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Recessions and Recoveries

The U.S. economy entered recession in July 1990 and began to recover, many analysts believe, in April or May 1991. Since then, the economy has grown at a pace so sluggish as to be indistinguishable, in some ways, from continued recession. However, as early as spring 1991, several observers were expressing the opinion that the recovery from the 1990–91 recession would not be particularly robust because the recession itself was not particularly severe. For example, in *Business Week* in June 1991, Alan Blinder argued, "Shallow recessions are followed by weak recoveries for a simple reason: An economy that has not fallen far has little catching up to do. And catch-up is the main reason economies zoom upward in the early stages of recovery." *The Economist* magazine, in an editorial on January 18, 1992, pointed out that "there are good reasons to think that the coming expansion may be weaker than most of its predecessors," the main one being "the mildness of the recession that preceded it." Most recently, the Shadow Open Market Committee, an independent private group that critiques the actions of the Federal Reserve, argued that one of the main reasons the economy remained sluggish in 1992 was that "modest recessions are usually followed by modest recoveries" (1992, 5).

The notion that the economy experiences a "bounce-back" or "rubber-band" effect following declines in economic activity contains a certain amount of intuitive appeal but seems to have been subject to few empirical tests. The earliest study and one of the most comprehensive analyses of this issue that we have found is Moore (1961), who tried to test the view that "the strength of a recovery in its early stages depends upon the level from which it starts" (p. 86). He examined the behavior of groups of leading, coincident, and lagging indicators in the first seven months of six recoveries (the earliest being that following the trough in July 1924, the latest being that following the trough in August 1954, since revised to May 1954) and tentatively concluded that "recoveries in output, employment, and profits have usually been faster after severe depressions than after mild contractions" (p. 88). Moore (1965) contains a restatement of the finding that severe contractions tend to be followed by strong expansions, and Bry and Boschan (1971) present further evidence on this proposition, focusing on growth in nonagricultural employment.

Another of the few authors addressing this question is Milton Friedman, who asked, "Is the magnitude of an expansion related systematically to the magnitude of the succeeding contraction? Does a boom tend on the average to be followed by a large contraction? A mild expansion, by a mild contraction?" (Friedman 1969, 271). On the basis of an examination of simple rank correlation coefficients for three different measures of activity, Friedman found no relationship between the size of an expansion and the size of the succeeding contraction but did find that "a large contraction in output tends to be followed on the average by a large business expansion; a mild contraction, by a mild

We wish to thank Adrienne C. Slack and Shengyi Guo for excellent research assistance on this project. This article draws on work reported in an Economics Letters *article (Wynne and Balke 1992) and in an unpublished paper (Balke and Wynne 1992).*

expansion" (p. 273). Friedman went further, to sketch out a theory of business cycles (the "plucking model of fluctuations") that he felt was consistent with these patterns in activity, but to date his model seems to have received scant attention.

Finally, we note that Neftci (1986), in the course of addressing a slightly different question, reports results that are relevant to the recession–recovery relationship. Focusing on the behavior of pig iron production since the latter half of the nineteenth century, he finds a significant negative correlation between the length of expansions and the length of contractions: for every additional twelve months of expansion, the economy experiences 1.8 fewer months of contraction. However, the length of contractions does not affect the length of subsequent expansions. Furthermore, he shows that there is a significant relationship between the peak-to-trough decline in output and the increase over the course of the subsequent expansion but none between the gains in output over the expansion and the losses over the subsequent contraction.

In this article, we will study the behavior of output during and immediately after recessions to see whether there is any validity to the notion of a bounce-back effect.[1] Our analysis differs from that of Moore, Friedman, and Neftci in a number of ways. First, we focus on the behavior of industrial production rather than look at a variety of indicators. The reason is that we can obtain reasonably consistent estimates of industrial production for long periods, allowing us to look at recoveries from a large number of recessions. Second, we estimate a simple linear regression model rather than look at simple correlations, which enables us to discriminate between the effects of different measures of the severity of the preceding recession. The two measures of severity we focus on here are the depth of the recession, as measured by the output loss from the peak date to the trough date, and the length of the recession, as measured by the number of months from the peak date to the trough date. Third, we look at a larger number of recessions and recoveries than does either Moore or Friedman, including a number of pre–World War I business cycles. Each recession will be viewed as an independent event, and we will look for regularities common to the 23 recessions and recoveries that the United States has experienced over the past hundred years. Fourth, we only look at output growth in the early stages of an expansion (either the first six months or the first twelve months) and see how growth over this horizon is influenced by the severity of the preceding recession. This contrasts with Friedman's and Neftci's examination of the relationship between growth over the entire expansion and the severity of the preceding recession.

