Section I is that the periods that stand out as distinctive in the postwar United States are those where unemployment was rising quickly, and where output and employment were not just rising more slowly than normal, but actually falling. Over the postwar period, trend growth in the United States has been relatively steady at a moderate positive level. There has therefore been a relatively close correspondence between falling output and employment and a rapidly rising shortfall of output and employment from normal. As a result, moving to a definition based on rapid increases in the shortfall would continue to pick out the distinctive postwar episodes, and would not have a large impact on what postwar U.S. episodes are identified as recessions. But, in addition to moving to a narrower definition more tied to modern theories of business cycles, the change would provide a definition better suited to other environments, such as ones where trend growth is very low or very high.

We believe it is appropriate to classify all rapid negative movements of economic activity away from its previous normal path as recessions. The alternative would be to predicate the division of economic activity into its normal and cyclical components on a specific theory of macroeconomic fluctuations, such as one that equates normal output with its flexible-price level, and so attributes all departures from normal to sticky prices. But the fact that a rapid increase in

¹⁶ There is also a substantial NBER tradition of seeking to identify “growth cycles,” which are fluctuations around the long-run growth trend of a nation's economy. See, for example, Mintz (1969 and 1974), Moore (1975), and Klein and Moore (1985).

the shortfall of activity from its previous path can result from a broad range of factors—sharply contractionary monetary policy together with nominal rigidity, a sudden disruption of the financial system that sharply reduces access to credit, a rapid move away from a wartime economy, a pandemic with a mix of supply-side and demand-side effects, and more—argues for the more expansive view. Given the current state of knowledge, we see no fruitful way of trying to limit the definition of a recession to only a subset of these possibilities.

An open question is whether as our knowledge of the sources of fluctuations improves or different types of shocks become more important, it might be appropriate to revisit this issue. For example, consider a sudden, permanent fall in an economy’s productive capacity with no impact on output relative to that capacity. Such a development would cause a sharp fall in economic activity in the whole economy relative to its previous path, but it would have essentially nothing else in common with other episodes that are identified as recessions. Thus, if such developments occurred, there might be value to adopting a definition of a recession that was narrower than the one we have proposed.

For the postwar period we propose to focus on three specific measures of deviation from normal: the deviation of real GDP from potential, the deviation of the unemployment rate from the natural rate, and the deviation of employment from trend employment. These are three broad aggregate indicators that reflect developments in all sectors of the economy. Moreover, they are widely viewed by both economists and policymakers as fundamental indicators of the health of the economy. The sources of the data are given in the data appendix. As discussed there, we use the estimates from the Congressional Budget Office (CBO) of potential GDP and the natural rate of unemployment as our “normal” benchmarks. For trend employment, we use the CBO estimates of the potential labor force and the natural rate of unemployment to infer an estimate of trend employment.¹⁷ For GDP and employment, we calculate the change in the deviation from normal

¹⁷The resulting series for trend employment is in terms of the household survey, while our measure of actual employment is from the payroll survey. Since our focus is on growth rates, our implicit assumption is that

as the change in the logarithm of the actual value of the series minus the change in the logarithm of its normal value. For unemployment, we use the change in the actual series minus the change in the natural rate. We express all three in percentage points at an annual rate.

The CBO estimates begin in 1949. As we describe in the data appendix, it is straightforward to extend them back to the beginning of 1948 (when the unemployment series begins). Because the CBO estimates are only available quarterly, we restrict our analysis to the identification of quarterly turning points. For most research and summary purposes, a quarterly recession chronology should be adequate.

For dating recessions in the interwar period, we are forced to use proxies for our preferred aggregate indicators and their normal values. The proxies we use are industrial production and an early survey-based unemployment rate series. The data appendix describes the sources and adjustments we make to these series, and our procedures for constructing crude estimates of their normal values.¹⁸

C. Put More Weight on Quantitative Metrics and Statistical Inference

Judgment should play a role in dating business cycles. There may be unusual relationships among different series, or patterns of short-run rises and falls that had not occurred before. Or, a series that typically provides little information beyond those the NBER usually emphasizes may show something unexpected. Or (in the spirit of Burns and Mitchell's treatment of changes caused by strikes and highly unusual weather), there might be no alternative to using judgment to assess how some exceptional development should be taken into account. An obvious example along these lines is the downturn associated with the ongoing Covid-19 pandemic, where factors very different

the growth rate of potential payroll employment and trend household employment are the same (or differ only by a constant), which appears to be a reasonable approximation.

¹⁸ For the interwar era, we do not include the employment gap in the Markov-switching model. Because the employment series we have available (production workers in manufacturing) had a flat trend in the 1920s, surged during World War II, and then remained substantially higher in the early postwar period, we found it difficult to construct a rigorous "normal" trend series. As discussed below, we do however consider employment in the more judgmental part of the analysis.

from those at work in any previous episode are undoubtedly central. In identifying and dating a recession in this episode, it makes sense to consider whether its unique nature should cause it to be treated differently in some way.

Despite the necessity for some judgment, it would clearly be desirable to rely on quantitative, statistics-based rules to the extent possible. The Markov-switching approach described in Section I is one such approach. When estimated on the change in the deviation of key series from normal, it captures an important feature of our proposed definition of a recession—a rapid increase in the shortfall of economic activity from normal. We propose to use that as a starting point for identifying periods of recession.

Our preferred approach is to run the Markov-switching model separately for the change in each of the three series mentioned above (the deviation of GDP from potential, the deviation of the unemployment rate from the natural rate, and the deviation of employment from trend). We then average the resulting estimates of the probability that the economy was in recession in a given quarter. This approach has the benefit of using the information provided by each series independently.¹⁹ Because we are forced to use different data sources before 1948 (and, indeed, do not have an acceptable measure of the employment gap for the interwar period), we estimate the Markov-switching model separately for 1929 to 1947 and 1948 to 2019.

Hamilton (1989) uses an estimated probability of 50 percent as his cut-off for whether a quarter should be classified as a recession quarter. We find that small changes in data and samples can often move the estimated probabilities for particular quarters by 10 percentage points or so. For this reason, we suggest using 80 percent as the cut-off for when a quarter is clearly in recession. For quarters when the probability is between 20 percent and 80 percent, we suggest a procedure of using guided judgment. Relatively few observations fall in this range, so it is possible to think carefully about each one.

¹⁹ As when we consider the behavior of the raw series rather than their deviations from normal, estimating a single model for all three series jointly produces estimates that put almost no weight on the behavior of GDP. See n. 4.

Our guided judgment involves three steps. The first is to consider what is driving the model results in unclear quarters. The behavior of the series in previous and subsequent quarters influences the probability the model places on the current quarter being part of a recession. However, our definition suggests that whether a quarter at the start or end of a period of a rapidly rising shortfall of activity from normal should be classified as part of the recession should be based only on what was happening in that quarter. Identifying cases where strong movements in the preceding or following quarters appear to be unduly affecting the estimated probability for the current quarter can therefore lead us to change how we interpret the model estimates.

The second step is to look at alternative measures of the same concept. In the postwar era there are alternative measures of two key indicators: real gross domestic product and total employment. Real gross domestic income (GDI) is conceptually identical to real gross domestic product but measured from the income side rather than the expenditure side. Total household employment measures employment using a household survey, whereas payroll employment surveys employers. Though the two series are conceptually slightly different (for example, payroll employment double counts people with multiple jobs), both are measures of total employment. Because any data series has sampling error, in cases where the model is unclear we look at the behavior of the alternative series to see if it suggests a clearer answer.

The third step is to consider two other relatively trendless indicators: average weekly hours and capacity utilization. Both these measures reflect deviations from normal and cover a large fraction of the economy. The data appendix gives the sources for these two indicators. Our suggestion is to use these two additional indicators largely as tie-breakers when the alternative indicators of GDP and employment are also inconclusive.

Data limitations for the interwar period force us to use a somewhat abbreviated judgment process. We do not have alternative measures of key indicators. For this period, we therefore focus on understanding the source of the model results and the behavior of two additional series: employment in manufacturing and average weekly hours.

IV. A PRELIMINARY NEW RECESSION CHRONOLOGY FOR 1929 TO 2019

In this section, we apply the new procedures described in the previous section. In particular, we estimate a Markov-switching model on various indicators of the deviation of economic activity from normal. We then use the guided judgment procedures outlined above to adjudicate cases where the model is uncertain. Because we estimate the model separately for the postwar and interwar periods, we discuss the results separately as well.

A. New Recession Dates since 1948

If the growth rates of normal GDP and employment and the change in the natural rate of unemployment were steady, applying the Markov-switching model to the deviations from normal would produce results identical to those using the raw variables (except that estimated mean growth in each regime would be shifted by a constant). In practice, the behavior of the normal trend components over the postwar period has been reasonably but not completely smooth. As a result, the estimates are similar but not identical to those in Section I.A.

Panel (a) of Table 1 reports the parameter estimates from the regime-switching model estimated using each of our three series for the change in activity relative to normal over the postwar period. The estimates paint a consistent picture across the series. As with the changes in the raw series in Section I.A, the two regimes can reasonably be described as recessions and expansions. Average performance in the recession regime is quite poor: GDP is falling relative to normal at an annual rate of 5.16 percent, employment is falling relative to normal at an annual rate of 3.25 percent, and the unemployment rate is rising relative to the natural rate at an annual rate of 3.05 percentage points. Similarly, for all three series average performance in the expansion regime is slightly better than normal. With each series, the estimated probability of switching from the expansion regime to the recession regime is about 5 percent per quarter, implying that expansions last on average about 20 quarters. But there is a noticeable difference across the series in the probability of moving from the recession to the expansion regime. For the GDP gap and the difference between unemployment and the natural rate, it is about 30 percent per quarter,

implying that recessions last on average just slightly over three quarters; for the deviation of employment from normal, it is 18 percent per quarter, implying that the average length of a recession is between five and six quarters. Presumably this result is largely driven by the tendency of employment relative to normal to continue falling substantially after GDP and unemployment relative to normal have begun to stabilize or even recover, most notably in the “jobless recoveries” of the 1990s and early 2000s.

