Remeasuring Business Cycles

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This article evaluates the consistency of the NBER business cycle reference dates. It finds that the early reference dates are derived from detrended data, whereas the dates after 1927 are derived from data in levels. To evaluate the importance of this and other changes in technique, I derive a simple algorithm that matches the postwar NBER peaks and troughs closely. When this algorithm is applied to data for 1884 to 1940, the new prewar dates differ systematically from the NBER dates and challenge the conventional view that recessions have gotten shorter over time.

The business cycle reference dates for the United States produced by the National Bureau of Economic Research (NBER) play a crucial role in forming impressions about macroeconomic fluctuations. These dates, which show the peaks and troughs of economic activity from the mid-1800s to today, are often taken as the definitive summary of whether conditions were good or bad in some particular era. They are also a much used tool of macroeconomic analysis. The NBER reference dates are frequently employed, for example, to analyze how some particular variable behaves in relation to the business cycle.[1] Finally, the NBER peaks and troughs have been influential in forming impressions about possible changes in business cycles over time. For example, the NBER dates are often used to measure the length of expansions and contractions in certain eras. Since the NBER dates for the United States show that expansions have become longer over time and contractions have become shorter, many economists have inferred that economic fluctuations have become less severe between the prewar and postwar eras.[2]

One reason that the NBER reference dates have been so influential is simply that they are very convenient. They provide a quick shorthand that economists can use to summarize a very complex phenomenon. More fundamentally, the NBER dates have been influential because they are thought to be reliable. The amount of work that went into their

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[1] Among the classic studies employing the NBER dates in this way are Abramovitz, *Inventories*; Friedman and Schwartz, *Monetary History*; and Hultgren, *Costs, Prices, and Profits*. More recent studies employing the NBER dates include Sachs, "Changing Cyclical Behavior"; and Grossman, "Macroeconomic Consequences."

[2] See, for example, Moore and Zarnowitz, "Development and Role"; and Diebold and Rudebusch, "Have Postwar Economic Fluctuations?"

development is extremely impressive. Arthur Burns and Wesley Mitchell's seminal study *Measuring Business Cycles*, in which the NBER methodology is described and developed, is surely one of the most respected books in American macroeconomics.

Although Burns and Mitchell's contribution to business cycle dating is indeed monumental, it is nevertheless reasonable to question the accuracy of the NBER reference dates and particularly the consistency of these dates over time. Statistical techniques and the understanding of economic fluctuations have advanced greatly in the 45 years since *Measuring Business Cycles*. It is possible that these advances have caused the procedures used to select the reference dates to have been improved over time. In addition, even in the absence of such advances, it is possible that unintended inconsistencies have crept into the NBER dating procedures over the long period that the NBER has been setting reference dates.

Perhaps the strongest urging for such questioning of the NBER reference dates comes from Burns and Mitchell themselves. In *Measuring Business Cycles* they state:

> This is not to say that the reference dates must remain in their present state of rough approximation. Most of them were originally fixed in something of a hurry; revisions have been confined mainly to large and conspicuous errors, and no revision has been made for several years. Surely, the time is ripe for a thorough review that would take account of extensive new statistical materials, and of the knowledge gained about business cycles and the mechanics of setting reference dates since the present chronology was worked out.[3]

Burns and Mitchell had planned to carry out this thorough review, "but this project had barely started when the investigators placed in charge were drawn into war work. For the time being, therefore, we must put up with a reference scale that requires extensive reworking."[4] Such reworking, however, has never occurred.

In this article I examine the consistency of the NBER reference dates over time. The first section compares the methods that the NBER uses today to date cycles with the methods employed by early NBER researchers. I find that the NBER reference dates for the cycles before 1927 were chosen long before the modern procedures described in *Measuring Business Cycles* were established. As a result, the methods used to date the early cycles are quite different from those used in the postwar era. The most important difference between the early and modern methods is that the business cycle reference dates before 1927 appear to be derived primarily from detrended data, whereas the dates after 1927 are based on data that include the secular trend.

The early NBER's focus on data with the secular trend eliminated could lead to the misclassification of growth recessions as genuine

[3] Burns and Mitchell, *Measuring Business Cycles*, p. 95.
[4] Ibid.

business cycles in the pre-1927 era. Hence, it could cause more cycles to be identified in the early period than in the modern era. The focus on detrended data could also cause systematic differences between early and modern turning points. If the extremes in a series are fairly smooth and the upward trend is significant, then the peak in the detrended data will come before the actual peak and the trough in the detrended data will come after the actual trough. Thus, the move from dating cycles using detrended data to dating cycles using data with the trends included could result in the length of early contractions being systematically overstated relative to modern contractions.[5]

In the second and third sections I present statistical evidence on the importance of this change and of other alterations in technique over time. I first derive a simple algorithm for identifying cycles and choosing turning points from monthly data on industrial production that yields dates that match the postwar NBER reference chronology very closely. I then use the same algorithm to choose turning points in the prewar index of industrial production recently compiled by Jeffrey Miron and Christina Romer. The prewar turning points deduced using the algorithm are systematically different from the NBER reference dates: many of the new prewar peaks are several months later than the NBER peaks and many of the new troughs are several months earlier. Statistical sensitivity analysis shows that the new dates are fairly robust to the prewar index of industrial production used in their derivation. In addition, an examination of the business press suggests that the new dates generally match contemporaneous perceptions of business conditions more closely than do the traditional NBER dates.

The final section of the article analyzes what the new, more consistent dates reveal about possible changes in business cycles over time. Most obviously, the new dates affect the comparison of the average duration of recessions in the prewar and postwar eras. Whereas the NBER reference dates show a dramatic decline in the length of contractions over time, the new dates that I derive show a slight increase in average

[5] Zarnowitz, "Business Cycles and Growth," p. 506, contains a long discussion of the fact that the identification of prewar NBER reference dates "relied to a considerable extent on business annals and trend-adjusted indexes of business conditions." Although Zarnowitz suggests that the use of detrended data could lead to the misclassification of growth recessions as business cycles, he does not consider the possibility that it could also result in the systematic misdating of cycles. Moore, on the other hand, indicates that the prewar reference dates could be systematically biased. Trueblood, "Dating of Postwar Business Cycles," p. 16, reports that "a recent statement by Geoffrey Moore in an unpublished National Bureau staff report found that 'the National Bureau business cycle reference dates between 1885 and 1914 (possibly earlier) seem to be biased in the sense that peaks are frequently predated and troughs are frequently postdated.' " Trueblood also reports that Moore believes "a rough correction of this bias has the effect of lengthening the mean duration of expansions, 1854–1914, by 4 months and of decreasing that of contractions by an equal amount." Moore, however, in all of his subsequent work on the duration of cycles has taken the NBER reference dates as given and has never published a major revision of the prewar reference dates.

duration between the pre–World War I and the post–World War II eras. The new dates, however, confirm the traditional finding that cycles are more frequent in the prewar era. Analysis of the new dates, in conjunction with the industrial production series from which they are derived, shows that the average output loss associated with recessions is quite similar before World War I and after World War II, but that the time it took output to return to the previous peak level is nearly three months shorter in the prewar era than it is today.

CHANGES IN NBER DATING METHODS OVER TIME

Modern NBER Dating Procedures

According to Geoffrey Moore and Victor Zarnowitz, the procedures that the NBER currently uses to date business cycles were laid down in more or less their final form in *Measuring Business Cycles*.[6] In this work, Burns and Mitchell draw a distinction between the dates of "specific cycles," which are the peaks and troughs in a particular series, such as industrial production or bank clearings, and the dates of "reference cycles," which are the peaks and troughs for the economy as a whole. The reference cycle dates are what we typically think of as the turning points of business cycles. They do not necessarily reflect the extremes in any one aggregate series, but rather reflect a consensus of turning points in many specific series.

The procedures that Burns and Mitchell suggest for identifying specific cycles and their turning points involve many steps and guidelines. The first is that it is best to work with data that has been seasonally adjusted, but not detrended. To identify cycles in seasonally adjusted, but otherwise "raw" series, Burns and Mitchell look for "well-defined movements of rise and fall." That is, they seek to identify actual declines in the series, not mere slowdowns in growth. To decide which rises and falls are significant enough to be classed as specific cycles, Burns and Mitchell use a combination of a duration rule and a minimum amplitude rule. For a fluctuation to count as a specific cycle the duration must be "at least 15 months, whether measured from peak to peak or from trough to trough." It must also be less than 10 or 12 years in length. The amplitude rule takes the somewhat circular form that "the lower limit of the range of amplitudes of all fluctuations that we class confidently as specific cycles is our rough guide in deciding whether any doubtful fluctuation . . . is well enough defined to be accepted as a specific cycle."[7]

[6] Moore and Zarnowitz, "Development and Role." The descriptions of the deliberations of the NBER Committee on Business Cycle Dating provided in Moore, "What is a Recession?" and Zarnowitz and Moore, "Timing and Severity," are indeed consistent with the principles spelled out in *Measuring Business Cycles*.

[7] Burns and Mitchell, *Measuring Business Cycles*, pp. 57, 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 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."[8] 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.

Burns and Mitchell's description of how reference cycles are dated is much less precise than their discussion of specific cycles. They emphasize that reference cycles should not be identified by choosing the turning points in one aggregate series because, although a cycle must show up in a measure of aggregate economic activity, there could be movements in some aggregate that are driven by only a few series. For this reason, Burns and Mitchell prefer to look at the turning points in many specific series and check for coherence.

How such coherence is determined and particular dates for reference cycles actually chosen appears to be left deliberately vague. Burns and Mitchell emphasize that they do not simply average the turning points in various specific series. Nor do they have some particular weights attached to various series. Rather, they seem to rely on subjective judgment and an informal weighting scheme for deciding which series to use as their main guide. They refer to refining the "approximate dates by arraying the cyclical turns in the more important monthly or quarterly series."[9] Moore and Zarnowitz elaborate that, at least in the modern application of Burns and Mitchell's procedures, the series that deserve the most attention are ones that are "more comprehensive, more significant economically, more adequate statistically."[10]

Early NBER Dating Procedures

Although *Measuring Business Cycles* contains much information about how reference cycles should be dated in the future, it gives only a very brief description of the procedures that were actually used to derive the NBER reference dates for the late 1800s and early 1900s. The reason for the vagueness of *Measuring Business Cycles* about early procedures is probably the fact that the reference dates for the cycles before 1927 were set long before *Measuring Business Cycles* was written. Burns and Mitchell, in the same section in which they extol the need for revamping the reference dates, explain in a footnote that the

[8] Ibid., p. 58.
[9] Ibid., p. 77.
[10] Moore and Zarnowitz, "Development and Role," p. 747.

"American reference dates through 1927 have been allowed to stand as published in 1929."[11]

The earliest source for the NBER reference dates appears to be an article in the NBER *News-Bulletin* for March 1, 1929, entitled "Testing Business Cycles." This article, which is unsigned, is a summary of a (supposedly) forthcoming work by Mitchell.[12] Two other roughly contemporaneous sources for the NBER reference dates, Mitchell's entry on business cycles in the *Encyclopedia of Social Sciences* published in 1930 and Mitchell's chapter entitled "A Review," in *Recent Economic Changes*, published in 1929, make it clear that Mitchell was the person who set the NBER reference dates before 1927.[13]

All of Mitchell's early articles on the NBER reference dates refer to two major sources used to identify peaks and troughs: *Business Annals* and business indexes. "Testing Business Cycles," for example, says "a set of 'reference dates,' based on the National Bureau's *Business Annals* supplemented by business indexes, is made for each country covered to show the month and year when economic revivals and recessions occurred."[14] Because the description of the derivation of the early reference dates in all the sources does not go beyond such brief statements, it is necessary to deduce the procedures and criteria that the researchers at the NBER used for dating early business cycles.