The article begins with a brief discussion of how the National Bureau of Economic Research (NBER) determines the dates of the peaks and troughs in economic activity that give the business cycle its name. We then specify a simple empirical model for testing hypotheses about the relationship between recessions and expansions. We document the existence of a significant bounce-back effect in various measures of U.S. industrial production and show that this finding is robust to a variety of potential criticisms. Having established the existence of a bounce-back effect, we provide some intuition about the economic forces behind it. We then consider the behavior of the economy during the recovery from the 1990–91 recession and show that it is consistent with the bounce-back effect.

The U.S. experience with recessions

The NBER is responsible for the dating of the peaks and troughs in economic activity that mark the onset of recessions and expansions.[2] The dating of business cycles by the NBER is based on a definition of business cycles first formulated by Wesley Clair Mitchell in 1927:

[1] *Sichel (1992) also talks about a bounce-back effect following recessions in reference to a high-growth recovery phase at the beginning of an expansion but does not look at the relationship between the rate of growth during the recovery phase and output losses during the recession. He does, however, examine the predictive power of an output-gap variable for GNP growth, where the output-gap variable is defined as the deviation of GNP (gross national product) from its preceding peak value.*

[2] *Interested readers are referred to Moore and Zarnowitz (1986) for a detailed discussion of how the NBER dates business cycles. The discussion here is a very brief summary of their article.*

> Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; the sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own (Moore and Zarnowitz 1986, 736).

Note that the definition refers to fluctuations in "aggregate economic activity" rather than a more precisely defined aggregate, such as gross national product (GNP), industrial production, or total employment. This vagueness is intentional and recognizes that business cycles consist of movements in many different series that are not readily reduced to a single aggregate. Looking at a variety of series also helps minimize the risk of drawing erroneous conclusions based on mismeasurement. Finally, under the NBER definition, a period of slow, or "subpar," growth does not qualify as a contraction. Rather, peaks in activity are followed by periods of absolute decline in aggregate activity.[3]

A recession is defined as a peak-to-trough movement in economic activity. According to the NBER business-cycle chronology, the United States has experienced 30 recessions since the middle of the nineteenth century (see Burns and Mitchell 1946, Table 16; Moore and Zarnowitz 1986, Tables A.3, A.5). The dates of the peaks and troughs in U.S. economic activity chosen by the NBER are given in Table 1, along with statistics on the duration of expansions and contractions for the entire period. The chronology ends with the date of the most recent peak, July 1990.

At the time of our analysis (October 1992), the date of the trough marking the end of the most recent recession had not been announced officially, but several observers (including Moore 1992) have placed it in April or May 1991.[4] Addi-tional clues to the likely date of the most recent trough can be obtained from examining the recent behavior of the U.S. Commerce Department's composite index of coincident indicators. This index is explicitly designed to approximate cyclical movements in economic activity and to have turning points that match the business cycle. The coincident index peaked most recently in June 1990, just one month before the official peak in July, and seemed to hit a trough in January 1992. However, revisions to the index currently being undertaken by the Commerce Department and discussed in Green and Beckman (1992) move the trough in the index back to March 1991.

From the table we can see that the United States has experienced nine recessions since the end of World War II. This is a rather small sample for testing the idea that severe recessions tend to be followed by strong recoveries, so it is important to include pre–World War II recessions in our sample to be reasonably confident of our findings.[5] However, extending the statistical analysis to the pre–World War II period leads to problems of data availability and consistency. Furthermore, because the NBER chronology dates business-cycle peaks and troughs by month, a monthly indicator of economic activity is preferable for examining the hypothesis that deep recessions are followed by strong recoveries.

The requirement that the selected measure of aggregate economic activity be available at a monthly frequency and extend back to the prewar period leads us to use industrial production, as measured by the Federal Reserve Board's index of industrial production.[6] This index has the advan-

[3] This is not true, however, of "growth cycle" chronologies.

[4] See Hall (1992) for a discussion of the problem of determining the date of troughs in economic activity.

[5] Alternatively, we could look at the experience of other countries in the postwar period. Thus, in Balke and Wynne (1992), we look for a bounce-back effect in the Group of Seven countries during the postwar period, using the NBER's "growth cycle" chronology for these countries.

[6] Moore (1961, 88) notes that the relationship between the severity of a recession and the strength of the subsequent recovery is strongest for industrial production.