Analogously to Panel (b) of Figure 2, Figure 5 plots the average of the three estimated probabilities that the economy was in a recession, along with shading to show the NBER chronology. As discussed in Section III, we feel confident that quarters where the probability is greater than 80 percent should be classified as recession quarters. Likewise, quarters where the probability of recession is less than 20 percent are clear-cut periods of expansion. We view the quarters where the model probability is between 20 and 80 percent as more ambiguous and requiring additional judgment. Figure 5 shows that in 85 percent of the quarters in our sample, the average of the three recession probabilities is less than 20 percent or greater than 80 percent (and in 61 percent of the quarters, it is less than 1 percent or greater than 99 percent). There are nine episodes in the post-1948 period where the probability of recession is over 80 percent, and these all correspond to NBER recessions. In the two other episodes that the NBER identifies recessions (in the early 1990s and the early 2000s), the estimated probability of recession is high, but not above the 80 percent threshold.

As described in Section III, we supplement the analysis with guided judgment in cases where the model probabilities are between 20 and 80 percent. In particular, we consider whether there are reasons to doubt the reliability of the regime-switching analysis in these instances, and look at the input series, alternative measures of the same concept (such as real GDI as well as reach GDP), and two other broad aggregate indicators (capacity utilization and average weekly hours). Table 2 reports the behavior of the indicators we consider in every quarter where the average recession probability is over 20 percent (along with a few other quarters to add context

to some of the cases we discuss below). The quarters where the probability is between 20 and 80 percent are highlighted in red. In addition to reporting the behavior of our indicators, the table reports the average recession probability from the three Markov-switching models, whether the NBER classifies the quarter as part of a recession, our bottom line assessment of whether the quarter should be classified as a recession, and a summary of our uncertainty about our classification (with no entry reflecting high confidence and “???” reflecting maximum uncertainty).

Consistent with our view that probabilities above 80 percent or below 20 percent are clear-cut, the raw data provide no basis for disagreeing with the verdict of the Markov-switching models in such instances. For example, consider the end of the Volcker recession. For 1982Q4 (where the average recession probability is 82 percent), the data in Table 2 leave no doubt that the shortfall of economic activity from normal was rising rapidly, and thus that this quarter should be classified as a recession. Now consider 1983Q1 (where the average probability is 18 percent). Although employment was continuing to fall substantially relative to normal (using either measure of employment), all the other measures we consider show activity not just failing to decrease rapidly, but actually rising relative to normal. Thus, it is clear that this quarter should be classified as an expansion.

In the quarters where the average of the three recession probabilities is between 20 and 80 percent, by far the most common pattern is for the Markov-switching analysis to be fairly confident in its classification (that is, to be close to 20 percent or 80 percent), and for our procedures for applying judgment to support that conclusion. Consider, for example, the jobless recovery period of 2002Q1–2003Q2. Over these quarters, the average recession probability from the regime-switching analysis was relatively low, falling gradually from 38 to 24 percent. Throughout this period, employment was falling relative to normal at a moderately fast rate, but GDP was only barely falling relative to normal and unemployment was only creeping up slightly relative to the natural rate. Moreover, using GDI rather than GDP paints a slightly more positive

picture of output developments; using household rather than establishment employment paints a far less negative picture of employment developments; hours were only edging down; and capacity utilization was rising. Collectively, these series clearly confirm the assessment of the Markov-switching models that the shortfall of economic activity from normal was not increasing rapidly, and thus that these quarters should not be classified as recessionary.

One particularly interesting observation where the Markov-switching analysis is fairly confident and where judgment supports that conclusion is 2008Q1, which the NBER identifies as the first quarter of the Great Recession. The Markov-switching models on average put the probability the economy was in recession at just 22 percent. Among our three core series, GDP fell rapidly relative to normal, but the deviation of employment from normal fell only slightly and the unemployment gap increased only slightly. The estimated probability of a recession using the GDP gap appears to be pushed down somewhat by the rise in GDP relative to normal in the next quarter. Thus, the verdict of the core series is not completely clear. But the alternative measures of output and employment weaken the case for a recession considerably: the fall in GDI relative to normal was less than half that of GDP relative to normal, and employment measured by the household survey actually rose relative to normal. Finally, both average weekly hours and capacity utilization fell only slightly, and so do not point strongly to a recession. Thus, systematically examining the data from this episode yields a strong case for shifting the start of the Great Recession at least one quarter later than the NBER chronology.

Another notable observation where the verdict of the regime-shifting analysis is fairly clear and judgment supports that verdict is 1975Q2, which the NBER identifies as the first quarter of an expansion. The regime-switching estimates put the average probability that this quarter was a recession at 71 percent. Table 2 shows that this reflects a GDP gap that was basically flat, but an unemployment rate rising relative to the natural rate at a recessionary rate and a fall in employment relative to normal at a rate comparable to the fastest falls in many recessions. The remaining series in the table moderate this picture slightly, but not greatly. Thus, our procedures

point to shifting the end of the 1973–1975 recession one quarter later than the NBER.

The worst quarters of the 1990–1991 and 2001 recessions (1990Q4, 1991Q1, 2001Q3, and 2001Q4) are also cases where the Markov-switching model is relatively confident and guided judgment confirms that confidence. In each case, the average recession probability is between 69 and 78 percent, and in each case the detailed information in the table supports the verdict of the Markov-switching model. Since these are the only postwar NBER recessions that do not have any quarters where the average probability was greater than 80 percent, the fact that our procedures point clearly to identifying recession quarters during these episodes means that our approach agrees with the NBER about what periods involved recessions; our only disagreements are about specific starting and ending dates.

Another important set of observations are those where the Markov-switching approach is close to on the fence (with an average probability between 40 and 60 percent), but guided judgment points to a fairly clear answer. A good example is 1990Q3, which the NBER classifies as the last quarter of the expansion preceding the 1990–1991 recession. The regime-switching estimates average very close to 50-50 (52 percent). But all three of our core measures show a performance that was somewhat worse than the midpoint between the Markov-switching models' mean recession and nonrecession growth rates; and the recession probability using unemployment, which is the lowest of the three, is pulled down by the fact that unemployment barely changed in 1990Q2 and never rose extremely rapidly during this episode. In addition, GDI and household employment paint worse pictures than GDP and establishment employment; hours were falling moderately fast; and capacity utilization was falling slightly. With the exception of capacity utilization, all of these point to classifying this quarter as a recession.

Another observation where the Markov-switching model is highly uncertain, but guided judgment is not, is 1948Q4. The deviation of GDP from normal was falling at a recessionary rate; the cyclical component of employment was falling moderately fast; and unemployment was creeping up relative to the natural rate. And with the exception of GDI, the other series paint a

worse picture. The behavior of hours, which fell at a rate similar to the fastest declines in many recessions, is particularly notable.²⁰ Thus, our procedures for using judgment lead us to classify this quarter as a recession, which is contrary to the NBER.²¹

Finally, there are two cases where the Markov-switching analysis yields an average recession probability close to 50 percent and judgment does not point to a remotely clear answer. In light of the general observation that dividing macroeconomic fluctuations into recessions and expansions necessarily involves simplifications of a complex reality, and thus that there will almost inevitably be some cases where identifying the exact time of the peak or trough of a business cycle is close to arbitrary, the fact that there are such cases is not surprising. The first case is 1980Q1. What tips us to classifying this quarter as the last quarter of an expansion rather than the first quarter of a recession is that the estimated probabilities from the Markov-switching model appear to be increased by the dismal performance of the economy in 1980Q2: in 1980Q1, the GDP gap was falling only slightly, while growth rates of the employment and unemployment gaps were essentially at the midpoints between the Markov-switching model's mean recession and non-recession growth rates. The other quarter in this category is 2008Q2. Here, the fact that the behavior of economic activity relative to normal measured using GDI, establishment employment, and unemployment all point clearly (though hardly overwhelmingly) to a recession tip us to classifying this quarter as a recession. Both classifications match the NBER's. Interestingly, if one made the opposite decision about 2008Q2—which is essentially equally defensible—one would move the start of the Great Recession two quarters later than the NBER.

²⁰ As described in the data appendix, our data on average weekly hours for this period are for the manufacturing sector. The statement in the text refers to the behavior of manufacturing hours in 1948Q4 compared with its behavior in other postwar recessions.

²¹ The other observations where the average probability from the regime-switching model is between 40 and 60 percent but where our judgmental procedures lead to a reasonably clear answer are 1953Q3, 1974Q1, 1974Q2, and 2001Q2. In these cases, our bottom-line classification is the same as the NBER's. The end of the Great Recession (2009Q3) is a case where our classification is the same as the NBER's, but our confidence is decidedly lower. In this quarter, the behavior of the employment gap (both payroll and household) is sufficiently at odds with that of the other indicators that it is difficult to resolve the conflict. We ultimately classified it as a non-recession quarter because the GDP and GDI gaps were essentially unchanging and both hours and capacity utilization were increasing markedly.

Despite these few highly questionable quarters, the analysis in this section suggests that our new recession dating procedures generally yield quite clear classification of recessions and expansions. The recession dates that result from our approach are broadly similar, but not identical, to those of the existing NBER chronology. We identify the same recessions as the NBER, but shift a number of peaks and trough quarters slightly.

B. New Recession Dates 1929 to 1947

As discussed in Section III, for the interwar period we run the Markov-switching model on just two series: the change in the deviation of industrial production (IP) from an estimate of trend, and the change in the deviation of the unemployment rate from an estimate of the natural rate (both changes at an annual rate). The parameter estimates are given in Panel (b) of Table 1. Using either series, the model identifies a relatively brief state of rapidly deteriorating economic performance, and a relatively lengthy period of gradually improving conditions. For IP, the change in the deviation from normal is -33 percent in the bad (recession) state, and 13 percent in the good (expansion) state. The probability of switching out of a recession is 25 percent per quarter (implying that a typical recession lasts four quarters). For the unemployment gap, the change in the deviation from normal is 8.5 percentage points in the recession state (that is, the unemployment gap is increasing rapidly), and -2.4 percentage points in the expansion state. The probability of leaving the recession state is 22 percent per quarter.

The estimated Markov-switching model implies an estimate of the probability that the economy was in a recession state each quarter. We run the model separately for the industrial production and unemployment gaps, and then average the two recession probabilities for each quarter. Figure 6 shows the average estimated probabilities along with shading to show the NBER chronology. As discussed above, probabilities above 80 percent are very clear-cut. Based on this cut-off, the regime-switching model indicates that there were recessions in the early 1930s and in 1937–38, which is consistent with the NBER chronology. The model is less clear that the end of World War II should be classified as a recession, as the NBER chronology does.