Business Annals is a compendium of contemporaneous opinion on the state of the economy in various countries that was collected by Willard Thorp and published by the NBER in 1926.[15] Burns and Mitchell report that the *Annals* were used to "write down an interval within which a cyclical turn in general business probably occurred."[16] The importance of the *Annals* for deciding whether or not a cycle occurred can be seen in the fact that there are no cycles identified in the *Annals* that are not in the reference scale, and no cycles in the reference scale that are not identified in the *Annals*. There is much less correspondence between the actual dates of quarterly turning points deduced from the *Annals* and the

[11] Burns and Mitchell, *Measuring Business Cycles*, p. 95.

[12] The article itself is listed in a bibliography of Mitchell's writings presented in Burns, *Wesley Clair Mitchell*, p. 357, suggesting that Mitchell is the author. The book that Mitchell was working on in 1929 was never published in its original form. According to the *News-Bulletin* of the NBER for various years, in late 1933 Mitchell took on Arthur Burns as a collaborator, and the work was revised and eventually published as *Measuring Business Cycles* in 1946.

[13] Mitchell, in "Testing Business Cycles," mentions the fact that Simon Kuznets supervised the empirical work for the study. This may explain why in *Measuring Business Cycles*, p. 80, Burns and Mitchell say that "Simon Kuznets took a leading part in the preparation of the original set of reference dates." It seems clear that Kuznets's role was as a junior collaborator working under Mitchell on this project.

[14] Mitchell, "Testing Business Cycles," p. 2.

[15] Mitchell's 1913 book, *Business Cycles*, also compiled dates for peaks and troughs from contemporary business publications. These dates, however, do not appear to have been used explicitly in the setting of the NBER reference dates.

[16] Burns and Mitchell, *Measuring Business Cycles*, p. 77.

NBER reference dates.[17] Of the 24 peaks and troughs dated by the two sources for the period 1887 to 1924, the two agree perfectly in only ten instances. The average difference between the two sets of dates for the remaining 14 turning points is two quarters, with the largest difference being four quarters.[18]

The fact that the NBER reference dates differ quite markedly from the dates given in *Business Annals* suggests that business indexes must have played a significant role in the derivation of the actual NBER peaks and troughs. Mitchell's 1927 book, *Business Cycles: The Problem and Its Setting*, provides crucial information on which of the available statistical series are likely to have been used to set reference dates. The two series that receive the most attention in *Business Cycles* are the AT&T Business Index and the Snyder Clearings Index of Business. Many graphs show only these two series, and Mitchell refers to these two series as "the most significant of the statistical indexes which run back to 1875" and "the leading American . . . indexes of general trade which cover considerable periods."[19] Thus, it seems likely that these two series are the main ones that Mitchell consulted in setting the early reference dates.

Both of these series were intended to be comprehensive indicators of general business activity. The AT&T index includes such diverse series as pig iron production, wholesale prices, and bank clearings. The Snyder Clearings index is based on bank clearings outside New York City deflated by a weighted average of various price indexes. A crucial feature of both series is that they were detrended by their creators.[20] That Mitchell worked with detrended series in setting the early reference dates is consistent with his statement in 1930 that the most promising way to identify business cycles is to begin by "eliminating the secular trend of a series."[21]

[17] Chart VI on pp. 94–95 of Mitchell's long introduction to Thorp, *Business Annals* shows graphically the periods of prosperity, recession, depression, and revival that Thorp identified from the business press. To actually deduce dates from this chart, I assume that the peak occurs immediately before the onset of recession and that the trough occurs immediately before the onset of revival. This interpretation fits with the fact that in "Testing Business Cycles" Mitchell dates recessions as beginning the month after the NBER peak and revivals as beginning the month after the NBER trough. In the comparison with the NBER reference dates, I use the NBER dates denominated in quarters from Moore and Zarnowitz, "Development and Role," p. 750.

[18] This lack of correspondence is equally noticeable in periods for which the descriptive summaries of the *Annals* give a very exact opinion about a turning point. For example, the *Annals* for 1891 read "dullness continues until August, when revival sets in," but the NBER reference date for the trough of this cycle is May 1891 (Thorp, *Business Annals*, p. 136).

[19] Mitchell, *Business Cycles: Problem and Setting*, pp. 422, 367.

[20] See Mitchell, *Business Cycles: Problem and Setting*, pp. 294–95 and 304–5 for a description of the two series. The AT&T index is available in Rorty, "The Statistical Control," p. 159. The Snyder Clearings index is available in Snyder, *Business Cycles*, pp. 292–93.

[21] Mitchell, "Business Cycles," p. 94. Mitchell's writings over the period 1927–1946 show a definite change in his views toward detrending that parallels the apparent change in methods. *Business Cycles: Problem and Setting* contains a careful discussion of methods of detrending and

More concrete evidence that the AT&T index and the Snyder Clearings index were particularly important in setting the reference dates is provided by a comparison of the turning points in the five most prominent business indexes of the 1920s and the NBER reference dates. In *Business Cycles*, Mitchell lists the "Dates of the Troughs and the Crests of . . . Five Monthly Indexes of Business Activity."[22] Table 1 reproduces these dates, along with the NBER reference dates.

Table 1 shows that the NBER reference dates correspond much more frequently to the turning points in the AT&T and Snyder Clearings indexes than to any other series. Seven of the 12 pre-1927 reference troughs correspond to the later of the absolute troughs of the AT&T and Snyder Clearings indexes. Four other NBER troughs are exactly one month after the trough of the later of the two series.[23] Eleven of the 12 NBER peaks correspond to the absolute peak of one of these two series.[24] However, there is no systematic tendency for the NBER peak to correspond to the earlier or later of the peaks in the two series. The NBER peaks generally correspond to the peaks of the Snyder Clearings index through 1900 and the peaks of the AT&T index thereafter.[25]

That the early NBER reference dates appear to have been set largely on the basis of just two detrended business indexes may seem to contradict the numerous references in *Measuring Business Cycles* to the hundreds of series analyzed by the NBER. The resolution of this seeming contradiction is that the reference dates were an input to the

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specifically states on pp. 258–59 that, because "cyclical fluctuations stand out more clearly after the statistical trends and seasonal variations have been eliminated . . ., we shall therefore make such use as we can of these eliminations in our further work." This same view is expressed again three years later in Mitchell's entry on "Business Cycles" in the *Encyclopedia of the Social Sciences*, p. 94. In a preliminary draft of *Measuring Business Cycles*, written by Mitchell alone and tentatively titled *Business Cycles, Volume II*, Chap. III, Mitchell (pp. 48–49) expresses ambivalence about detrending. In response to the rhetorical question, "Ought we not eliminate secular trends from the original data of our time series before taking cyclical measurements?" Mitchell responds that there "would be substantial gains," but "they would be attended by a decrease in the significance of the results for our ultimate purpose." This debate is dropped from the final version of *Measuring Business Cycles*, which simply states on p. 270 that "we take as our basic unit of analysis a business cycle that includes the portion of secular trend falling within its boundaries."

[22] Mitchell, *Business Cycles: Problem and Setting*, table 14, p. 335. A comparison of these troughs and crests with the underlying data shows that Mitchell is simply reporting the actual extremes in the various series. When there are multiple crests and troughs of exactly the same magnitude, Mitchell lists both.

[23] The fact that the NBER trough is one month after the actual turning point in these instances is consistent with Burns and Mitchell's rule for treating horizontal stretches. In each case, the increase in the business index between the actual low and a month later is small relative to subsequent changes in the index.

[24] The NBER reference peak in 1918 is set much later than the crest in either of the series, presumably because of the war.

[25] The other business indexes listed by Mitchell may also have been used to set some of the reference dates. For example, the Frickey index is the only series with a trough corresponding to the NBER reference date in 1897. However, none of the other indexes mentioned by Mitchell has the systematic relationship with the NBER dates that the AT&T and Snyder Clearings indexes do.

TABLE 1
TROUGHS AND PEAKS IN BUSINESS INDEXES

NBER	AT&T	Snyder Clearings	Frickey	Persons	Snyder Deposits
			Troughs		
1888:4	+1888:3	+1888:3	+1888:3		1888:2
1891:5	‡1891:5	1891:3	1891:3		1891:1, 2
1894:6	‡1894:6	1893:10	1893:8		1894:10
1897:6	1896:10	1897:3	+1897:5		1897:4
1900:12	‡1900:11, 12	1900:9	1900:9		1900:9
1904:8	1903:12	+1904:7	1904:5	+1904:7	1904:4, 5
1908:6	‡1908:5, 6	1908:1	1907:12	1908:3	1907:12
1912:1	1911:4	+1911:12	1911:10	1911:4	1910:9
1914:12	‡1914:12	‡1914:12	+1914:11	+1914:11	1914:9, 10
1919:3	‡1919:3	‡1919:3		1919:6	‡1919:3
1921:7	‡1921:4, 5, 7	‡1921:3		‡1921:7	‡1921:3, 7
1924:7	+1924:6			+1924:6	
			Peaks		
1887:3	‡1887:3	1887:6	1887:6		1886:11, 12
1890:7	1890:5, 10	‡1890:7	‡1890:7		+1890:6
1893:1	1892:2	‡1893:1	‡1892:6, 1893:1		1893:2
1895:12	1895:10	‡1895:12	1895:10		1895:6
1899:6	1899:12, 1900:2	‡1899:6	1899:3		1899:2
1902:9	‡1902:9	1901:6	‡1901:5, 1902:9 1903:7		1901:4, 5
1907:5	‡1907:5, 7	1906:2	‡1907:5	‡1907:5	1906:1
1910:1	‡1910:1, 3	1910:4	1910:3	1910:3	1910:2
1913:1	‡1913:1	1913:2	1912:10	1912:10	1912:3, 4
1918:8	1916:11, 1917:1	1916:12, 1917:1		1917:5	1916:10, 11
1920:1	‡1920:1	1919:8, 9		1920:3	1919:7
1923:5	‡1923:5	‡1923:5		‡1923:5, 1924:6	‡1923:5

Notes: The dates are expressed as year:month. A double dagger (‡) denotes exact correspondence with the NBER reference date; a plus sign (+) indicates that the NBER date is one month after the turning point in the business index.
Sources: The NBER reference dates are from Moore and Zarnowitz, "Development and Role," p. 750. All other dates are from Mitchell, *Business Cycles: Problem and Setting*, table 14, p. 335.

analysis of many other series, not the final result of this analysis. As Burns and Mitchell note:

> 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.[26]

Thus, it is not surprising that the early reference dates are derived from only a limited amount of information.[27]

[26] Burns and Mitchell, *Measuring Business Cycles*, p. 24.

[27] Numerous other researchers also dated business cycles in the 1930s (see, for example, Persons, *Forecasting Business Cycles*; Axe and Houghton, "Financial and Business Cycles"; and Ayres, *Turning Points*). Without exception, these authors focused on detrended aggregate series similar to those used by Mitchell. Thus, the correlation between the early NBER reference dates

This comparison of the early NBER methods with the modern methods reveals that the early focus on detrended data is not the only difference between the two methods. For example, in the pre-1927 era the reference peaks typically coincide with the absolute peaks in either the AT&T or Snyder Clearings indexes, but there is no tendency for them to correspond to the later of the two. Mitchell does, however, seem to have systematically chosen the later of the troughs in the AT&T and Snyder series as the reference date. Because the early NBER procedures move troughs later but not peaks, they may tend to accentuate the length of contractions and understate the length of expansions relative to postwar procedures that treat multiple peaks and troughs symmetrically. This will obviously reinforce the bias imparted by the switch from detrended data to data in levels.