Table 1
NBER Business-Cycle Chronology for United States

Peak	Trough	Duration (Months) Contraction	Duration (Months) Expansion
June 1857	December 1858	18	22
October 1860	June 1861	8	46
April 1865	December 1867	32	18
June 1869	December 1870	18	34
October 1873	March 1879	65	36
March 1882	May 1885	38	22
March 1887	April 1888	13	27
July 1890	May 1891	10	20
January 1893	June 1894	17	18
December 1895	June 1897	18	24
June 1899	December 1900	18	21
September 1902	August 1904	23	33
May 1907	June 1908	13	19
January 1910	January 1912	24	12
January 1913	December 1914	23	44
August 1918	March 1919	7	10
January 1920	July 1921	18	22
May 1923	July 1924	14	27
October 1926	November 1927	13	21
August 1929	March 1933	43	50
May 1937	June 1938	13	80
February 1945	October 1945	8	37
November 1948	October 1949	11	45
July 1953	May 1954	10	39
August 1957	April 1958	8	24
April 1960	February 1961	10	106
December 1969	November 1970	11	36
November 1973	March 1975	16	58
January 1980	July 1980	6	12
July 1981	November 1982	16	92
July 1990	n.a.	n.a.	n.a.

Comparative statistics

	Average length of contractions	Average length of expansions
Pre–World War II	21.2	28.9
Post–World War II	10.7	49.9

n.a.—Not available.

NOTE: Length of contraction is the number of months from peak to trough.
Length of expansion is the length of the expansion after the trough date.

SOURCE: Moore and Zarnowitz (1986), Tables A.3, A.5.

tage of extending back to 1919, thus adding to the sample of recessions. The obvious drawback is that industrial production is an incomplete indicator of aggregate economic activity: industrial production currently accounts for only about one-fifth of total output. Looking at a broader measure of output, such as GNP, would probably be better; however, GNP estimates are available only on a quarterly basis and only as far back as 1947. On the other hand, movements in GNP and industrial production are highly correlated, with correlations of 0.998 using annual data and 0.964 using quarterly data.[7] Also, industrial production is a component of the index of coincident indicators, which is explicitly designed to have turning points that are the same as those of the business cycle.

Is there a bounce-back effect?

A useful first pass at answering the question of whether severe recessions are followed by strong recoveries is, simply, to plot the data. Figure 1 presents a scatter plot of the percentage change in output in each of the 14 recessions since 1919 (except the 1990–91 recession) against output growth in the first twelve months of the subsequent expansion, using the NBER business-cycle dates. A 135-degree line is included for reference. The scatter of points in Figure 1 certainly suggests the existence of some degree of correlation between the decline in industrial production over the course of a recession and growth in the first twelve months of an expansion. Obviously, the Great Depression (August 1929–March 1933) is very influential in suggesting the existence of a self-correcting mechanism, but it is clear that more is going on.[8]

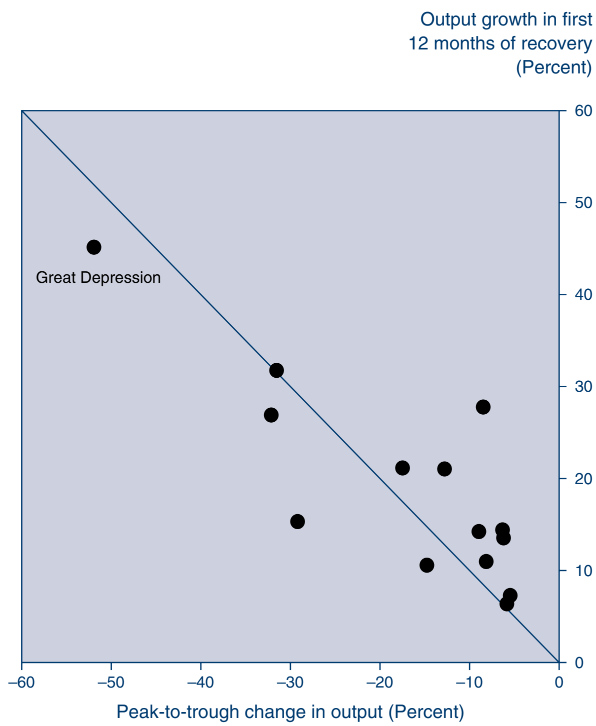
This simple ocular analysis of the data suggests that there is a correlation between the peak-to-trough decline in output over the course of recession and growth in the early stages of the subsequent recovery. Let us now turn to testing and quantifying the strength of this correlation.

Empirical analysis

Our strategy for testing for the existence of a bounce-back effect was to estimate a simple linear regression model of the form

Figure 1
Peak-to-Trough Change in Output and Output Growth, as Measured by Industrial Production

(NBER Business-Cycle Dates)



SOURCES OF PRIMARY DATA:
Board of Governors, Federal Reserve System.
Moore and Zarnowitz (1986).