Table 3 shows all of the interwar quarters where the average probability that the economy was in the recession state was greater than 20 percent (along with a few intervening quarters with lower probabilities included to add context). The table highlights observations where the probability of recession is between 20 and 80 percent. Following our suggested procedures, we consider whether there are reasons to doubt the reliability of the regime-switching analysis in these instances, and look at both the input series and two other broad aggregate indicators (manufacturing employment and average hours).

For the Great Depression, the Markov-switching model is slightly uncertain whether 1929Q4 should be classified as a recession quarter. However, some of this uncertainty comes from the fact that the estimated probability using unemployment is held down by the fact that unemployment fell sharply in the previous quarter and rose only moderately in the next one. A look at the raw indicators suggests that this is clearly a recession quarter. The fall in the IP deviation from normal was one of the largest in the Depression (−33 percent) and the rise in the unemployment gap was substantial (5.8 percentage points). The two additional indicators, manufacturing employment and average weekly hours, also both fell rapidly. Thus, we classify 1929Q4 as a recession, and place the peak in 1929Q3. This is consistent with the NBER quarterly chronology.

The Markov-switching model is highly certain that 1930Q1 through 1932Q2 were recession quarters. The recession probability for 1932Q3 is just below the 80 percent cutoff we use. That average probability reflects the fact that the unemployment gap rose substantially in this quarter, but the IP deviation from normal fell more modestly. Moreover, because the IP gap improved markedly in the subsequent quarter (before deteriorating again), the Markov-switching model is slightly uncertain about how to interpret the moderate fall in 1932Q3. Our interpretation is that the relatively high probability is sensible and argues strongly for counting 1932Q3 as a recession quarter. This view is confirmed by the behavior of employment and hours, both of which fell markedly in this quarter. This classification is consistent with the NBER chronology.

The regime-switching model puts the probability that the economy was in recession in 1932Q4 and 1933Q1 at very low levels (less than 10 percent). We nevertheless examine these observations carefully because this suggests a large deviation from the NBER, which dates the Great Depression as lasting through 1933Q1. It is easy to see why the model estimates low recession probabilities in these two quarters. The rise in the unemployment gap, which had been 9.5 percentage points in 1932Q3, was essentially zero in 1932Q4 and negative in 1933Q1. The negative IP gap also narrowed strongly in 1932Q4. The gap deteriorated again in 1933Q1, but then improved so strongly in 1933Q2 that the model interprets the 1933Q1 rise as potential noise. The behavior of employment and hours mimic the IP series—rising in 1932Q4 and falling in 1933Q1. The movements were strong enough that they give us pause, despite the low probability of recession assigned by the Markov-switching model. Because the rises in the IP gap, employment, and hours in 1932Q4 were larger than the falls in 1933Q1, and unemployment fell throughout, we ultimately classified 1932Q4 and 1933Q1 as non-recession quarters. We thus date the trough of the Great Depression in 1932Q3, which is two quarters earlier than the NBER. We are, however, somewhat uncertain.

There are three quarters in the mid-1930s (1933Q4, 1934Q3, and 1934Q4) where the model probabilities are in the ambiguous range. We classify all of them as non-recession quarters. The one that we found most difficult was 1934Q3 (where the model probability of recession is 77 percent). All four indicators—IP gap, unemployment gap, manufacturing employment, and average weekly hours—moved strongly in the contractionary direction. However, some of the decline was reversed the following quarter, implying at most a very short recession. Narrative accounts in *Business Week* for this period stress both a severe drought and labor unrest as affecting the economy in this particular quarter.²² Such factors, particularly when they are quickly

²² See, for example, *Business Week*, July 28, 1934, p. 3 and September 1, 1934, p. 3. The iron and steel industry, which received considerable weight in the Federal Reserve's Index of Industrial Production in the 1930s was particularly depressed in July, August, and September of 1934. Among the reasons *Business Week* gives for the fall in steel production were the effect of the drought on farm incomes and hence on farm durable goods, stockpiling of iron and steel earlier in 1934 in anticipation of price increases, and the end of

reversed, feel different from typical recessions, and so we do not classify this quarter as one. However, our uncertainty is substantial.

For the 1937–38 recession, the Markov-switching model is least certain about 1937Q3. The model puts the probability that this was a recession quarter at 28 percent. This fits with the fact that the IP gap fell a small amount (for the interwar era), but the unemployment gap also fell. There is nothing idiosyncratic about the model results in this quarter, so we put the usual substantial weight on the estimated probability. The other indicators also moved in opposite directions, with employment continuing to rise and hours beginning to fall. On net, we did not see a case for classifying this quarter as a recession. Thus, our quarterly recession chronology places the peak one quarter later than the NBER chronology. Though the probability of recession is technically in the marginal range in 1938Q2 (78 percent), all of the indicators except hours strongly agree that the economy continued to decline rapidly. So, like the NBER, we classify this quarter as a recession.

The decline in economic activity at the conclusion of World War II was by far the hardest for us to adjudicate. Even before we applied our normal procedures, we faced two decisions. One involved the estimation of “normal.” We chose to treat the wartime surge in industrial production and the fall in unemployment as deviations from a relatively stable normal, rather than as a large swing in normal. We feel this is reasonable (given widespread evidence of wartime inflationary pressures), and practical (given the difficulty of implementing an alternative assumption), but it was obviously a consequential choice. Second, the source of any rapid fall in the IP gap (or rise in the unemployment gap) in this case was clearly from an uncommon source: the ending of a major war. However, as discussed in Section III, something like demobilization (or a financial crisis or a pandemic) could cause a rapid increase in the shortfall of economic activity from normal because of frictions, sticky prices, or other forces. Hence, we felt it was reasonable to consider this episode

a rail and railroad equipment program. *Business Week* (August 25, 1934, p. 3) also reported: “Business is hitting the end of summer with a dull thud, though we are inclined to think the dullness is much exaggerated,” suggesting that it also did not see a clear recession in this quarter.

a possible recession.

The Markov-switching model puts moderate probabilities (46 and 58 percent, respectively) that the economy was in recession in 1945Q3 and 1945Q4. We suspect that the reason the model does not estimate a larger probability is that the surges in IP and the falls in unemployment during the war were so extreme that even the substantial downturns in 1945Q3 and 1945Q4 appear to be potential noise. The fall in the IP gap and the rise in the unemployment gap were large in both quarters, (and the IP gap was not just falling rapidly but negative in 1945Q4). Employment and hours also declined substantially. We therefore conclude that these two quarters should clearly be counted as recession, which is consistent with the NBER chronology.

We are much less confident about how to classify the quarters on either side of 1945Q3 and 1945Q4. In 1945Q2, the model probability is 46 percent. The IP gap fell substantially, but the unemployment gap was essentially unchanged. Employment and hours both fell a moderate amount. The fall in employment is consistent with the behavior of IP, and leads us to downweight the contradictory signal from unemployment. We therefore classify this quarter as a recession quarter, which is consistent with the NBER. However, we are highly uncertain. Indeed, for the interwar era, this is the marginal recession quarter. 1946Q1 is, in our view, the marginal non-recession quarter. The main difference between it and 1945Q2 is that unemployment barely rose and employment was essentially unchanged, so there is essentially no evidence of a deterioration in labor market conditions. We are again, however, quite uncertain about this classification.

Overall, our attempt at determining a new recession chronology for the 1929–47 period leaves the NBER chronology largely intact. Our more systematic approach based on changes in the deviation from normal identifies roughly the same three recessions. However, the new chronology shifts the trough of the Great Depression two quarters earlier and the peak of the 1937–38 recession one quarter later.

V. CONCLUSIONS

For most of the past hundred years—and perhaps longer—the American economy has been characterized by extended periods where economic activity was generally rising at slightly above-normal rates (“expansions”), punctuated by brief periods where activity was falling so rapidly relative to its normal path that it was declining in absolute terms (“recessions”). Identifying these periods—that is, “dating” business cycles—serves multiple purposes. It calls attention to this pattern of extended expansions interrupted by brief recessions as a central feature of aggregate fluctuations; it identifies key episodes in macroeconomic history; and it is a convenient starting point for back-of-the-envelope calculations and motivating facts. As a result, despite the enormous advances in theoretical modeling and empirical methods since the origins of business cycle dating, the concepts of expansions and recessions continue to play a central role in the analysis of macroeconomic fluctuations.

The National Bureau of Economic Research has long been the quasi-official arbiter of the dates of expansions and recessions in the United States. It has devoted a large amount of effort to this activity, and the dates it has chosen align closely with the results of both casual data analysis and more sophisticated econometric estimation of regime-switching models of fluctuations using a range of measures of the growth in economic activity. But these facts do not mean that the NBER dates cannot be improved on. In this paper, we propose three improvements.

The first is to change the definition of a recession to emphasize significant and rapid increases in the shortfall of economic activity from normal rather than significant declines in economic activity. In the modern United States, there has been a close correspondence between the two: because normal growth has been moderate and relatively steady, to a first approximation overall activity has declined if and only if its shortfall from normal has risen rapidly. But we argue that a definition based on a rapidly rising shortfall is nonetheless preferable. It is more closely tied to the division of output in modern macroeconomic models into its trend and cyclical components. Moreover, the close correspondence between the two types of episodes does not

carry over to other settings. In settings with low trend growth, a definition based on absolute declines in activity identifies many recessions, including ones where the behavior of the economy is barely different from normal; and in settings with high trend growth, it identifies few or no recessions, omitting episodes that are economically important and that have the hallmarks of recessions other than an absolute decline in activity.

The second improvement is to acknowledge the inconsistency of the NBER recession dates over time and, where possible to make them more consistent. The NBER dates prior to the Great Depression are based on an approach that differs fundamentally from those used to choose later dates. And there has been considerable evolution in the approach taken to the post-Depression dates in terms of the role of nominal variables, the role of the unemployment rate, and the number of series considered. For recession dates to be as useful as possible, these inconsistencies should be addressed.

The third improvement is to be more systematic in the identification of dates. Quantitative metrics and clearly specified guidelines for applying judgment play only limited roles in the current NBER approach. We argue that estimated recession probabilities from regime-switching models provide a valuable quantitative starting point for choosing the dates of recessions, and that it is possible to spell out an approach that largely follows a set of pre-specified procedures for resolving cases where the message of the regime-switching models is unclear.