In addition, there are obvious differences in the types of series analyzed in deriving the early and modern reference dates. The modern dates are derived almost exclusively from broad measures of real economic activity such as industrial production or employment. The AT&T index and the Snyder Clearings index that Mitchell consulted differ from the modern aggregates in that they contain many nominal series. The possible impact of using nominal variables is hard to gauge, but it could be an additional source of systematic differences between the early and modern reference dates. If, for example, nominal variables respond more quickly to changes in economic conditions than do real variables, this difference would cause the early NBER business chronology to date both peaks and troughs earlier than the postwar chronology.[28]

AN ALGORITHM FOR MATCHING POSTWAR NBER REFERENCE DATES

To test whether these changes in dating techniques have resulted in a meaningful inconsistency in the NBER reference dates over time, I derive a simple algorithm that chooses postwar turning points that

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and these other chronologies that Burns and Mitchell note in *Measuring Business Cycles*, p. 108, should not be surprising.

[28] Watson, "Business Cycle Durations," also considers possible inconsistencies in the NBER reference dates. He shows that if the early dates were based on many volatile series whereas the postwar dates are based on smoother aggregate series, this could lead to overidentification of prewar cycles and to systematic misdating of prewar peaks and troughs. However, my research suggests that early dates were not based on the many volatile series that *Measuring Business Cycles* analyzes and describes. Rather, they are based on only a few aggregate series. Furthermore, the AT&T and Snyder Clearings indexes that Mitchell appears to have used to date cycles are not significantly more volatile than the adjusted Miron-Romer-FRB series that I use. (For example, the standard deviation of the deviations from trend of the Miron-Romer-FRB series for 1884–1921, the sample period over which all three indexes exist, is 7.70; that for the Snyder series for the same period is 8.95; and that for the AT&T series is 9.34.) Hence, although this hypothetical bias could explain the inconsistency I find, it does not appear to be the actual source of the misdating of prewar cycles.

match the NBER reference dates very closely. This algorithm can be viewed as summarizing the modern NBER procedures. The algorithm can then be used to derive turning points for the prewar era that are relatively consistent with the postwar dates.

Data

Because an aggregate series could move without the requisite coherence between the various individual series, Burns and Mitchell did not want to deduce reference dates from any particular aggregate index. In practice, however, series such as real GNP, industrial production, and total employment fluctuate substantially only when many of the individual components fluctuate. It is useful therefore to see if one can find an algorithm for choosing turning points in some comprehensive aggregate that mimics the NBER postwar reference dates closely. Finding an algorithm that works on a single series is important both because it greatly simplifies the analysis and because there are few comprehensive, high-frequency series that are available for both the postwar and prewar eras.

The aggregate series that I use is the Federal Reserve Board's (FRB) index of industrial production. I choose this series for three reasons. First, industrial production is one of the most comprehensive aggregate series that is available monthly. Burns and Mitchell stress that "the monthly reference dates are basic"; therefore, to mimic the NBER procedures, one needs to use a monthly series.[29] Second, the FRB index of industrial production is one of the main series that the current NBER Committee on Business Cycle Dating considers in setting modern reference dates, and the NBER classifies it as a coincident indicator.[30] It is therefore reasonable to hope that dates derived from this series will match the NBER reference dates closely. Third, in a recent paper, Miron and Romer derive a new index of industrial production for the period 1884 to 1940 that can be adjusted to form an adequate prewar extension to the FRB index. Hence, a rule for identifying postwar cycles using industrial production can also be used to deduce cycle dates for the prewar era.

Loss Rules

The Burns and Mitchell rules for identifying specific cycles, which are expressed in terms of duration and amplitude, are complex and cumbersome.[31] Therefore, instead of applying these rules to the postwar FRB index, I derive an alternative dating algorithm that parsimoniously

[29] Burns and Mitchell, *Measuring Business Cycles*, p. 80.

[30] Moore, "What is a Recession?" p. 7. Cloos, "How Good?" also advocates the use of the FRB index for setting reference dates.

[31] Bry and Boschan, *Cyclical Analysis*, develop a computer algorithm for mimicking NBER specific cycle dating procedures that is indeed quite complicated.

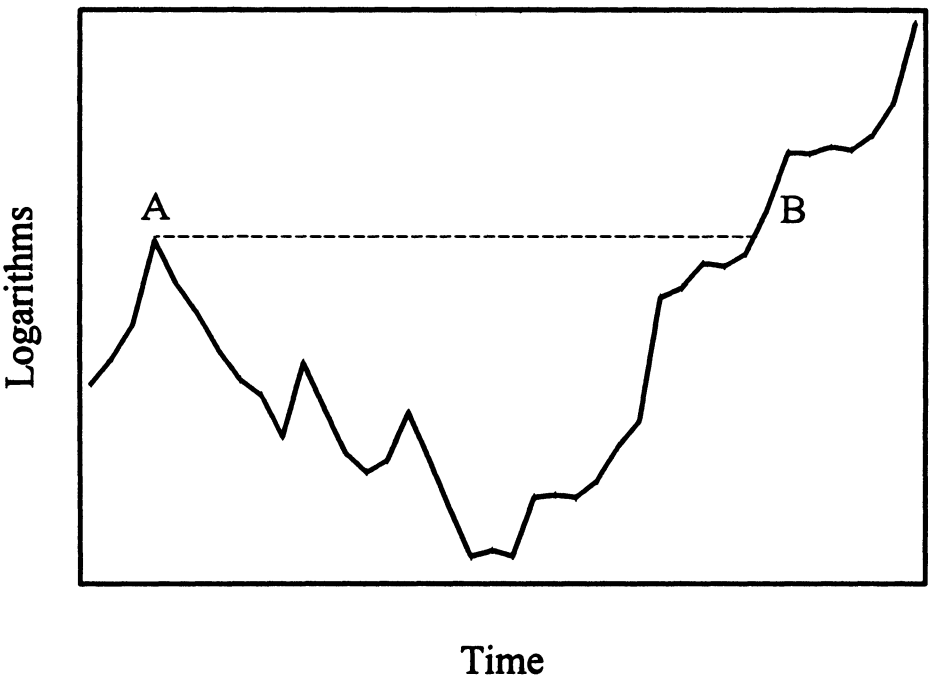

FIGURE 1

CONCEPT OF OUTPUT LOSS

Notes: The graph shows the Federal Reserve Board index of industrial production from 1981:4 to 1984:7. The output loss is the area between the dashed line and the graph of industrial production.
Sources: See the text.

incorporates the duration and amplitude criteria, as well as the other rules for assigning actual dates to turning points.

Burns and Mitchell's idea that contractions must have some minimum duration and amplitude to be classified as business cycles can be well represented by the notion that the amount of output lost during a recession must be a certain quantity. Figure 1, which shows the logarithm of industrial production during a typical recession, illustrates the notion of output loss. The area between the horizontal line from Point A to Point B and the graph of industrial production shows the cumulative output loss between the peak and the time when output returns to its previous peak level.

A rule that says the output loss must be of a particular size for a recession to have occurred should capture very well Burns and Mitchell's notion that both the duration and amplitude of a cycle must be significant for a fluctuation to count as a business cycle. Indeed, the only cases in which this rule might fail are a very short but sharp recession, or a very long but mild one. Fortunately, as a practical matter, such episodes are rare in the United States for the period for which we have industrial production data. Furthermore, in practice the NBER appears

to support not the strict application of separate duration and amplitude rules but some balancing of the two. For example, in their justification of the identification of a recession in 1980, Zarnowitz and Moore write: "The 1980 declines in the indicators of major economic activities were relatively short but widespread and deep enough to qualify as another business cycle contraction."[32]

A loss rule can also be used for making concrete Burns and Mitchell's idea that the latest of multiple peaks or multiple troughs should be chosen as the turning point for a series, unless the overall trend of the series has been clearly down between multiple peaks or clearly up between multiple troughs. The rule could be to choose a later local peak unless the amount of output lost between the absolute peak and the later peak exceeds some threshold. For troughs, a similar rule could be used, but one would look at the gain in output between the absolute trough and a later local low.

Finally, for extremes that are flat rather than jagged, Burns and Mitchell say that the turning point should be placed at the end of the horizontal stretch. However, they provide little guidance about how much output can move and still be considered part of a flat region. A loss rule, again, can be used to make this criterion concrete. One can impose a rule that says a month is considered part of a plateau if the loss or gain in output between it and the previous month is not greater than some amount.

Parameterization of the Loss Rules

The next step is to parameterize the loss rules described above so that when they are applied to data on industrial production, they yield postwar business cycle dates that match the NBER reference dates as closely as possible. For the postwar industrial production series I use the Federal Reserve Board total index. I seasonally adjust the index but do not remove the secular trend, as is consistent with modern NBER procedures.[33] This series is shown in Figure 2.

To deduce the necessary parameters, I first identify every local peak in industrial production and calculate the cumulative loss in log output that occurs between the peak and the date at which industrial production first returns to the peak level.[34] I also identify the actual lowest point in the downturn. Next, I find the cumulative loss between the absolute peak and any later local peaks before the absolute trough in

[32] Zarnowitz and Moore, "Timing and Severity," p. 17.

[33] I use the revised version of the index, which is on a 1986 base and is available without seasonal adjustment from the Federal Reserve Board. To remove seasonal fluctuations, I regress the logarithm of the unadjusted series on a constant, 11 monthly dummy variables, and a linear trend. I then use the residuals, with the trend and constant added back in, as the seasonally adjusted series.

[34] I start these calculations in 1948 to abstract from the effects of World War II and demobilization.