One contribution of the paper is to apply these ideas to setting quarterly recession dates. We argue that a lack of comparable data in the pre-Depression period and differences in the very nature of early macroeconomic fluctuations are so significant that, at least for now, the prudent approach is to not attempt a recession chronology for the period before 1929. For the period since 1929, we implement our proposed approach. Regime-switching models estimated using measures of the growth of activity relative to normal deliver clear-cut verdicts about the vast majority of observations, and our procedures for applying judgment resolve most of the remaining ones reasonably clearly.

Not surprisingly in light of the close correspondence between the periods the NBER identifies as recessions and periods of rapidly rising shortfalls of activity from normal, our analysis does not lead to major proposed changes to the NBER chronology. Perhaps the most interesting results are that our analysis suggests shifting the trough of the Great Depression two quarters earlier and the start of the Great Recession one quarter later. More importantly, however, we believe our revisions yield a business cycle chronology that is more consistent over time and on a firmer theoretical and empirical footing. It is also likely to be more robust across a variety of settings going forward.

Several questions remain open. One is whether there is a good way of extending our approach to the period before 1929. As we have described, the challenges are formidable, raising the possibility that researchers may never be able to confidently identify early U.S. business cycles in a way comparable to modern dates. But as discussed in Section III, further efforts in this direction are surely possible.

A second open issue involves applying our approach at the monthly rather than the quarterly frequency. For identifying key episodes and summarizing variables' cyclical properties, quarterly dates are generally sufficient. But there may be value in a higher frequency recession chronology. In contrast to identifying pre-Depression turning points, choosing new modern monthly dates seems clearly possible. One obstacle is that the existing estimates of potential output, normal unemployment, and trend employment from the Congressional Budget Office are only available quarterly. Since estimates of potential tend to be quite smooth, simply interpolating to form monthly values should be adequate.

The lack of an official monthly GDP series is a more serious limitation. Many pieces of real GDP, such as personal consumption expenditures, are available at a monthly frequency, but some of the most volatile ones, such as investment and inventory accumulation, are not. One topic for future research would be to test whether the lack of a comprehensive monthly GDP measure is an insuperable impediment. For example, one could use our suggested procedures run only on

quarterly values of series that are available monthly to create an alternative quarterly chronology. A comparison of that alternative chronology with our current version (which is based heavily on the quarterly real GDP and real GDI series) could provide suggestive evidence on how serious a problem it is to not have monthly GDP data. Another topic for further research would be to see if a refinement of our procedures could use the new quarterly dates based partly on GDP, which are inherently more reliable, to discipline the monthly chronology.

The final open issue we want to highlight is how the 2020 Covid-19 pandemic will impact the dating of business cycles. There is no doubt that the episode involves a recession by our definition. GDP and employment fell sharply relative to estimates of potential, and unemployment rose dramatically relative to estimates of the natural rate. Moreover, the movements in 2020Q1 were sufficiently in line with past recessions that they do not pose a challenge to the regime-switching algorithm: carrying our analysis through 2020Q1 shows an elevated recession probability in that quarter, with essentially no change to the estimated probabilities in the remainder of the sample.²³

Carrying the analysis of the pandemic's implications for business cycle dating further, however, raises two issues, one practical and one conceptual. The practical issue is that the sheer magnitude of the downturn and, potentially, the subsequent rebound may require adjustments to the regime-switching algorithm. The decline in GDP relative to normal in 2020Q2 was more than

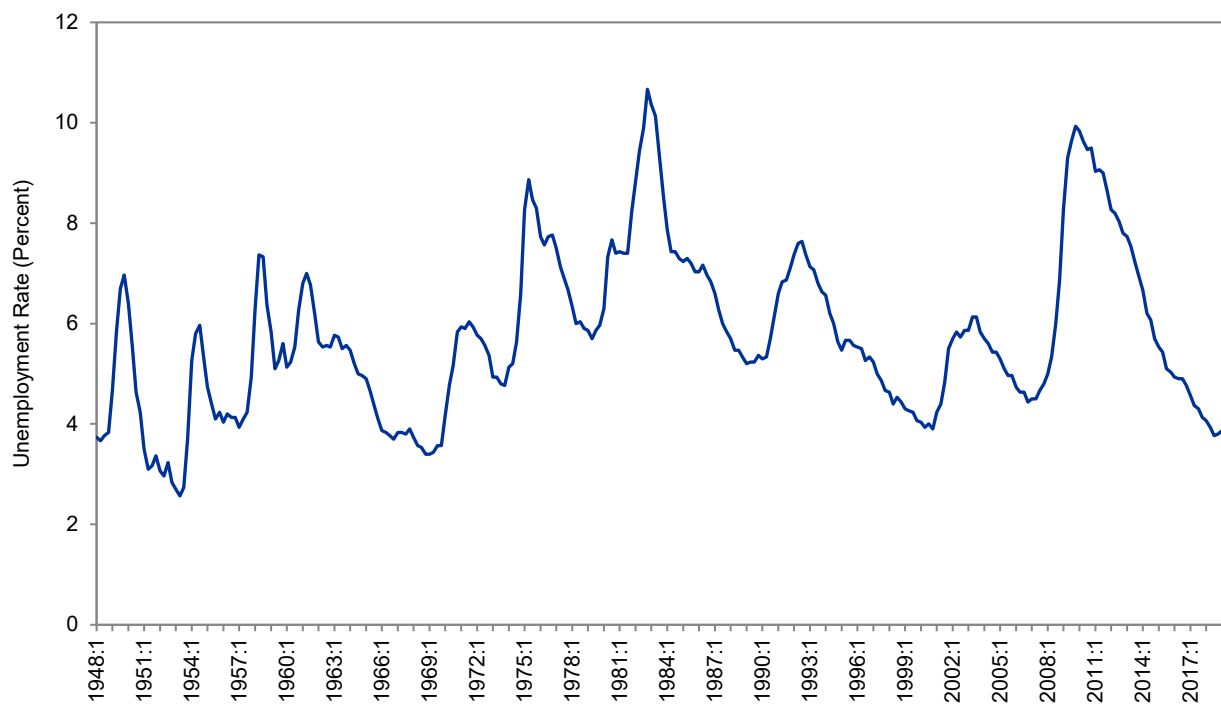
²³ Using the published numbers for GDP growth, the change in unemployment, and employment growth (and the same sources as in the rest of the paper for potential GDP, the natural rate, and potential employment) yields estimated recession probabilities in 2020Q1 of 71 percent using growth of the output gap, but just 3 percent using the change in unemployment relative to the natural rate and 1 percent using growth of the employment gap. However, there are important issues with the March 2020 labor market data: misclassification errors between individuals who are unemployed and ones out of the labor force appear to have reduced the measured rise in the unemployment rate by “almost 1 percentage point”; and because the establishment survey counts individuals who are not working but who are being paid as employed, it greatly understated the decline in the number of individuals actually working (see https://www.bls.gov/news.release/archives/empsit_04032020.htm). Adding 0.3 percentage point to the unemployment rate in 2020Q1 and reestimating the model using the resulting series for the change in unemployment relative to the natural rate gives a recession probability in 2020Q1 of 67 percent; and estimating the model using the growth rate of employment as measured by the household survey relative to normal employment (which gives similar results for the period 1948–2019 as our other series) yields an estimated recession probability of 44 percent.

three times as large as the largest fall in our postwar sample, and so is poorly described by the two-regime model. Thus it may be necessary to exclude some observations from this period (or otherwise adjust for them) for the two-regime model to adequately capture the nature of the vast majority of postwar fluctuations.

The conceptual issue is how much, if any, of the decline in activity should be classified as a change in normal activity. As we have discussed, we believe it makes sense to take an expansive view of the possible sources of a decline in economic activity relative to normal (rather than, for example, equating such movements only with fluctuations due to nominal rigidity). That said, one can imagine arguments that some parts of the recent declines reflect factors not at all comparable to any previous downturn, and the passage of time may reveal that some of the sharp decline reflected a permanent downward shift in activity rather than a temporary fluctuation.

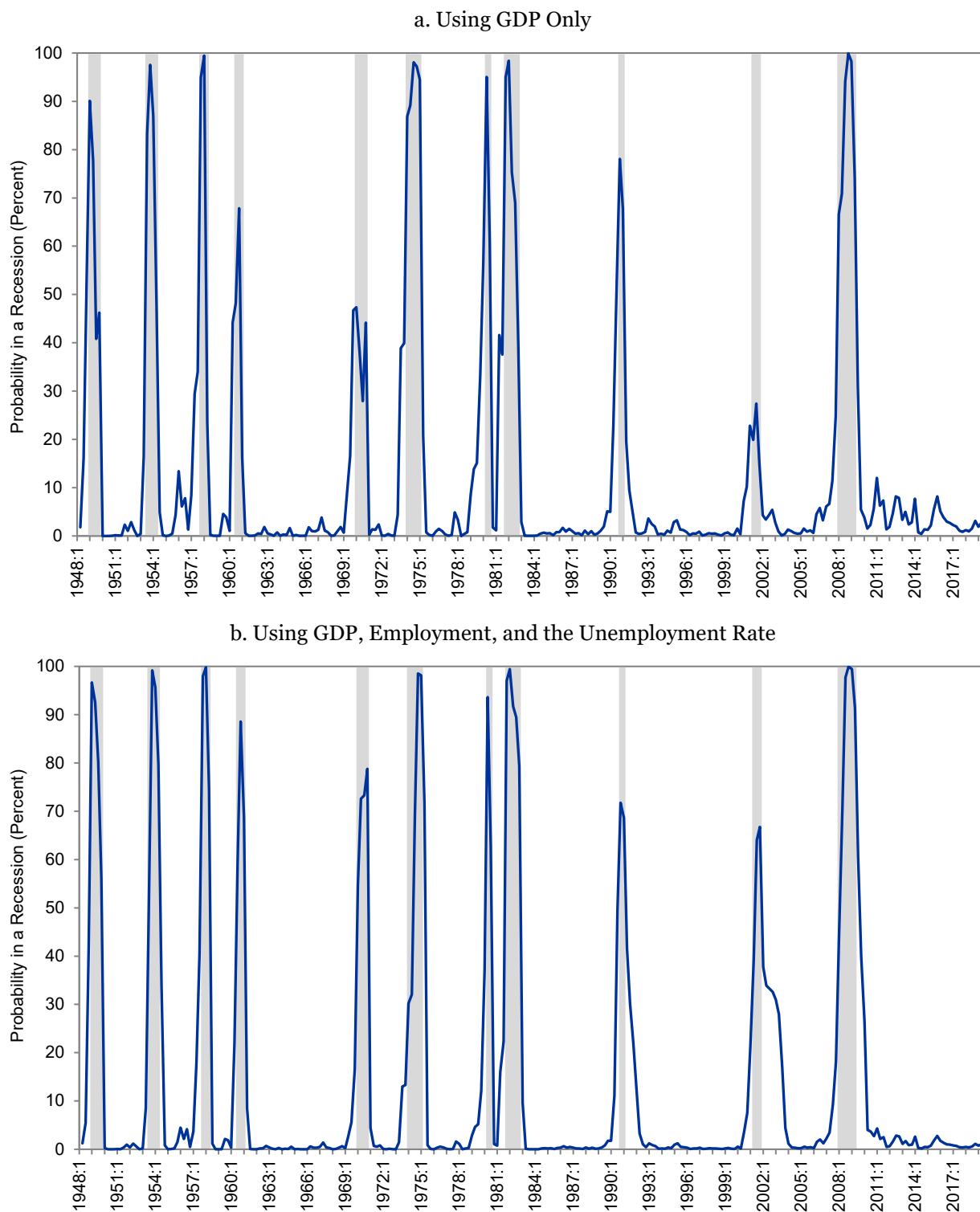
It is clearly too soon to resolve either issue. As we obtain more data about the path of economic activity over the course of the pandemic and the subsequent recovery, we will have a clearer picture of how this episode affects estimates from the two-regime model and what type of adjustments, if any, may be needed. And as we study the how the pandemic affected economic activity in both the short run and the long run, we are likely to develop a better understanding of whether any important parts of the movements should be viewed as changes in normal economic activity rather than movements relative to normal. For now, however, these remain important subjects for future research.

FIGURE 1
Unemployment Rate in the United States, 1948–2019



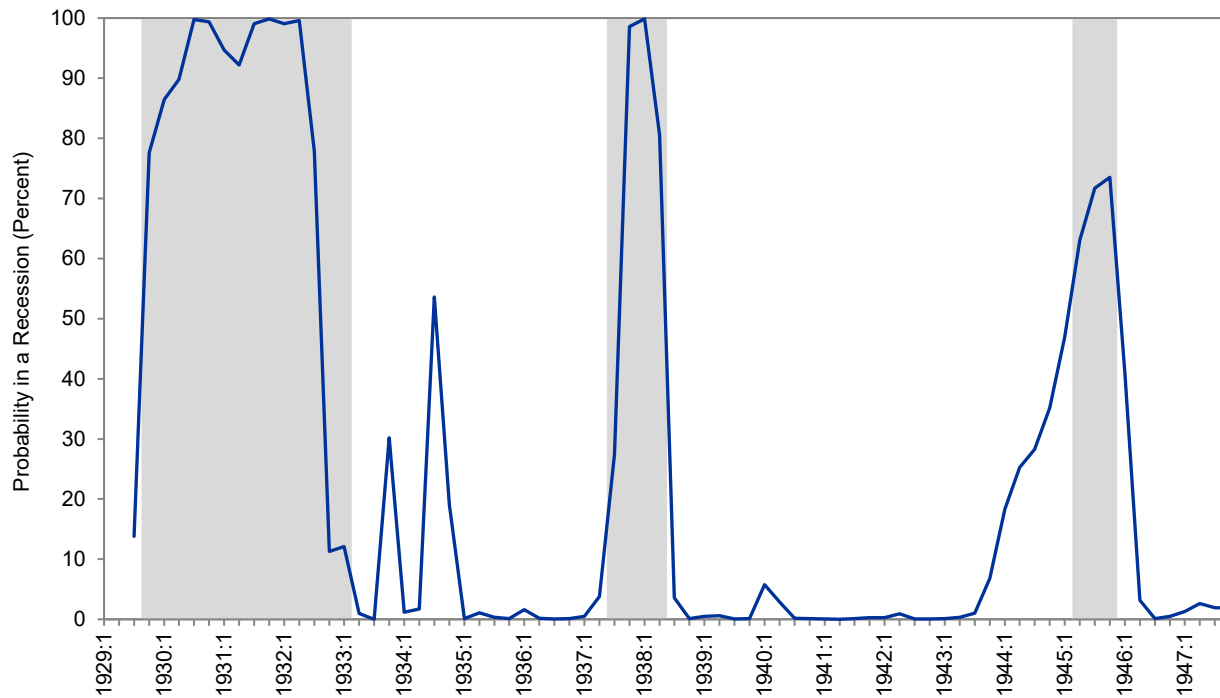
Notes: The figure shows the quarterly average of monthly, seasonally adjusted unemployment for the period 1948Q1–2019Q4. See data appendix for source.

FIGURE 2
Estimated Probability the Economy Is in a Recession, 1948–2019



Notes: The blue lines show the estimated probability that the economy is in a recession. Panel (a) is from the model using only the change in growth rate of real GDP; Panel (b) is the average of the probabilities using the growth rate of real GDP, the growth rate of employment, and the change in the unemployment rate. The gray shaded areas show the quarters the NBER identifies as being in a recession. See text for details and data appendix for data sources.

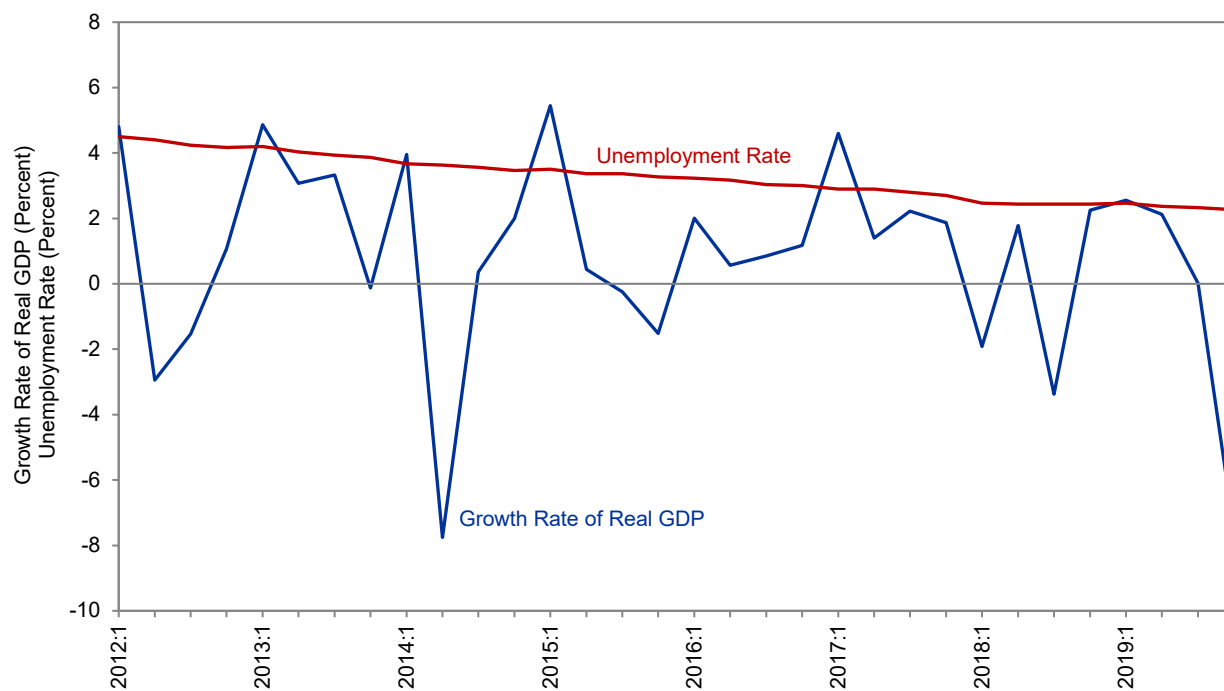
FIGURE 3
Estimated Probability the Economy Is in a Recession, 1929–1947



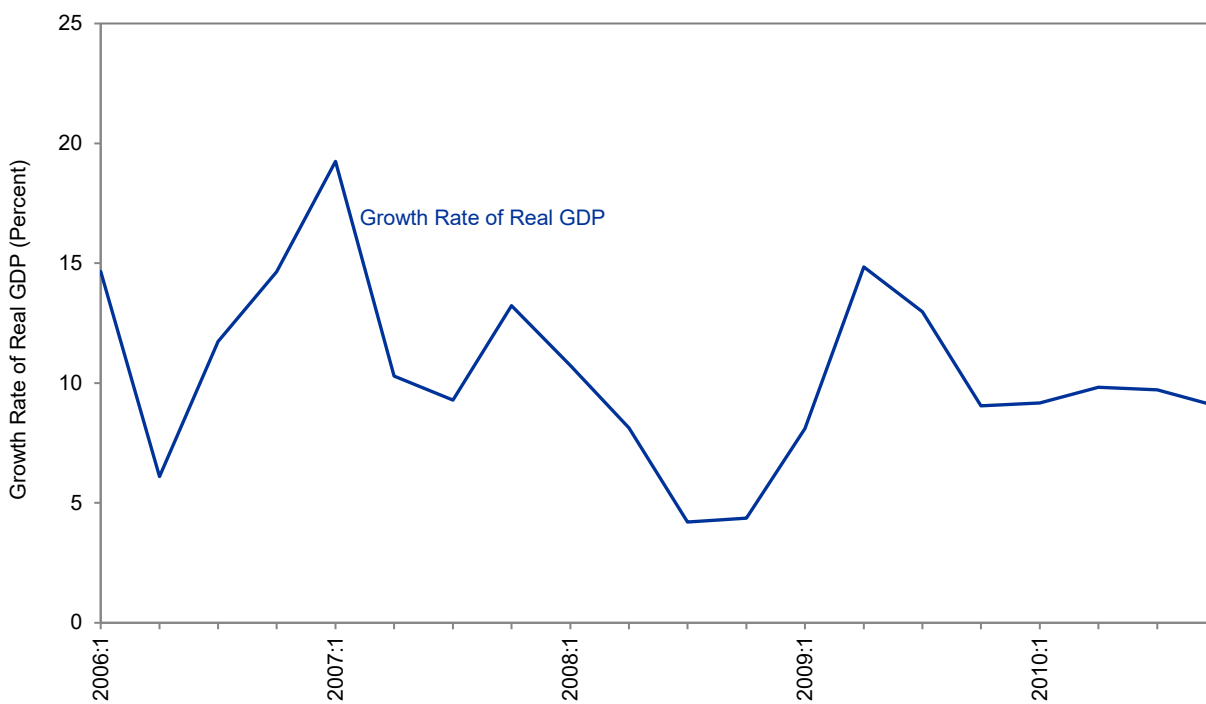
Notes: The blue line shows the average of the estimated probabilities that the economy is in a recession using the growth rate of industrial production, the growth rate of manufacturing employment, and the change in the unemployment rate. The gray shaded areas show the quarters the NBER identifies as being in a recession. See text for details and data appendix for data sources.