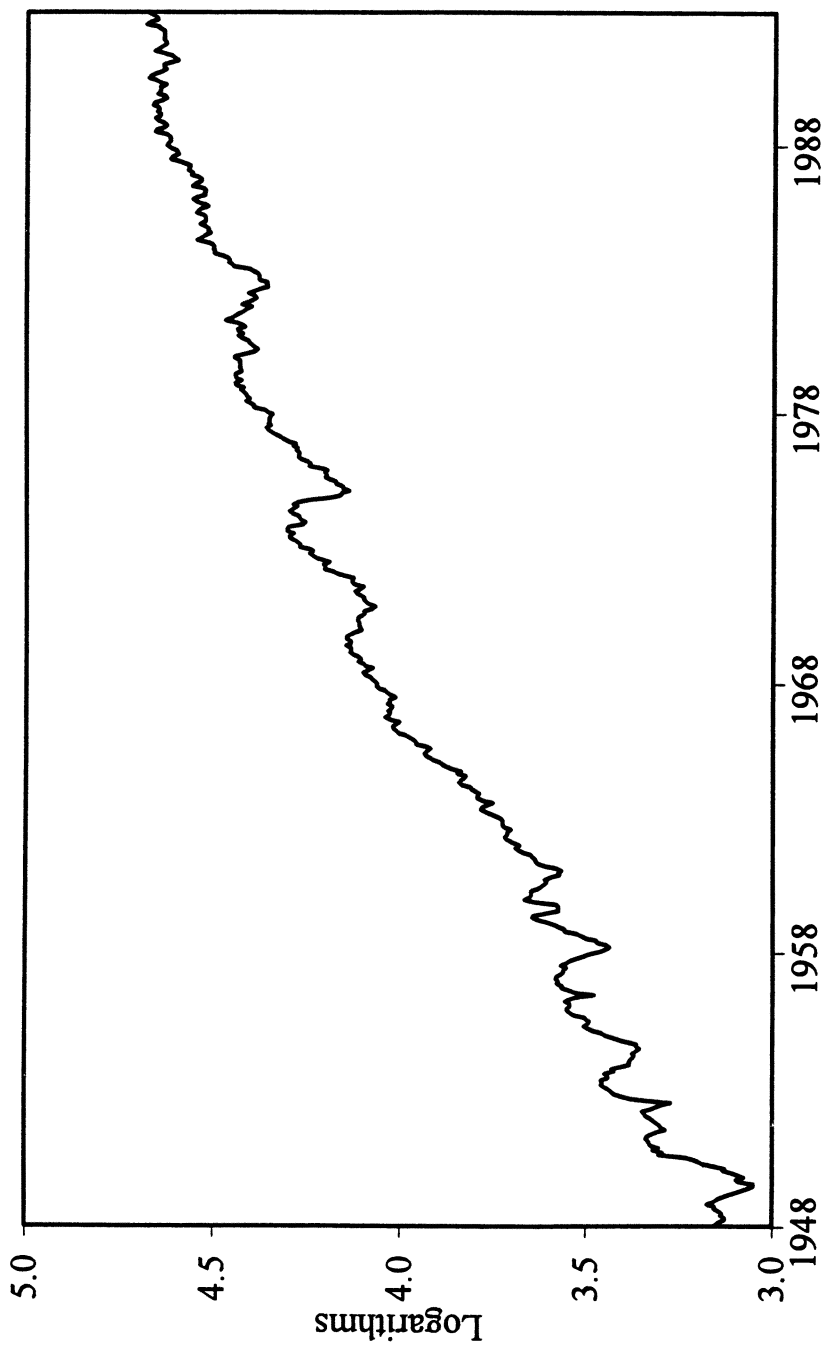

FIGURE 2

INDEX OF INDUSTRIAL PRODUCTION, 1948–1992

Note: This series is a seasonally adjusted version of the Federal Reserve Board index of industrial production.
Sources: See the text for the source of the series and a discussion of the method of seasonal adjustment.

industrial production. I also find the gain between the absolute trough and any later local troughs in the same way. Finally, for every possible peak or trough, I calculate the loss (or gain) between each of the subsequent three months. Armed with these various measures of loss and gain, I then search for business cycle dating rules that yield cycle dates that match the NBER reference dates as well as possible.

A comparison of the loss in output in various contractions with the NBER reference dates shows that the smallest postwar downturn that the NBER has classified as a recession is the 1980 cycle. The cumulative loss of log output between the absolute peak in industrial production in February 1980 and the return to this peak level in June 1981 is 0.421; that is, the loss is 42 percentage-point-months of industrial production, or about two weeks' output. There are no fluctuations in industrial production with a loss larger than 0.421 that are not counted by the NBER as cycles. Thus, a rule for deciding which fluctuations to count as business cycles that matches the NBER classification exactly is that the cumulative loss of industrial production between the absolute peak and the return to peak must be at least 0.421.

The loss analysis shows several characteristics of the local peaks and troughs in industrial production that are closest to the NBER reference dates. First, in no case does the NBER reference date correspond to a local peak or trough in industrial production that is before the absolute extreme. Second, one of the most striking features of postwar fluctuations in industrial production is that there is frequently a small dip in output that precedes the main downturn and a small rise that precedes the main upturn. The NBER reference date frequently corresponds to the local peak or trough that is after the absolute high or low in industrial production.

However, the NBER only takes a local peak or trough after the absolute extreme if there has not been a significant rise or fall in industrial production. Although no rule can explain all of the NBER's choices exactly, the one that causes the fewest discrepancies is that a later local peak or trough is chosen as the turning point if the loss or gain in output is less than or equal to 0.095. This quantity, 0.095, is the second largest loss or gain that the NBER has accepted and occurred when the later local peak in August 1957 was chosen as the NBER reference peak over the absolute peak in February 1957. The largest loss or gain that the NBER has ever accepted is 0.113, which occurred for the trough in 1949. I do not choose this quantity because there are two later extremes with a loss or gain between 0.095 and 0.113 that are not accepted as NBER reference dates.

The loss analysis also shows two characteristics of the movements in output that the NBER counts as plateaus. First, the NBER almost never chooses a reference date that is more than one month later than the actual peak or trough. Thus, in deducing the algorithm for matching the

TABLE 2
POSTWAR PEAKS AND TROUGHS

NBER Reference Dates		Dates Derived from the Algorithm	
Peak	Trough	Peak	Trough
1948:11	1949:10	1948:10	1949:7
1953:7	1954:5	1953:8	1954:8
1957:8	1958:4	1957:8	1958:4
1960:4	1961:2	1960:5	1961:2
1969:12	1970:11	1969:10	1970:11
1973:11	1975:3	1973:11	1975:3
1980:1	1980:7	1980:3	1980:6
1981:7	1982:11	1981:7	1983:4
1990:7	1991:3	1990:8	1991:3

Sources: The NBER reference dates are from Moore and Zarnowitz, "Development and Role," p. 750. For the source of the dates derived from the algorithm, see the text.

NBER dates I only consider whether the first month after a local extreme should be considered a horizontal stretch. Second, the cutoff for what constitutes a plateau appears to be roughly 0.008. That is, the NBER typically sets the reference date one month after the chosen extreme only if the gain or loss in output for that month is less than or equal to 0.008. Once again, this rule does not fit perfectly; there are two cases where a loss or gain over 0.008 is accepted and one case where a loss of 0.005 is rejected. However, a cutoff of 0.008 reconciles most of the NBER's choices.

When the rules described above are used to identify cycles and deduce turning points from the postwar industrial production series, the resulting dates are very close to the NBER reference dates. This can be seen in Table 2, which shows both the NBER reference dates and the dates chosen by the algorithm. Of the 18 reference dates between 1948 and 1992, the dates chosen by the algorithm match the NBER dates exactly in eight instances, and are within one month of the NBER date in five more instances. The largest discrepancy is five months, which occurs for the NBER trough in 1982. There is also no systematic pattern to the discrepancies; the date chosen by the algorithm is roughly as likely to be before the NBER date as to be after.

NEW PREWAR BUSINESS CYCLE DATES

The final step in the evaluation of the consistency of the NBER dates is to apply the dating algorithm to the prewar era. If the criteria for dating cycles have not changed, then the dates that the algorithm chooses for the prewar era should match the prewar NBER dates about as closely as the new postwar dates match the postwar NBER peaks and troughs. If not, then this would be evidence that the prewar and postwar NBER reference dates are inconsistent.

Assumptions

This approach rests on two crucial assumptions. First, the algorithm that I derive for the postwar era uses industrial production as the only economic indicator. If this series is a more representative indicator for the postwar economy than for the prewar economy, then the new prewar dates could differ from the NBER dates even if the NBER dates were consistent over time. One piece of evidence that industrial production is roughly as good an indicator for the prewar economy as for the postwar economy is the fact that manufacturing and mining, the two main components of any index of industrial production, have not become a larger or smaller fraction of the economy between 1884 and today. The fraction of national income originating in manufacturing and mining increased from about 21 percent in the late 1800s to 29 percent in the 1930s. After World War II, this fraction reached a high of 31 percent in the 1950s and then declined to about 23 percent in the 1980s.[35] Thus, on average, the industrial sector has been equally important in the eras before and after the Great Depression. Further evidence that industrial production should be a good cyclical indicator for the entire twentieth century is provided by J. Bradford De Long and Lawrence Summers.[36] They find that private nonfarm GDP shows roughly the same change in cyclical movements over time as total GDP. This suggests that the relative decline in agriculture and the relative rise in government services have not affected the cyclical behavior of the economy.[37]

The second crucial assumption concerns the consistency of the measures of industrial production over time. The postwar algorithm can deduce accurate prewar turning points only if the data to which the algorithm is applied are consistent over time. If there are systematic errors in the prewar measures that are absent from the postwar series, there is no reason to expect the algorithm to date prewar cycles in a way that is consistent with the postwar dates. Therefore, it is important to analyze the consistency of the data.

For the period 1884 to 1940, Miron and Romer have created a monthly index of industrial production.[38] This series is not truly consistent with the modern FRB index because it is based on many fewer series than is the modern FRB index, and many sectors of the economy are either over- or underrepresented relative to their actual share of value added.

[35] The data for the period before 1969 are from U.S. Bureau of the Census, *Historical Statistics*, p. 238. The data for the period after 1969 are from U.S. Bureau of Economic Analysis, *National Income and Product Accounts*, p. 256.

[36] De Long and Summers, "Changing Cyclical Variability," pp. 685–86.

[37] Kuznets would not have been surprised by this finding. In his "Comment" on a paper by Schumpeter, p. 160, Kuznets suggested that the decline in agriculture and the rise in services may have simply replaced one acyclical sector with another.

[38] Miron and Romer, "New Monthly Index."

The Miron-Romer index is also based very heavily on inputs to the production process and the output of simple manufactures, rather than on the output of highly fabricated products. However, this index shares many important features with the FRB index. Its most important virtue is that, like the FRB index, it is based on physical production data. The other business indexes for the prewar era include nominal variables such as prices, bank clearings, or interest rates. The other main virtue of the Miron-Romer index is that it has not already been detrended, seasonally adjusted, or otherwise manipulated. This is again in contrast to the existing prewar indexes of industrial production, which are typically available only in highly adjusted forms.

The Federal Reserve Board index of industrial production itself exists on a consistent basis back to 1923. For the four years 1919 to 1922 there is also official data, though the FRB has not attempted to make these observations strictly comparable to the postwar series.[39] Since the Miron-Romer index and the FRB index overlap for the period 1919 to 1940, it is possible to see just how similar these two indexes actually are. Because the Miron-Romer index is based largely on inputs and simple manufactures, it is more volatile than the FRB index. In addition, because it is constructed using relatively few commodities, it tends to have more random movements.

Given these obvious differences between the two series, it would be inappropriate to simply apply the dating algorithm derived from the postwar FRB index to the prewar Miron-Romer index. Instead, I first adjust the Miron-Romer index to be more comparable to the FRB index. To do this, I use a regression to estimate the relationship between the FRB index and the Miron-Romer series in a period of overlap. I then use this estimated relationship to form adjusted values for the Miron-Romer index for the period before 1919. The details of this adjustment are given in the Appendix. The resulting prewar index of industrial production that combines the FRB index after 1919 and the adjusted Miron-Romer series through 1918 is shown in Figure 3.

Comparison of the New Dates and the NBER Reference Dates

The application of the postwar rules given in the previous section to the prewar index of industrial production is straightforward. Because the adjusted prewar index only extends back to 1884, I am only able to identify cycles beginning in the late 1800s. In applying the algorithm to the prewar era, I carry the analysis through 1940. The dates that the postwar algorithm chooses as turning points for prewar business cycles, along with the corresponding NBER reference dates, are shown in Table 3.

[39] The interwar FRB index is described in U.S. Board of Governors, "New Federal Reserve Index."