FIGURE 4
Economic Activity in Japan and China

a. Japan, 2012–2019

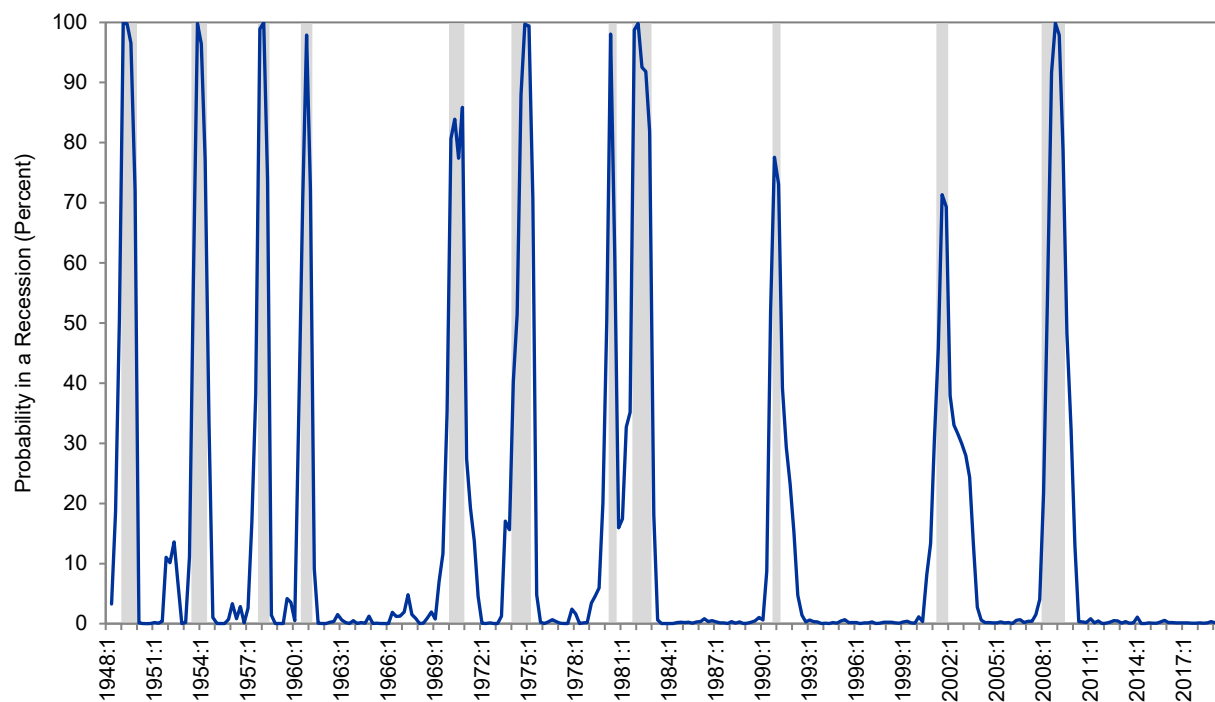


b. China, 2006–2010



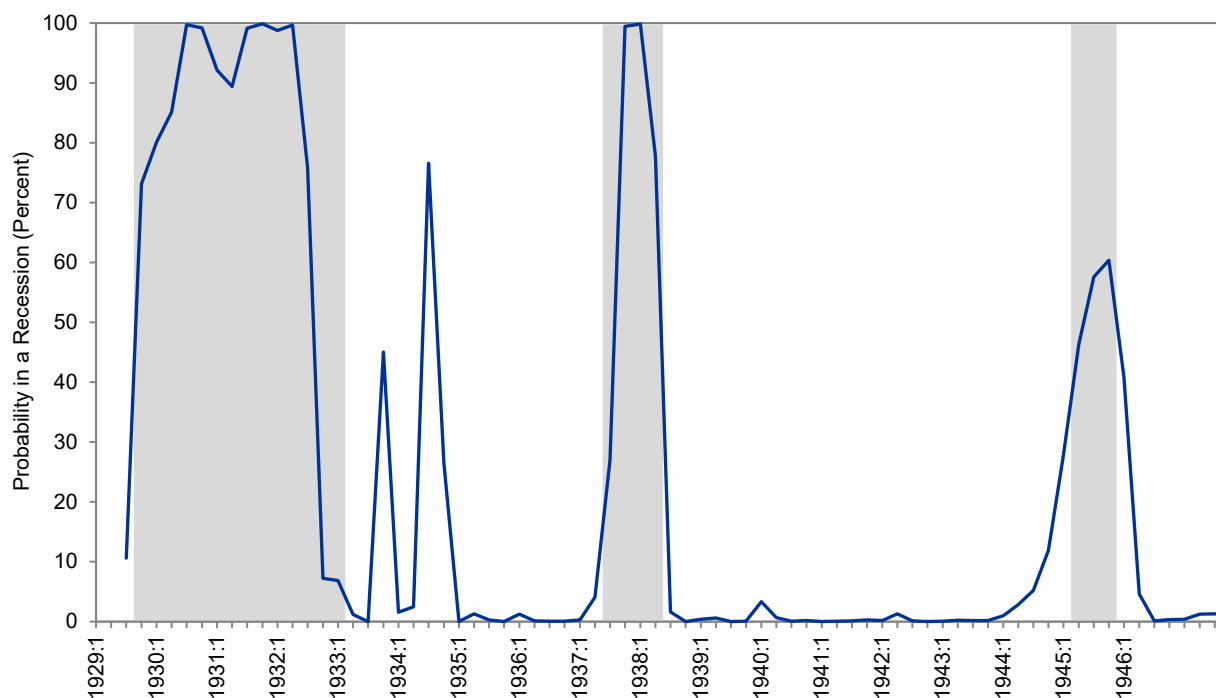
Notes: See text for details and data sources.

FIGURE 5
 Estimated Probability the Economy Is in a Recession Based on Deviations from Normal, 1948–2019



Notes: The blue line shows the average of the estimated probabilities that the economy is in a recession using the change in the deviation of GDP from potential, the change in the deviation of the unemployment rate from the natural rate, and change in the deviation of employment from normal. The gray shaded areas show the quarters the NBER identifies as being in a recession. See text for details and data appendix for data sources.

FIGURE 6
 Estimated Probability the Economy Is in a Recession Based on Deviations from Normal, 1929–1947



Notes: The blue line shows the average of the estimated probabilities the economy is in a recession using the change in deviation of industrial production from normal and the change in deviation of the unemployment rate from the natural rate. The gray shaded areas show the quarters the NBER identifies as being in a recession. See text for details and data appendix for data sources.

TABLE 1
Parameter Estimates from the Regime-Switching Model Using Measures
of the Change in Economic Activity Relative to Normal

a. 1948–2019			
	GDP Gap (Percent)	EMP Gap (Percent)	U Gap (P. Points)
Recession—mean change	-5.16 (0.87)	-3.25 (0.33)	3.05 (0.23)
Expansion—mean change	0.81 (0.24)	1.30 (0.14)	-0.41 (0.07)
Recession—probability of switching	0.32 (0.10)	0.18 (0.05)	0.31 (0.08)
Expansion—probability of switching	0.05 (0.02)	0.05 (0.01)	0.04 (0.01)
b. 1929–1947			
	IP Gap (Percent)	U Gap (P. Points)	
Recession—mean change	-33.13 (5.58)	8.48 (1.35)	
Expansion—mean change	13.20 (3.23)	-2.39 (0.64)	
Recession—probability of switching	0.25 (0.12)	0.22 (0.11)	
Expansion—probability of switching	0.09 (0.05)	0.05 (0.03)	

Notes: Standard errors are in parentheses. The sample period is 1948Q2–2019Q4 in Panel (a) and 1929Q3–1947Q4 in Panel (b). GDP gap is the deviation of GDP from potential; EMP Gap is the deviation of employment from normal; and U Gap is the deviation of the unemployment rate from the natural rate. See text for details and data appendix for data sources.

TABLE 2
Postwar Quarters where the Probability of Recession is above 20 Percent

Quarter	NBER Rec.?	Model Prob.	Change in							New Rec.?	Conf.
			GDP Gap	U Gap	EMP Gap	GDI Gap	Household EMP Gap ^a	Avg. Weekly Hours	Capacity Util.		
(Quarters where the Probability Is Between 20 and 80 Percent Are in Red)											
1948Q4	0	50.60	-4.82	0.24	-1.28	-3.23	-1.70	-4.34	-8.38	1	?
1949Q1	1	99.93	-10.82	3.31	-6.94	-13.28	-3.36	-4.39	-14.03	1	
1949Q2	1	99.77	-6.63	4.77	-5.16	-6.41	-5.31	-4.09	-13.71	1	
1949Q3	1	96.56	-1.30	3.31	-3.86	-3.26	-1.44	3.75	1.48	1	
1949Q4	1	72.05	-8.47	1.04	-4.45	-10.54	1.53	1.02	-5.62	1	
1953Q3	1	56.19	-5.82	0.65	-1.49	-6.17	-2.37	-4.26	-5.31	1	
1953Q4	1	99.84	-9.27	3.85	-5.46	-11.28	-5.42	-5.64	-20.83	1	
1954Q1	1	96.41	-4.87	6.25	-6.32	-2.10	-2.99	-3.35	-15.78	1	
1954Q2	1	77.12	-2.23	2.12	-3.98	-1.95	-3.55	1.01	-4.51	1	
1954Q3	0	33.38	2.00	0.66	-2.68	1.08	-1.58	1.01	-2.21	0	
1957Q3	0	38.18	0.68	0.52	-1.91	-1.51	-0.42	-1.00	-2.83	0	
1957Q4	1	98.92	-7.49	2.79	-4.99	-7.92	-3.30	-6.74	-17.75	1	
1958Q1	1	99.98	-13.83	5.45	-8.32	-12.32	-7.14	-4.44	-21.54	1	
1958Q2	1	73.79	-0.80	4.25	-6.75	-2.23	-2.60	1.71	-6.64	1	
1960Q2	0	36.18	-6.14	0.37	-0.40	-4.05	3.80	-2.99	-12.61	0	?
1960Q3	1	70.80	-2.05	1.17	-3.38	-3.99	-1.57	-3.35	-9.68	1	
1960Q4	1	97.92	-9.13	2.91	-3.68	-6.14	-2.43	-5.41	-12.19	1	
1961Q1	1	72.15	-1.33	2.10	-3.64	-3.21	-1.91	2.72	-8.10	1	
1969Q4	0	35.20	-5.55	-0.05	-0.79	-4.43	-0.13	-0.71	-6.67	0	
1970Q1	1	80.63	-3.99	2.35	-1.47	-6.10	-1.34	-2.14	-13.34	1	
1970Q2	1	83.88	-2.65	2.34	-3.28	-3.15	-3.21	-3.23	-5.59	1	
1970Q3	1	77.39	0.61	1.54	-3.62	0.25	-2.66	-0.36	-5.24	1	
1970Q4	1	85.89	-7.25	2.61	-4.92	-6.72	-2.50	-1.45	-10.95	1	
1971Q1	0	27.43	7.80	0.34	-1.19	4.98	-2.34	-0.73	4.57	0	
1973Q1	0	15.64	0.32	-0.19	1.16	0.72	1.59	-0.72	3.04	0	
1974Q1	1	40.28	-6.95	1.42	-0.74	-6.68	-0.42	-1.82	-6.09	1	?
1974Q2	1	51.51	-2.56	0.22	-1.09	-5.08	-2.02	-1.09	-3.43	1	?
1974Q3	1	87.90	-7.25	1.69	-2.02	-5.63	-1.45	-0.37	-3.89	1	
1974Q4	1	99.69	-4.95	3.82	-4.81	-8.19	-4.83	-3.30	-16.96	1	
1975Q1	1	99.37	-8.20	6.63	-8.90	-7.87	-8.30	-3.33	-27.82	1	
1975Q2	0	70.75	-0.36	2.36	-4.74	0.09	-2.67	0.00	-6.52	1	?
1979Q4	0	20.09	-1.81	0.42	-1.12	-1.24	-0.02	0.00	-2.27	0	
1980Q1	0	50.34	-1.19	1.36	-1.00	-2.78	-1.49	-2.63	-1.52	0	???
1980Q2	1	98.04	-10.37	4.16	-4.28	-8.56	-6.02	-3.03	-18.79	1	
1980Q3	1	61.29	-2.12	1.36	-4.12	1.35	-2.54	-0.76	-8.64	1	?
1981Q2	0	32.70	-5.37	-0.10	-1.12	-2.22	0.06	-0.38	-0.54	0	
1981Q3	0	35.12	2.15	0.04	-1.29	3.09	-3.40	-1.52	-2.76	0	

TABLE 2 (continued)
Postwar Quarters where the Probability of Recession is above 20 Percent

Quarter	NBER Rec.?	Model Prob.	Change in								New Rec.?	Conf.
			GDP Gap	U Gap	EMP Gap	GDI Gap	Household EMP Gap	Avg. Weekly Hours	Capacity Util.			
(Quarters where the Probability Is between 20 and 80 Percent Are in Red)												
1981Q4	1	98.78	-7.20	3.37	-3.83	-6.94	-3.70	-1.52	-9.99	1		
1982Q1	1	99.82	-9.25	2.44	-4.81	-6.17	-3.52	-3.44	-9.07	1		
1982Q2	1	92.50	-1.29	2.44	-4.13	-1.67	-1.86	1.15	-3.15	1		
1982Q3	1	91.83	-4.75	1.90	-5.03	-4.77	-2.78	-0.38	-3.86	1		
1982Q4	1	81.87	-3.14	3.10	-4.35	-5.06	-3.65	-1.54	-6.87	1		
1983Q1	0	18.14	1.96	-1.16	-1.12	1.00	-1.83	0.77	5.54	0		
1990Q2	0	8.67	-1.34	0.21	0.07	-0.58	-1.67	-0.78	0.13	0		
1990Q3	0	51.98	-2.42	1.54	-1.79	-2.98	-2.23	-1.17	-1.04	1		
1990Q4	1	77.56	-6.24	1.81	-2.75	-4.45	-2.46	-0.78	-7.17	1		
1991Q1	1	73.07	-4.37	1.94	-2.98	-3.33	-3.24	-0.78	-8.52	1		
1991Q2	0	39.22	0.69	1.01	-3.03	-1.25	-1.47	-0.39	0.32	0		
1991Q3	0	29.33	-0.35	0.20	-1.31	-1.25	-1.53	0.39	4.41	0		
1991Q4	0	23.24	-0.96	1.00	-1.25	-0.96	-1.24	0.00	-0.08	0		
2001Q1	0	30.81	-4.74	1.38	-0.67	1.12	-0.17	-0.78	-8.06	0		
2001Q2	1	45.70	-1.08	0.71	-2.34	-3.96	-3.13	-1.17	-6.79	1		
2001Q3	1	71.32	-4.89	1.78	-2.46	-5.09	-2.33	-1.18	-6.50	1		
2001Q4	1	69.33	-1.96	2.71	-3.66	-5.15	-2.68	-1.58	-4.33	1		
2002Q1	0	37.94	0.59	0.84	-2.50	1.60	-1.56	0.39	1.48	0		
2002Q2	0	33.01	-0.37	0.58	-1.54	0.58	-0.42	1.18	3.46	0		
2002Q3	0	31.57	-0.94	-0.36	-1.41	-2.24	0.17	-0.39	1.91	0		
2002Q4	0	29.98	-2.04	0.58	-1.07	0.08	-1.56	-0.79	-0.34	0		
2003Q1	0	27.94	-0.42	0.04	-1.55	-2.02	1.23	-0.79	1.55	0		
2003Q2	0	24.35	0.78	1.11	-1.76	0.81	-0.44	-1.19	-1.51	0		
2007Q4	0	3.99	0.53	0.59	-0.07	-2.37	0.15	0.00	-0.51	0		
2008Q1	1	21.70	-4.16	0.85	-0.56	-1.73	0.75 ^a	-0.79	-2.50	0		
2008Q2	1	53.67	0.30	1.37	-2.02	-2.61	-1.42	-0.40	-6.08	1	???	
2008Q3	1	91.66	-3.80	2.67	-2.65	-3.24	-2.39	-0.79	-10.36	1		
2008Q4	1	99.88	-10.24	3.45	-5.23	-9.97	-3.80	-2.78	-16.55	1		
2009Q1	1	97.90	-5.84	5.55	-7.20	-7.93	-7.74	-2.40	-17.70	1		
2009Q2	1	78.46	-1.77	4.05	-6.05	0.51	-3.82	-2.01	-6.09	1		
2009Q3	0	48.25	0.36	1.23	-3.35	0.49	-2.97	0.81	6.17	0	??	
2009Q4	0	32.33	3.32	1.09	-1.92	4.09	-3.36	0.80	5.75	0		

Notes: “NBER Rec.?” is an indicator variable for whether the NBER classifies the quarter as being in a recession; “New Rec.?” is an indicator for whether we classify the quarter as being in a recession; “Conf.” refers to the uncertainty we have in our classification (ranging from 0 to 3 question marks). The model probability is the average of the probabilities for the models using the changes in the GDP gap, the employment gap, and the unemployment gap. See text for details and the data appendix for the data sources. Other data series are also described in the data appendix.

^a Adjusted for the discontinuity in the population measure used by the Bureau of Labor Statistics from December 2007 to January 2008, which reduced the reported change in employment by 598,000. See https://www.bls.gov/news.release/archives/empsit_02012008.pdf.

TABLE 3
Interwar Quarters where the Probability of Recession is above 20 Percent

Quarter	NBER Rec.?	Model Prob.	Change in				New Rec.?	Conf.
			IP Gap	U Gap	Manuf. Employ.	Avg. Weekly Hours		
(Quarters where the Probability Is between 20 and 80 Percent Are in Red)								
1929Q3	0	10.59	2.63	-3.82	8.48	-0.82	0	
1929Q4	1	73.14	-32.67	5.78	-15.86	-9.46	1	
1930Q1	1	80.10	-25.54	3.30	-26.08	-9.40	1	
1930Q2	1	85.13	-19.22	2.12	-10.65	-10.51	1	
1930Q3	1	99.75	-40.07	11.31	-22.89	-22.83	1	
1930Q4	1	99.19	-31.53	16.03	-20.82	-8.55	1	
1931Q1	1	92.15	-11.04	3.66	-24.08	-0.64	1	
1931Q2	1	89.43	-2.70	3.23	-2.50	3.83	1	
1931Q3	1	99.12	-33.53	9.62	-11.42	-22.19	1	
1931Q4	1	99.88	-40.57	11.88	-24.31	-16.79	1	
1932Q1	1	98.79	-26.16	3.30	-16.50	-16.43	1	
1932Q2	1	99.69	-51.47	13.87	-29.75	-17.77	1	
1932Q3	1	75.82	-12.58	9.48	-13.13	-2.14	1	
1932Q4	1	7.25	27.23	0.10	18.13	21.27	0	?
1933Q1	1	6.84	-22.86	-2.38	-16.80	-17.35	0	?
1933Q2	0	1.21	71.10	3.74	24.58	31.36	0	
1933Q3	0	0.00	69.59	-11.41	72.46	-14.69	0	
1933Q4	0	45.05	-60.01	-5.81	4.27	-48.39	0	
1934Q1	0	1.55	21.93	-13.76	6.65	4.96	0	
1934Q2	0	2.47	17.21	-3.24	24.70	3.02	0	
1934Q3	0	76.60	-44.84	12.10	-12.80	-22.84	0	??
1934Q4	0	26.42	7.97	3.48	-1.88	11.00	0	
1937Q3	1	26.99	-9.86	-1.40	3.32	-17.43	0	
1937Q4	1	99.44	-82.54	10.47	-26.44	-23.75	1	
1938Q1	1	99.85	-54.55	14.99	-50.12	-19.37	1	
1938Q2	1	77.78	-16.92	6.99	-16.38	3.10	1	
1945Q1	0	27.83	-10.98	0.43	0.03	-0.88	0	
1945Q2	1	46.33	-23.21	0.43	-13.14	-6.22	1	??
1945Q3	1	57.58	-62.89	3.88	-41.87	-24.92	1	
1945Q4	1	60.40	-50.32	5.77	-44.45	-6.40	1	
1946Q1	0	40.86	-20.32	1.80	-1.37	-6.50	0	??