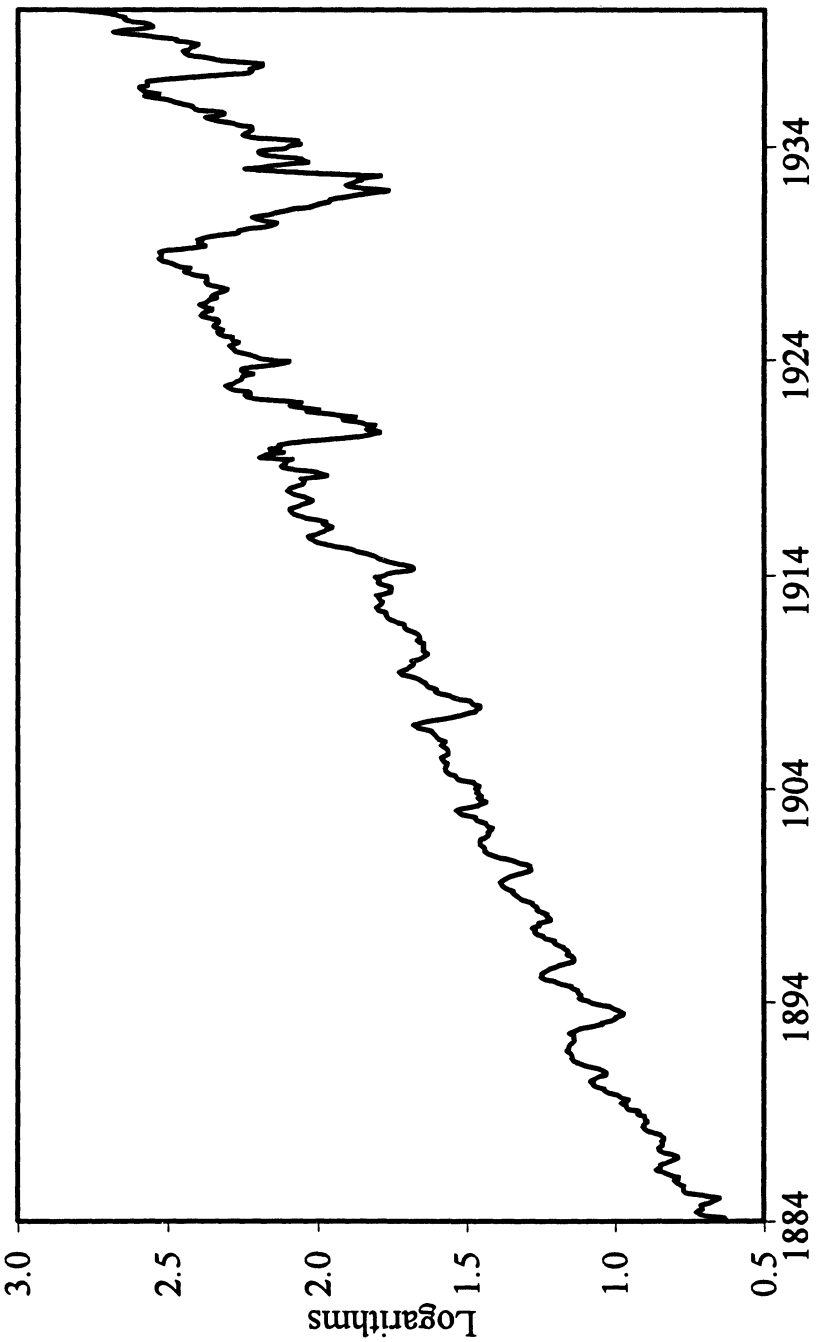

FIGURE 3

INDEX OF INDUSTRIAL PRODUCTION, 1884–1940

Notes: For 1884–1918 this series is the seasonally adjusted, smoothed version of the Miron-Romer index described in the Appendix. For 1919–1940 this series is the Federal Reserve Board index of industrial production, which I have also seasonally adjusted.
Sources: See the text.

TABLE 3
PREWAR PEAKS AND TROUGHS

NBER Reference Dates		New Dates	
Peak	Trough	Peak	Trough
1887:3	1888:4	1887:2	1887:7
1890:7	1891:5		
1893:1	1894:6	1893:1	1894:2
1895:12	1897:6	1896:1	1897:1
1899:6	1900:12	1900:4	1900:12
1902:9	1904:8	1903:7	1904:3
1907:5	1908:6	1907:7	1908:6
1910:1	1912:1	1910:1	1911:5
1913:1	1914:12	1914:6	1914:12
		1916:5	1917:1
1918:8	1919:3	1918:7	1919:3
1920:1	1921:7	1920:1	1921:3
1923:5	1924:7	1923:5	1924:7
1926:10	1927:11	1927:3	1927:12
1929:8	1933:3	1929:9	1932:7
1937:5	1938:6	1937:8	1938:6
		1939:12	1940:3

Sources: The NBER reference dates are from Moore and Zarnowitz, "Development and Role," p. 750. For the derivation of the new dates, see the text.

Table 3 shows several similarities and differences between the new dates chosen by the postwar algorithm and the prewar NBER reference dates. The strongest similarity involves what counts as a cycle. There is only one fluctuation between 1884 and 1940 that the NBER identifies as a cycle that the postwar algorithm does not choose. This is the recession of 1890, and it is not counted by the postwar algorithm because the total output loss between the absolute peak and the return to peak is only 0.25, whereas the smallest postwar loss that counts as a cycle is 0.42. This cycle is one that other researchers have frequently mentioned as being questionable, so its exclusion will probably surprise few.[40] The fact that there are not more instances of growth recessions being classed as cycles may indicate that Mitchell set the criterion for what counts as a cycle in detrended data strictly enough that most cycles correspond to a substantial fall in real output. The fact that the *Business Annals* played a key role in the identification (but not the actually dating) of cycles could also explain why there are not more questionable prewar cycles in the NBER chronology. It is likely that the business press only took notice of significant declines in production.

Several other prewar NBER recessions that others have questioned are confirmed by the application of the postwar algorithm. For example, the recessions that began in 1887 and 1927 are often alleged to have been

[40] Zarnowitz, "Business Cycles and Growth," p. 503, for example, lists it among the mildest prewar cycles, and Fels, *American Business Cycles*, p. 159, describes it as "singularly mild."

mere slowdowns in growth rather than actual declines in real output.[41] However, the output loss in both instances (0.58 in 1887 and 0.68 in 1927) is sufficient for them to be counted as cycles according to the postwar NBER criterion. Similarly, the immediate post–World War I recession in 1918 that is often skipped by other chronologies also appears to be a genuine cycle according to the modern criterion.

There are two fluctuations in the prewar era that the postwar algorithm classifies as cycles but the NBER does not. These recessions began in 1916 and 1939. Both these fluctuations are reasonably small (the loss in 1916 is 0.46 and that in 1939 is 0.65) and brief, and both are associated with the start of war in Europe. Because of the special circumstances associated with these fluctuations, their inclusion does not constitute a major discrepancy with the NBER. Overall, the close correspondence between what the NBER classifies as prewar cycles and what the postwar algorithm identifies as cycles suggests that the NBER has been quite consistent over time in the identification of cycles.

There is much less similarity between the dates of peaks and troughs in the NBER chronology and the new chronology derived from the algorithm. Of the 16 turning points between 1887 and 1917 for which both chronologies date a cycle, there is exact agreement on the date of the peak or trough in only five instances. The average absolute value of the discrepancy between the NBER dates and the new dates for this period is 4.5 months. The largest discrepancy occurs for the peak shortly before World War I: the NBER dates the peak in January 1913, whereas the postwar algorithm chooses June 1914. There is more agreement for the turning points in the two decades between the World Wars. Of the 12 turning points between 1918 and 1940 for which both chronologies date a cycle, there is exact agreement on the month and year of the peak or trough in five instances, and the average discrepancy is 1.9 months.[42]

Not only is there little agreement between the turning points in the two chronologies, but the differences are systematic. Of the ten peaks between 1887 and 1940 for which the two chronologies do not agree, the new date that I derive is later than the NBER peak in eight instances. Of the eight troughs between 1887 and 1940 for which the two chronologies

[41] See, for example, Ayres, *Turning Points*; and Moore and Zarnowitz, "Development and Role."

[42] The fact that there is more similarity between the dates chosen by the algorithm and the NBER peaks and troughs in the interwar era than in the pre–World War I period is consistent with the fact that the NBER's methods changed in 1927, halfway through the interwar period. Also, according to Moore and Zarnowitz, "Development and Role," p. 748, some of the reference dates for the interwar period were changed slightly in the early 1950s. These revisions are sufficiently small that it does not appear that there was a thorough revamping of the dates. However, of the five dates that were changed (the original dates were 1919:4, 1921:9, 1927:12, 1929:6, and 1938:5), four of the new dates are closer to the dates chosen by the algorithm than are the original NBER turning points.

do not agree, the new date that I derive is earlier than the NBER trough in seven instances. Averaged over all 14 cycles that are identified in both chronologies, the new peaks lag the NBER peaks by an average of 3.4 months, and the new troughs lead the NBER troughs by an average of 3.0 months. Clearly, the algorithm systematically dates peaks later and troughs earlier than does the NBER prewar business cycle chronology.

The differences between the new dates derived using the postwar algorithm and the NBER dates are exactly what one would expect given the fact that the NBER dates before 1927 were derived from detrended data and the new dates are based on data in levels. When peaks or troughs are sharp, as in 1920 or 1908, detrending should not affect turning points. And indeed, the new dates and the NBER dates are identical in these episodes. On the other hand, when fluctuations are smooth, as in 1900 or 1911, the peak in detrended data should occur a few months before that in levels, and the trough should occur a few months later. This is again exactly what happens. Finally, when there are multiple extremes, as in 1913/1914, detrending can have very large effects on the dates of cycles. In this example, the peak in detrended data occurs at the start of 1913. However, in levels, the recovery in late 1913 is large enough that the absolute peak occurs in mid-1914. Since the modern NBER methods never date a peak before the absolute peak in levels, the only possible date for this turning point is June 1914.[43]

Evaluation of the New Dates

That the new dates I derive using the postwar algorithm differ systematically from the prewar NBER turning points provides statistical evidence that there is an important inconsistency between the early and modern NBER reference dates. However, before one accepts this statistical evidence, and especially before one uses the new dates in applications, it is important to evaluate the accuracy and reasonableness of the new dates. To do this, I present both additional statistical evidence and descriptive evidence from the business press.

STATISTICAL EVIDENCE

The most obvious source of concern about the new dates is that the adjusted Miron-Romer index might be a flawed prewar extension of the FRB index of industrial production used to derive the postwar algorithm. As reported in the Appendix, the R^2 of the regression of the detrended FRB index on six lags and six leads of the detrended Miron-Romer index in the period of overlap is 0.9, suggesting a

[43] The closest parallel to the 1913–1914 experience occurs in 1948. Industrial production peaked in January 1948 and fell through June. It then recovered to its previous peak and began to fall again in October 1948. Because the output loss in the first cycle was relatively small, this is not counted as an independent cycle by the NBER. Because output in October 1948 surpassed the January 1948 peak, the NBER dated the peak in October.

TABLE 4
INTERWAR PEAKS AND TROUGHS USING ALTERNATIVE OUTPUT SERIES

New Dates		Alternative Dates (Adjusted Miron-Romer Index)	
Peak	Trough	Peak	Trough
1920:1	1921:3	1920:5	1921:6
1923:5	1924:7	1923:5	1924:8
1927:3	1927:12	1927:7	1928:3
1929:9	1932:7	1929:7	1933:3
1937:8	1938:6	1937:11	1938:9

Notes: Because the adjustment filter uses several leads and lags of the Miron-Romer index, the adjusted Miron-Romer series cannot be used to analyze the cycle in 1939–1940. Therefore, the comparison stops in 1938.
Sources: See the text.

less-than-perfect correlation between the two series. As a result, it is possible that other prewar indexes of industrial production and other ways of adjusting the Miron-Romer index could lead to different prewar dates.

The most direct test of whether differences between the FRB index and the adjusted Miron-Romer index matter is to look at the period of overlap between the two series, 1919 to 1940. In the derivation of the new business cycle chronology given in Table 3, the FRB index is used after 1919. If one uses the adjusted Miron-Romer index instead, the dates that result are given in Table 4. Table 4 shows that the dates derived from the adjusted Miron-Romer index for this era are quite similar to those derived from the FRB index. Both series identify the same cycles. There is a slight tendency for the dates based on the Miron-Romer series to lag those based on the FRB index (the average turning point is 2.7 months later), but peaks and troughs lag roughly equally. This comparison suggests that, although the new dates based on the adjusted Miron-Romer series may be a few months behind the true peaks and troughs in economic activity, they should reflect the length of expansions and contractions accurately.

Another way to evaluate the robustness of the new dates to the particular adjustment of the Miron-Romer series I use is to apply the postwar algorithm to two alternative prewar indexes of industrial production. The first of these series is an official continuation of the FRB series back to 1899 constructed by Thomas.[44] This series has some obvious weaknesses; most notably, it only exists for a limited period and the specifics of its derivation are not described anywhere. However, it does appear to be based on many of the same series as the later FRB index and thus is likely to be reasonably consistent with the FRB series. The second series to consider is a less-adjusted version of the

[44] This series is given in Ayres, *Turning Points*, p. 202–3. Annual values are published in the U.S. Board of Governors, *Federal Reserve Bulletin*, Jan. 1931, p. 46.

TABLE 5
PRE–WORLD WAR I PEAKS AND TROUGHS USING ALTERNATIVE OUTPUT SERIES

New Dates		Alternative Dates (Thomas Index)		Alternative Dates (Less-Adjusted Miron-Romer Index)	
Peak	Trough	Peak	Trough	Peak	Trough
				1884:11	1885:8
1887:2	1887:7			1887:3	1887:7
1893:1	1894:2			1892:6	1894:2
1896:1	1897:1			1895:10	1896:8
				1898:2	1898:9
1900:4	1900:12	1900:1	1900:10	1900:3	1900:11
1903:7	1904:3	1903:6	1903:12	1903:8	1904:6
1907:7	1908:6	1907:6	1908:4	1907:7	1908:6
1910:1	1911:5	1910:1	1911:7	1910:1	1911:5
1914:6	1914:12	1913:6	1914:12	1913:2	1914:11
1916:5	1917:1				

Sources: See the text.

prewar Miron-Romer index. The adjustments to the Miron-Romer series described in the Appendix not only smooth and seasonally adjust the raw series, but also dampen cyclical fluctuations. An extreme alternative adjustment procedure is to merely smooth the series, while leaving the cyclical fluctuations as severe as in the unadjusted series.[45] This is an extreme alternative because the unconstrained regression between the FRB and Miron-Romer series suggests that cyclical fluctuations in the Miron-Romer series should be damped roughly 40 percent. Therefore, if the new dates are robust to this adjustment, it is plausible to believe that they will be robust to a wide range of less extreme variations in the adjustment procedures.

The dates that result from applying the postwar algorithm to these series, as well as the new dates, are shown in Table 5. The most obvious conclusion from Table 5 is that there is far from perfect correlation between the new dates and those derived from alternative measures of industrial production. Many of the peaks and troughs differ by several months across the three chronologies. However, there is also a great deal of similarity. First, for the Thomas index, applying the postwar algorithm yields almost exactly the same cycles as shown by the new dates. The only exception is that the dates based on the Thomas index do not include the recession beginning in 1916 present in the new dates.[46] Most of the turning points derived from the Thomas index are

[45] This less-adjusted version of the Miron-Romer series is derived by imposing the constraint that the sum of the coefficients on the leads and lags of the Miron-Romer series in the regression described in the Appendix equal one. It is important to smooth the Miron-Romer index because the series has several isolated extremes that are due to temporary industry-specific disturbances such as strikes or tariffs.

[46] The Thomas index does show output declining in the second half of 1916 just as the adjusted

also within a month or two of the new dates. As with the FRB index for 1919 to 1940, the dates derived from the Miron-Romer index for both peaks and troughs appear to be a few months later than those in the Thomas index; the average lag is 2.2 months. As before, however, because the whole cycle is moved a few months later, the lengths of expansions and contractions are essentially unaffected. Furthermore, a comparison with the NBER dates given in Table 3 shows that, for every case except one, the date derived from the Thomas index is either closer to the new date than to the NBER date, or equidistant from the two.

For the smoothed but undamped Miron-Romer index, applying the postwar algorithm identifies a few cycles not shown by the new dates. This is to be expected because the series has much larger fluctuations on average and thus more declines that meet the cutoff for what counts as a recession. Once again, however, even the dates derived from this very different measure of industrial production are closer to the new dates than to the NBER dates. Of the 16 turning points for which all three chronologies list a date, the date from the undamped Miron-Romer index is closer to the new date in 7 instances, equidistant from the two in 5, and closer to the NBER in only 4.

Overall, the application of the postwar algorithm to the three different measures of industrial production suggest both a note of caution and a note of reassurance to potential users of the new dates. The fact that different indexes yield different dates suggests that the particular dates I present could be off by several months in some instances. However, considering how different the various measures of industrial production are, the similarity in the dates suggests that the new turning points are only moderately sensitive to the index that is used. Furthermore, nearly all of the dates derived from the alternative measures of industrial production are closer to the new dates than to the NBER dates. Thus, although the new dates are surely imperfect, they appear to be more accurate than the NBER dates.

DESCRIPTIVE EVIDENCE

Another way to examine the plausibility of the new prewar dates is to examine what the contemporary business press reported about the state of economic activity in certain periods. The main business publications that I examine are *Dun's Review*, a weekly magazine of business conditions, and the *Financial Review*, an annual compendium of the *Commercial and Financial Chronicle*. *Bradstreet's*, another weekly business journal, is also analyzed for the late 1880s when *Dun's Review* does not exist. As discussed above, the new business cycle chronology

Miron-Romer index does, but the magnitude of the decline is smaller. As a result, although the fall in the Miron-Romer index is just barely large enough to count as a cycle, that in the Thomas index is not.

and the NBER chronology identify very similar cycles, and those differences that exist are easily understood. Therefore, the business press is only examined to check the plausibility of the new turning points, not the plausibility of added or eliminated cycles. Furthermore, since it is in the period before World War I that the new dates are most different from the NBER dates, I only examine the press accounts before 1917.[47] Finally, I discuss only the press accounts for the peaks and troughs where the two chronologies differ by more than a few months.

The first major discrepancy between the two chronologies occurs in the recession of 1887: the new date for the trough is July 1887, whereas the NBER trough is April 1888. The *Financial Review* is of little help in adjudicating this dispute because it takes little notice of the recession. Its "Retrospect of 1887" is filled with glowing accounts of the amount of new railroad track laid and makes only passing reference to declines in the production of certain goods and the rise in business failures. *Bradstreet's*, however, indicates that the new earlier date is more accurate. In late May 1887, *Bradstreet's* notes that among "the special lines of industry suffering from depression" are those manufacturing woolens, iron and steel, nails, and flour.[48] By late July 1887, however, it reports "an increased number of favoring business conditions."[49] During the fall, it reports that "the industrial situation is fairly satisfactory" and there is "a continuance of most of the favorable features of general trade heretofore noted."[50] Although *Bradstreet's* does note some financial stringency during the fall, it stresses that the effects on output are small.[51] Thus, there is nothing in the business press to suggest that recovery was delayed until mid-1888.

For the recession of 1896, the new business cycle chronology dates the trough in January 1897, whereas the NBER dates the trough in June 1897. *Dun's Review* agrees with the new date. It reports at the start of 1897 that "January has been a month of disappointment, but of real gain," and that "a study of conditions governing business indicates that the wheels are on the right track and moving in the right direction."[52] A month later it reports that "in nearly every branch, the great iron and

[47] The only substantial disagreement between the new dates and the NBER dates in the interwar era involves the trough of the Great Depression. The new trough in July 1932 is nine months before the NBER trough in March 1933. The source of this disagreement, however, can be easily understood from the behavior of industrial production shown in Figure 3. Industrial production reaches its absolute trough in July 1932 and then recovers substantially. It then falls again with the financial panics of early 1933. Since the recovery in late 1932 was quite large, the postwar algorithm chooses the absolute trough. Burns and Mitchell, in contrast to the NBER's later criteria, chose instead the quite deep local trough in March 1933.

[48] *Bradstreet's*, May 28, 1887, p. 358.

[49] *Bradstreet's*, July 23, 1887, p. 493.

[50] *Bradstreet's*, Aug. 27, 1887, p. 573, and Oct. 1, 1887, p. 653, respectively.

[51] *Bradstreet's*, Sept. 24, 1887, p. 637.

[52] *Dun's*, Jan. 30, 1897, p. 1.

steel industry feels the upward impulse," and that "other industries are gaining also, though less conspicuously."[53] The *Financial Review* also suggests that by January 1897 "the indications favored the belief that the country was making substantial progress toward a better state of things," and notes that in February 1897 the collapse of the steel-rail pool "had a quickening effect on all branches of the iron and steel trades."[54] However, the *Financial Review* sees the greatest recovery in the second half of 1897. Thus, it could be read as favoring either the new date or the NBER date.

One of the largest discrepancies between the new dates and the NBER dates occurs around 1900, when the algorithm dates a peak in April 1900, and the NBER dates a peak in June 1899. In this instance the business press is clearly in accord with the new date. In the "Retrospect of 1899," the *Financial Review* states that "in trade affairs . . . hardly a cloud appeared on the horizon from the beginning to the end of year."[55] The "Retrospect of 1900" indicates that there was "a halt in a state of exceptional trade activity" and mentions in particular the shut-down of numerous steel mills in April 1900.[56] Similarly, nearly every issue of *Dun's Review* in the second half of 1899 and early 1900 relates that business is doing well. For example, in December 1899 it states: "business continues wonderfully large, prosperous and healthy."[57] In March 1900 *Dun's* admits some weakening when it reports that "a certain hesitation in business with shrinkage in its volume is not unusual or unnatural at this season."[58] By May 1900 it reports: "business is not what it was a year ago. . . . Works are stopping to relieve excessive output in manufactures."[59]

For the recession of 1903, there is considerable disagreement between the new dates and the NBER dates for both the peak and the trough. The new date for the peak is July 1903, whereas the NBER date is September 1902. The business press provides no support for the NBER date; both the *Financial Review* and *Dun's Review* describe 1902 as uniformly prosperous. For example, the *Financial Review* says of 1902: "it marked a further and very distinct advance in that unexampled era of prosperity."[60] As late as May 1903, *Dun's Review* reports that "manufacturing plants are generally well occupied."[61] If anything, the business press supports a peak even later than the new date. Although the *Financial Review* reports that widespread strikes in the building

[53] *Dun's*, Feb. 20, 1897, p. 1.
[54] *Financial Review*, 1898, pp. 4–5.
[55] *Financial Review*, 1900, p. 11.
[56] *Financial Review*, 1901, pp. 11–12.
[57] *Dun's*, Dec. 2, 1899, p. 1.
[58] *Dun's*, Mar. 10, 1900, p. 1.
[59] *Dun's*, May 19, 1900, p. 1.
[60] *Financial Review*, 1903, p. 11.
[61] *Dun's*, May 23, 1903, p. 3.

industry in May and June began to affect manufacturing in July, it is not until September 1903 that they feel "industrial affairs began to wear a decidedly less assuring aspect."[62] It is not until October 1903 that *Dun's Review* reports "some contraction in trade and industry has undoubtedly taken place."[63]

The new date of the trough of this recession is March 1904, whereas the NBER trough is August 1904. Both the *Financial Review* and *Dun's Review* suggest the earlier date is plausible. The *Financial Review's* "Retrospect of 1904" notes that a Supreme Court decision in March was viewed as beneficial to business and "hence, the more hopeful feeling which developed."[64] *Dun's Review* states in late February that "manufacturing plants are gradually restoring idle machinery," and reports in April that "manufacturing plants are increasingly active, and structural work is gradually resuming normal proportions."[65] Both periodicals, however, also make it clear that there was another dip in economic activity in the late spring and that rapid recovery did not begin until the third quarter of 1904. Thus, both the new date and the NBER date are plausible based on the accounts of the business press.