Notes: "NBER Rec." is an indicator variable for whether the NBER classifies the quarter as being in a recession; "New Rec." is an indicator for whether we classify the quarter as being in a recession; "Conf." refers to the uncertainty we have in our classification (ranging from 0 to 3 question marks). The model probability is the average of the probabilities for the models using the changes in the industrial production gap and the unemployment gap. See text for details and the data appendix for the data sources. Other data series are also described in the data appendix.

DATA APPENDIX

This appendix describes the sources of the aggregate economic indicators for the United States used in the analysis and any needed data transformations.

POSTWAR (1948–2019)

Real GDP. The data are from the Bureau of Economic Analysis, National Income and Product Accounts, Table 1.17.6. The series used is gross domestic product (GDP), millions of chained (2012) dollars, seasonally adjusted at annual rates. We downloaded the data from the BEA website (<https://www.bea.gov/>) 6/25/2020.

Real GDI. The data are from the Bureau of Economic Analysis, National Income and Product Accounts, Table 1.17.6. The series used is gross domestic income, millions of chained (2012) dollars, seasonally adjusted at annual rates. We downloaded the data from the BEA website (<https://www.bea.gov/>) 6/25/2020.

Unemployment Rate. The data are from the Bureau of Labor Statistics. The series used is unemployment rate, percent, monthly, seasonally adjusted. We downloaded the data from FRED (<https://fred.stlouisfed.org/>), series UNRATE, 5/29/2020.

Payroll Employment. The data are from the Bureau of Labor Statistics. The series used is all employees, total nonfarm, thousands of persons, monthly, seasonally adjusted. We downloaded the data from FRED, series PAYEMS, 5/29/2020.

Household Employment. The data are from the Bureau of Labor Statistics. The series used is employment level, thousands of persons, monthly, seasonally adjusted. We downloaded the data from FRED, series CE16OV, 6/17/2020.

Average Weekly Hours. The series is constructed by joining two series (in percent changes with no further adjustment). The data are from the Bureau of Labor Statistics. For 1939Q1 to 1964Q1 the series is average weekly hours of production and nonsupervisory employees, manufacturing, hours, monthly, seasonally adjusted. We downloaded the data from FRED, series AWHMAN, 6/17/2020. For 1964Q2 to 2019Q4, the series is average weekly hours of production and nonsupervisory employees, total private, hours, monthly, seasonally adjusted. We downloaded the data from FRED, series AWHNONAG, 6/17/2020.

Capacity Utilization. The data are from the Federal Reserve Board. The series used is capacity utilization: manufacturing, percent of capacity, quarterly, seasonally adjusted. We downloaded the data from FRED, series CAPUTLBOO004SQ, 5/29/2020.

Potential Real GDP. The data are from the Congressional Budget Office. The series used is real potential gross domestic product (billions of chained 2012 dollars). We downloaded the data from the CBO website (<https://www.cbo.gov/publication/56020>, Historical Data and Economic Projections, Jan 2020), 5/29/2020. We use this series for both our baseline output gap measure and for the output gap measure using GDI. The CBO series begins in 1949Q1. The growth rate of the series is essentially constant over the four quarters of 1949. We therefore extend the series back to 1948Q1 by subtracting the change in the log of the CBO series from 1949Q1 to 1949Q2 from log potential real GDP recursively over the previous four quarters. We then convert the log series back into levels.

Underlying Long-Term Rate of Unemployment. The data are from the Congressional Budget Office. The series used is quarterly, seasonally adjusted. We downloaded the data from the CBO website (<https://www.cbo.gov/publication/56020>, Historical Data and Economic Projections, Jan 2020), 5/29/2020. The CBO series begins in 1949Q1. However, the series rises very smoothly and gradually in the early years of the sample. We therefore carry it back to 1948Q1 using the rise from 1949Q1 to 1949Q2 (which is 0.006 percentage point) as the quarterly change in each quarter of 1948.

Potential Labor Force. The data are from the Congressional Budget Office. The series used is potential labor force (millions of people). We downloaded the data from the CBO website (<https://www.cbo.gov/publication/56020>, Historical Data and Economic Projections, Jan 2020), 5/29/2020. The growth rate of the series is essentially constant over the four quarters of 1949. We therefore extend the series back to 1948Q1 by subtracting the change in the log of the CBO series from 1949Q1 to 1949Q2 from log potential labor force recursively over the previous four quarters. We then convert the log series back into levels.

Potential Employment. We construct this series using the CBO data on the potential labor force and the underlying long-term rate of unemployment. Specifically, potential employment is calculated as the potential labor force times 1 minus the underlying long-term rate of employment (expressed as a decimal).

INTERWAR (1929–1947)

Industrial Production. The data are from the Federal Reserve Board. The series used is industrial production index, 2012=100, monthly, seasonally adjusted. It is available starting in 1919. We downloaded the data from FRED, series INDPRO, 6/16/2020.

Unemployment Rate. The data for 1929M4–1940M2 are from the National Industrial Conference Board. The series used is unemployment rate for United States, percent, monthly, seasonally adjusted. We downloaded the data from FRED, series M0892AUSM156SNBR, 5/7/2020. The data for 1940M3–1946M12 are from the National Industrial Conference Board. The series used is unemployment rate for United States, percent, monthly, seasonally adjusted. We downloaded the data from FRED, series M0892BUSM156SNBR, 5/7/2020. The base data for 1947M1–1948M12 are from the Bureau of the Census. The series used is calculated as the ratio of the number unemployed to the labor force, and is not seasonally adjusted. We entered the data from the *Statistical Abstract of the United States* (volumes for 1948 and 1949). As discussed below, we calculate seasonal adjustment factors using the standard series on the unemployment rate from the Bureau of Labor Statistics, both seasonally adjusted and not seasonally adjusted, for 1948. We downloaded the data from FRED, series UNRATE and UNRATENSA, 5/29/2020.

We adjust and splice the series together in the following way. First, the Census series for 1947 and 1948 is not seasonally adjusted. We use the difference between the BLS seasonally adjusted unemployment rate series and the unadjusted series in each month of 1948 to create monthly seasonal adjustment factors. We add these to the Census series for both 1947 and 1948 to create a seasonally adjusted series. Because there are no obvious breaks in the three unemployment series (the two NICB series and the constructed seasonally adjusted Census series), we simply merge them into one series. We then make two adjustments. One, which is very small, is to calculate the average difference between the standard BLS series and our constructed seasonally adjusted Census series in 1948. We then add this difference (which is 0.4 percentage point) to the entire pre-1948 series. Second, the NICB series appears to be implausibly low early in the sample, but then very similar to the Census series starting in 1940. For this reason, we adjust our monthly

seasonally adjusted series using Lebergott's (1964) annual estimate of the unemployment rate in 1930. In particular, we calculate the difference between the Lebergott series and the annual average of the NICB series in 1930 (which is 2.6 percentage points). We then create a correction factor that declines linearly between 2.6 at the midpoint of 1930 to 0 in 1940M1, and add this correction factor to the pre-1940 NICB series. (Note, the Lebergott series in census years, such as 1930, is based on relatively accurate census data, and thus should be relatively free of the spurious volatility discussed in Romer (1986)).

Employment. The data are from the Bureau of Labor Statistics, *Employment and Earnings Statistics for the United States, 1909-60*, Bulletin of the United States Bureau of Labor Statistics, No. 1312. The series used is production worker employment, manufacturing, total for United States, thousands of persons, monthly, not seasonally adjusted. We downloaded the data from FRED, series MO81FBUSM175NNBR, 5/7/2020. The series does not show an obvious seasonal pattern, and so we do not seasonally adjust it.

Average Weekly Hours. The data through 1932Q1 are from the National Industrial Conference Board. The series used is average hours of work per week, manufacturing industries, total wage earners for United States, hours, monthly, not seasonally adjusted. We downloaded the data from FRED, series MO829AUSMO65NNBR, 7/7/2020. The data for 1932Q2 to 1947Q4 are from the Bureau of Labor Statistics. The series used is average hours of work per week, production workers, manufacturing, total for United States, hours, monthly, not seasonally adjusted. We downloaded the data from FRED, series MO829BUSMO65NNBR, 7/7/2020. We splice the two series together in percent changes. The series does not show an obvious seasonal pattern, and so we do not seasonally adjust it.

Potential Industrial Production. Because we are interested in using an output gap measure for the interwar period, we construct a crude proxy. Specifically, we choose two years when the economy appears to have been at potential, and interpolate log industrial production between them. The Romer (1986) unemployment series was roughly at potential in 1925; and actual unemployment was very close to the CBO underlying long-term unemployment rate in 1949Q3. Thus, we interpolate between mid-1925 and 1949Q3. The constant monthly growth rate in potential industrial production (calculated as differences in logs) that this procedure imposes is 0.0028. We then average the monthly series to create a quarterly log potential industrial production series.

Underlying Long-Term Rate of Unemployment. The CBO series on the Underlying Long-term Unemployment Rate (which is only available quarterly) begins in 1949. As discussed above, since this series rises very smoothly and very gradually in the early years of the sample, we carry it back to 1948Q1 using the rise from 1949Q1 to 1949Q2 (which is 0.006 percentage point). This yields a value of 5.23 in 1948Q1, which is very similar to the Romer (1986) annual unemployment rate in the non-recession years of the 1920s (such as 1925 and 1928). For this reason, we use 5.23 percent as our estimate of the natural rate for the entire period 1929Q2-1947Q4.

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