For the recession of 1910, the new trough is May 1911, whereas the NBER trough is January 1912. The accounts in the business press suggest that the earlier date is, again, at least as plausible as the later date. The *Financial Review* reports that "the origin of the trade revival of 1912 . . . undoubtedly had its inception in the great break in iron and steel prices which occurred in the summer of 1911."[66] It goes on to discuss that "with trade already in a state of great activity, the large crops raised [in 1911] were a powerful influence in keeping it so."[67] *Dun's Review* also notes some turnaround in the summer of 1911. In early May it refers to the fact that the "business situation as a whole is . . . very unsatisfactory."[68] In June it reports that "the actual volume of business continues below producing capacity, . . . yet the trend is unquestionably for the better."[69] By September it finds that "steady improvement in business conditions is indicated by most of the reports . . . from the leading industries."[70]

The largest discrepancy between the new dates and the NBER dates occurs for the peak shortly before World War I. The new date, June 1914, is 17 months later than the NBER date of January 1913. Neither the *Financial Review* nor *Dun's Review* provides support for the very

[62] *Financial Review*, 1904, p. 21.
[63] *Dun's*, Oct. 17, 1903, p. 9.
[64] *Financial Review*, 1905, p. 16.
[65] *Dun's*, Feb. 27, 1904, p. 5, and Apr. 23, 1904, p. 3, respectively.
[66] *Financial Review*, 1913, p. 14.
[67] Ibid.
[68] *Dun's*, May 13, 1911, p. 5.
[69] *Dun's*, June 24, 1911, p. 5.
[70] *Dun's*, Sept. 9, 1911, p. 5.

early NBER date. The *Financial Review*, in the "Retrospect of 1913," reports that "for a good part of the year, the volume of trade was well maintained," and *Dun's Review* reports in late May 1913 that "the volume of business in nearly all branches of trade and industry continues very large."[71] Both sources then see the slowdown in economic activity that is evident in the index of industrial production given in Figure 3. The *Financial Review* reports that in "the last half of the year . . . indications of trade reaction became very manifest" and "with the completion of tariff legislation [in October 1913], the reaction ran into depression."[72] *Dun's Review* indicates in November 1913 that there are "evidences of trade recession [in] industrial lines."[73] Thus, the business press can be read as favoring a date roughly equidistant from the new date and the NBER date.

Both sources, however, also see the revival in economic activity in early 1914 and the rapid decline following the outbreak of war in Europe that lead the algorithm to pick the later date. *Dun's Review*, for example, reports in February 1914 that "there are further evidences of reviving business activity."[74] The *Financial Review* stresses the large effect of the war when it writes: "business in the United States had not been good even before the war broke out in 1914; the occurrence of that cataclysm produced utter demoralization in all current activities here."[75] This suggests that accounts in the business press can also be read as supporting the new peak in mid-1914.

Overall, the analysis of the business press suggests that the new business cycle chronology is in substantial agreement with contemporary press accounts, whereas many of the NBER dates are directly contradicted by the business annals. The fact that all of the new dates appear plausible from the press accounts suggests that the new chronology is adequate even for applications unrelated to those pursued in this article.

IMPLICATIONS OF THE NEW BUSINESS CYCLE DATES

Duration

Because the new prewar dates that I derive differ systematically from the NBER reference dates, the more consistent business cycle chronology yields very different conclusions about changes in business cycles over time. Most obviously, the new dates radically alter one's view of changes in the duration of contractions and expansions over time. Table 6 shows the average duration of contractions and expansions in various

[71] *Financial Review*, 1914, p. 11; and *Dun's*, May 24, 1913, p. 3, respectively.
[72] *Financial Review*, 1914, p. 11.
[73] *Dun's*, Nov. 1, 1913, p. 3.
[74] *Dun's*, Feb. 7, 1914, p. 3.
[75] *Financial Review*, 1916, p. 7.

TABLE 6
DURATION OF CONTRACTIONS AND EXPANSIONS

Sample Period	Average Length of Contractions (months)		Average Length of Expansions (months)	
	NBER	New	NBER	New
1887–1917	17.7	9.7	24.2	32.2
1918–1940	18.0	13.1	26.0	28.0
1948–1992	10.7	10.9	51.5	51.4

Sources: See the text.

time periods using both the NBER reference dates and the new dates. The periods that I consider are 1887 to 1917, 1918 to 1940, and 1948 to 1992.

As has been noted in many previous studies, using the NBER reference dates for all periods leads to the conclusion that there has been a significant decline in the length of contractions and a tremendous rise in the length of expansions over time.[76] For both the pre–World War I period (1887 to 1917) and the interwar period (1918 to 1940), the average length of contractions using the NBER dates is approximately 18 months, whereas in the period after 1948, the average length of contractions is less than 11 months. For expansions, the average duration is roughly half as long for the two periods before World War II as for the postwar era.

The results are very different when one considers the new dates. For the postwar era I report estimates of duration derived from both the NBER reference dates and the dates that result from the application of my algorithm. Because the two postwar chronologies are very similar by construction, the duration measures are nearly identical. When one compares my new dates for 1887 to 1917 to either of the postwar chronologies, there is no evidence of a decline in the duration of contractions over time.[77] On the contrary, the average contraction appears to increase by roughly one month between the pre–World War I and the post–World War II eras. This result holds just as strongly when one considers the median rather than the mean contraction duration: the median contraction using the new business cycle dates lasts eight

[76] See, for example, Moore and Zarnowitz, "Development and Role"; and Diebold and Rudebusch, "Have Postwar Economic Fluctuations?"

[77] The duration estimates are very robust. Using the dates presented in Table 5, the average length of contractions in the period 1900–1918 is 9.8 months for the new dates, 12.2 months for the dates based on the Thomas index, and 13.2 months for the dates based on the undamped Miron-Romer index. All of these are substantially shorter than the average duration of 20.2 months shown by the NBER dates for the same period.

months in the pre–World War I era and nine months in the postwar period.[78]

The relative length of expansions and contractions in the pre–World War I era is also very different when the new dates are used in place of the NBER dates. Using the NBER chronology, the average expansion in the period 1887 to 1917 is only slightly longer than the average contraction. This similarity in the average length of expansions and contractions is exactly what one would expect if the early NBER turning points were derived from detrended data. Using the new dates, the average expansion in the pre–World War I era is roughly three times as long as the average contraction. This is consistent with the fact that both gross national product and standards of living increased tremendously between the 1880s and World War I.

Even using the new dates, there is evidence of an increase in the average length of expansions over time. The average expansion in the period 1887 to 1917 using the new dates is 32 months, whereas the average postwar expansion is 51 months. This is less of a change than is shown by the NBER dates, but it is still large. However, some of the long average duration of postwar expansions is due to the very long expansion in the 1960s. If one considers the median rather than the mean expansion, there is less lengthening of expansions over time: the median expansion is 31 months in the period 1887 to 1917 and 43 months in the period 1948 to 1992.

Severity

The loss measures calculated in the derivation of the new dates also change one's view of the severity of the typical recession in different eras. Table 7 shows the loss in industrial production from the absolute peak to the return to this peak for each recession in the periods 1887 to

[78] Two experiments can be used to identify the contribution of the various changes in NBER procedures to the difference between the average length of contractions implied by the early NBER chronology and by the new dates. First, to quantify the importance of the use of detrended data, I compare the absolute peaks and troughs in the log level of the prewar industrial production series with the peaks and troughs in detrended industrial production. Because many peaks and troughs are sharp rather than smooth, the turning points in these two series are often the same. But in several key cases (most notably the peaks in 1913 and 1926 and the trough in 1904), the turning points in the detrended series are much closer to the NBER reference dates than are the turning points in the raw series. A comparison of the average duration of contractions in the raw data and in the detrended industrial production series for the period 1887–1917 implies that about half of the difference in the length of contractions between the early NBER reference dates and the dates produced by the algorithm is due to the NBER's use of detrended data. Second, to measure the importance of the early NBER's procedure of using the later of multiple troughs, but not of multiple peaks, I consider the effects of choosing a later trough rather than the absolute trough in detrended industrial production if there is a plausible candidate and the NBER chose a late trough. Again, this change has a large effect in several important cases (most notably the troughs in 1888, 1897, and 1911). The experiment implies that the NBER's policy of adjusting troughs but not peaks accounts for approximately one-third of the difference in the average length of early contractions as measured by the NBER and by the algorithm. The remainder of the difference is most likely due to the early NBER's use of nominal variables, the application of subjective judgment by the NBER, and random factors.

TABLE 7
CYCLES RANKED ACCORDING TO OUTPUT LOSS

1887–1917		1918–1940		1948–1992	
Peak	Loss	Peak	Loss	Peak	Loss
1916	0.46	1939	0.65	1980	0.42
1887	0.58	1927	0.68	1960	0.92
1914	0.75	1918	0.71	1990	0.93
1900	0.80	1923	1.89	1969	0.99
1903	1.16	1937	5.79	1948	1.17
1896	1.36	1920	6.64	1953	1.20
1910	1.53	1929	31.18	1957	1.39
1893	2.60			1981	1.68
1907	3.04			1973	2.47

Notes: The loss measure shows the cumulative loss in industrial production between the absolute peak associated with each cycle and the return to peak. To facilitate comparison, however, the dates of the peaks listed are the years corresponding to the final turning points identified by the algorithm and given in Tables 2 and 3.
Sources: See the text.

1917, 1918 to 1940, and 1948 to 1992. The recessions are ordered according to severity.

Based on these measures, the mean and median loss in industrial output in recessions are very similar before and after the interwar era. For the period 1887 to 1917, the mean loss associated with a recession is 1.36, and the median loss is 1.16. For the period 1948 to 1992, the mean loss is 1.24, and the median loss is 1.17. This suggests that recessions have not, on average, become less severe over the twentieth century. In the interwar era, however, the typical loss is much higher: the mean loss associated with a recession is 6.79, and the median loss is 1.89. The difference between the mean and the median for this period is dramatic testimony to the severity of the Great Depression.

The similarity of the typical loss associated with a recession in the pre–World War I and post–World War II eras masks an important change in the distribution of the severity of recessions over time. In both the pre-1917 era and the interwar period there is a wide range of cycles, including many mild cycles and many severe cycles. In the postwar era, in contrast, most cycles fall in the moderate range. This change suggests that the distribution of cyclical severity has primarily narrowed over time, rather than shifted uniformly toward milder cycles.

This change in the distribution of cycles may affect how one views the apparent lengthening of expansions over time. Some of the greater length of postwar expansions comes from the fact that there are many mild cycles that break up expansions in the pre–World War I and interwar eras. Whereas the smallest postwar recession (1980) involved a loss of 0.42, the second smallest recession (1960) involved an output loss of 0.92. In the pre-1917 period there are four recessions with output

losses between 0.42 and 0.92, and in the interwar era there are three such contractions. The greater frequency of mild cycles causes expansions to look shorter in the pre–World War I and interwar eras than in the post–World War II era, but nearly all of this change would disappear under a more stringent definition of what counts as a cycle.[79]

Persistence

Another factor to consider when analyzing the length of expansions is the time that it takes output to recover to its previous peak level. Daniel Sichel describes this time between the trough and the return to peak as a third phase of the business cycle and argues that it indicates how rapidly the effects of a recession are undone.[80] The new dates of peaks and troughs, in conjunction with the adjusted prewar index of industrial production, show that in the pre–World War I era it took the U.S. economy an average of 7.7 months to move from the trough to the previous peak. In the postwar era the average time to recovery is 10.4 months, and in the interwar era it is 16.6 months.

The largest difference is obviously between the interwar era and both the pre–World War I and post–World War II periods. Some of this greater interwar time to recovery reflects the severity and persistence of the Great Depression. However, even the median time to recovery is substantially longer in the period 1918 to 1940 than in the decades before and after, because the recoveries from the recessions of 1921, 1924, and 1938 were all relatively slow.

The difference in the time to recovery between the pre–World War I and the post–World War II periods is 2.7 months. This suggests that the economy was somewhat more resilient before World War I than it is today. This shorter prewar time to recovery compounds the earlier finding that the average time from peak to trough is roughly one month shorter before 1917 than after 1948. These two findings taken together imply that the average time that the economy spent below the previous peak was about a third of a year shorter before World War I than after World War II. Thus, while the average loss in output is the same in the two eras, the loss was more concentrated in the pre–World War I era than today.

CONCLUSIONS

This article provides two types of evidence of inconsistency in the NBER chronology of business cycle peaks and troughs. First, an

[79] For example, eliminating all cycles with a loss of less than 0.92 from the new chronology would result in an average expansion of 52.8 months in the pre–World War I era and 59.1 months in the post–World War II era.

[80] Sichel, "Inventories."

analysis of the methods used to derive the early and modern reference dates shows that the NBER procedures for dating peaks and troughs have changed substantially over time. Most importantly, there was much more emphasis in the pre-1927 era on using detrended data and on dating troughs, but not peaks, as late as possible. Second, statistical analysis shows that an algorithm that deduces postwar turning points that are nearly identical to the NBER reference dates yields prewar turning points that differ systematically from those of the NBER. The new chronology consistently dates prewar peaks later and prewar troughs earlier than does the NBER.

Removing the inconsistencies in the NBER reference dates invalidates the usual view that recessions have become shorter over time. Using the new business cycle chronology, the length of contractions actually increases slightly between the pre–World War I and post–World War II eras. At the same time, even the consistent business cycle dates show that expansions have become substantially longer over time. The new dates and the revised index of industrial production from which they are derived also show that the average loss in output is nearly identical in pre–World War I and post–World War II contractions. However, there has been a compression of the distribution of the severity of cycles: in the pre–World War I and interwar eras there are both more mild cycles and more severe cycles than in the post–World War II period. The average time that it takes industrial production to recover from its trough to the previous peak level has also increased over time, suggesting that cycles are somewhat more persistent today than they were in the past.

Thus, the changes in recessions revealed by the new chronology do not show an obvious improvement in business cycles over time. Although the time separating contractions has become longer between the pre–World War I and postwar eras, recessions themselves have not on average become shorter, less severe, or less persistent over time. Inconsistencies in the way that the NBER reference dates have been set led researchers to mistake mere changes in dating procedures for genuine improvements in economic stability.

Appendix

To adjust the Miron-Romer index of industrial production for 1884 to 1918 to be more consistent with the modern FRB index, I run a regression between the two series over the period 1923 to 1928. I choose this limited period rather than the full period of overlap for two reasons. First, it is undesirable to use the period 1919 to 1922 because the FRB index for this period may be inconsistent with later FRB data. Therefore, a regression based on this period might not yield a prewar series consistent with the postwar series. Second, it seems wise to exclude the boom of 1929 and the Great Depression because

the FRB index may behave unusually in extreme times.[81] The 1923 to 1928 period does, however, include two recessions, so there is ample variation from which to estimate a relationship.[82]

The specification that I use regresses the log level of the FRB index (not seasonally adjusted) on a constant, a trend, 11 monthly dummy variables, the contemporaneous log level of the Miron-Romer index, and six lags and six leads of the Miron-Romer index.[83] The contemporaneous value of the Miron-Romer series is obviously included to capture the main relationship of interest. The constant and the monthly dummies are present to take into account seasonal fluctuations. The trend takes into account possible differences in the trend of the two series over the mid-1920s. The six lags and leads of the Miron-Romer index are included to allow for the possibility that the timing of the two indexes could be different at a fairly short horizon.

The results of this regression suggest that there is a very close relationship between the two industrial production series. The R^2 of the regression is .90. The sum of the coefficients on the lags and leads of the Miron-Romer index is 0.67 with a standard error of 0.10. The contemporaneous value of the Miron-Romer series, the first lead, and the second lag are the largest and most significant individual coefficients. There does not appear to be any systematic difference in timing between the FRB and the Miron-Romer indexes.

To form the adjusted Miron-Romer index for the period before World War I, I first regress the Miron-Romer index for 1884 to 1918 on a constant, a trend, and 11 monthly dummy variables and form a seasonally adjusted series by removing the effect of the monthly dummy variables. I then use the estimated coefficients from the regression for the 1920s to combine the lags and leads of this index. Because the seasonal effects are removed in a separate step, I do not use the seasonal coefficients in forming these fitted values.[84] This procedure allows for the possibility that seasonal movements may have changed between the turn of the century and the 1920s. The final prewar index of industrial production that I use merges the adjusted Miron-Romer series for 1884 to 1918 with the FRB index for 1919 to 1940. By construction, the series match up very closely in 1919.

[81] Romer, "Prewar Business Cycle," shows that even series that are traditionally quite stable became very volatile during the Great Depression.EW

[82] I have tried using other sample periods, including the full sample 1919–1940. The results are quite robust.

[83] I use the version of the Miron-Romer index that excludes wool receipts in mid-1897.

[84] I do, however, add in the constant and the trend from the 1920s regression. This essentially adjusts the pre-1918 trend by an amount equal to the usual difference between the trend of the FRB index and the trend of the Miron-Romer index in the period 1923–1928.

REFERENCES

Abramovitz, Moses, *Inventories and Business Cycles* (New York, 1950).

Axe, Emerson Wirt, and Ruth Houghton, "Financial and Business Cycles, Manufacturing Growth, and Analysis of Individual Industries, 1883–1930," *The Annalist*, 37 (Jan. 16, 1931), pp. 94–98 and 150–51.

Ayres, Leonard P., *Turning Points in Business Cycles* (New York, 1939).

Bradstreet's: A Journal of Trade, Finance and Public Economy (various issues).

Bry, Gerhard, and Charlotte Boschan, *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs* (New York, 1971).

Burns, Arthur F., ed., *Wesley Clair Mitchell: The Economic Scientist* (New York, 1952).

Burns, Arthur F., and Wesley C. Mitchell, *Measuring Business Cycles* (New York, 1946).

Cloos, George W., "How Good Are the National Bureau's Reference Dates?" *Journal of Business*, 36 (Jan. 1963), pp. 14–32.

De Long, J. Bradford, and Lawrence H. Summers, "The Changing Cyclical Variability of Economic Activity in the United States," in R. J. Gordon, ed., *The American Business Cycle* (Chicago, 1986), pp. 679–734.

Diebold, Francis X., and Glenn D. Rudebusch, "Have Postwar Economic Fluctuations Been Stabilized?" *American Economic Review*, 82 (Sept. 1992), pp. 993–1005.

Dun's Review: A Journal of Finance and Trade—Domestic and Foreign (various issues).

Fels, Rendig, *American Business Cycles, 1865–1897* (Chapel Hill, 1959).

The Financial Review (various issues).

Friedman, Milton, and Anna J. Schwartz, *A Monetary History of the United States* (Princeton, 1963).

Grossman, Richard, "The Macroeconomic Consequences of Bank Failures Under the National Banking System," *Explorations in Economic History*, 30 (July 1993), pp. 294–320.

Hultgren, Thor, *Costs, Prices, and Profits: Their Cyclical Relations* (New York, 1965).

Kuznets, Simon, "Comment on 'Historical Approach to the Analysis of Business Cycles' by Joseph A. Schumpeter," in M. Anderson, ed., *Conference on Business Cycles* (New York, 1951), pp. 155–62.

Miron, Jeffrey A., and Christina D. Romer, "A New Monthly Index of Industrial Production, 1884–1940," this JOURNAL, 50 (June 1990), pp. 321–32.

Mitchell, Wesley C., *Business Cycles*, Memoirs of the University of California (Berkeley, 1913), vol. 3.

Mitchell, Wesley C., *Business Cycles: The Problem and Its Setting* (New York, 1927).

Mitchell, Wesley C., "Testing Business Cycles," *News-Bulletin* of the NBER, No. 31 (Mar. 1, 1929), pp. 1–8.

Mitchell, Wesley C., "A Review," in *Recent Economic Changes in the United States*, Report of the Committee on Recent Economic Changes of the President's Conference on Unemployment (New York, 1929), vol. 2, pp. 841–910.

Mitchell, Wesley C., "Business Cycles," in *Encyclopedia of the Social Sciences* (New York, 1930), vol. 3, pp. 92–107.

Mitchell, Wesley C., assisted by Arthur F. Burns, A Preliminary Draft of Chapters I, II, and III of *Business Cycles, Volume II, Analysis of Cyclical Behavior* (Unpublished manuscript, circa 1937).

Moore, Geoffrey H., "What is a Recession?" in G. H. Moore, ed., *Business Cycles, Inflation, and Forecasting* (Cambridge, MA., 1983), pp. 3–9.

Moore, Geoffrey H., and Victor Zarnowitz, "The Development and Role of the National Bureau of Economic Research's Business Cycle Chronologies," in R. J. Gordon, ed., *The American Business Cycle* (Chicago, 1986), pp. 735–79.

National Bureau of Economic Research, *News-Bulletin* (various issues).

Persons, Warren M., *Forecasting Business Cycles* (New York, 1931).

Romer, Christina D., "The Prewar Business Cycle Reconsidered: New Estimates of Gross National Product, 1869–1908," *Journal of Political Economy*, 97 (Feb. 1989), pp. 1–37.

Rorty, M. C., "The Statistical Control of Business Activities," *Harvard Business Review*, 1 (Jan. 1923), pp. 154–66.

Sachs, Jeffrey, "The Changing Cyclical Behavior of Wages and Prices, 1890–1976," *American Economic Review*, 70 (Mar. 1980), pp. 78–90.