[7] *Correlations were calculated using annual data for 1929–90 and quarterly data for 1947–90.*

[8] *The recovery from the Great Depression of 1929–33 has recently been examined in some detail by Romer (1991). The specific question she addresses is, What proportion of the extraordinary rates of real GNP growth observed in the mid-1930s and late 1930s can be attributed to the severity of the downturn, and what proportion can be attributed to monetary and fiscal stimuli to aggregate demand? She finds that stimulative monetary policy in the form of unsterilized gold inflows played a key role in the recovery, and she concludes that her findings suggest that "any self-corrective response of the U.S. economy to low output was weak or non-existent in the 1930s" (p. 1). The role of activist fiscal and monetary policy in generating vigorous recoveries is an issue we do not address directly in this article.*

Table 2
Rate of Growth During First Twelve Months of Recovery

	Constant	Change from peak to trough	Length of recession	$\bar{R}^2$
Industrial production	8.24**	–.63***	—	.64
	(2.79)	(.13)		
	6.27	–.47**	.34	.65
	(3.25)	(.19)	(.30)	
Manufacturing	9.13**	–.62***	—	.58
	(3.35)	(.14)		
	5.19	–.35*	.63*	.66
	(3.58)	(.19)	(.31)	
Durables manufacturing	–.69	–1.31***	—	.68
	(8.22)	(.24)		
	–10.50	–.83**	1.61**	.77
	(8.24)	(.29)	(.70)	
Nondurables manufacturing	9.00***	–.42***	—	.59
	(1.16)	(.10)		
	6.90***	–.24*	.26*	.66
	(1.51)	(.13)	(.13)	

* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

NOTE: All data were seasonally adjusted. The sample period is January 1919–December 1991, which includes 14 recessions, not counting the 1990–91 recession. Peak and trough dates are from the official NBER business-cycle chronology. The dependent variable is the rate of growth during the first twelve months of recovery (defined as trough to trough plus twelve months).
Figures in parentheses are standard errors.

$$(1)\quad \left(\frac{Y_{T+12}-Y_T}{Y_T}\right)_i = \alpha_0 + \alpha_1\left(\frac{Y_T - Y_P}{Y_P}\right)_i + \alpha_2(T-P)_i + \epsilon_i,$$

where Y is some measure of output, T denotes the month of a business-cycle trough as determined by some business-cycle chronology, P denotes the month of a business-cycle peak, i indexes recessions, and ϵ is an error term.[9] The dependent variable is the percentage increase in output in the twelve months after the trough month.[10] The explanatory variables, apart from the constant, are the peak-to-trough change in output in percentage terms and the length of the recession in months.

[9] *In Balke and Wynne (1992), we estimate a slightly different model that allows us to distinguish between three measures of the severity of a recession—length, depth, and steepness. Moore (1961, 86) notes that recessions have at least three dimensions—"depth, duration, and diffusion." We do not consider diffusion as a measure of severity in this article, primarily because of the degrees-of-freedom problem.*

[10] *Looking at growth beyond twelve months is complicated by the fact that for three of the recessions in our sample, the subsequent expansion lasted twelve months or less.*

Table 3

Rate of Growth During First Twelve Months of Recovery, Excluding the Great Depression

	Constant	Change from peak to trough	Length of recession	$\bar{R}^2$
Industrial production	9.72**	–.51**	—	.35
	(3.22)	(.19)		
	6.26	–.47**	.34	.31
	(6.73)	(.20)	(.57)	
Manufacturing	11.51**	–.43**	—	.25
	(3.64)	(.19)		
	2.99	–.36*	.81	.30
	(7.39)	(.19)	(.62)	
Durables manufacturing	5.52	–.97***	—	.43
	(8.62)	(.31)		
	–16.19	–.84**	2.09	.48
	(16.88)	(.31)	(1.42)	
Nondurables manufacturing	9.61***	–.28**	—	.29
	(1.12)	(.12)		
	7.69	–.24	.19	.25
	(3.09)	(.14)	(.28)	

* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

NOTE: All data were seasonally adjusted. The sample period is January 1919–December 1991, which includes 14 recessions, not counting the 1990–91 recession. Peak and trough dates are from the official NBER business-cycle chronology. The dependent variable is the rate of growth during the first twelve months of recovery (defined as trough to trough plus twelve months).
Figures in parentheses are standard errors.

If deep recessions are followed by strong recoveries, the estimate of α_1 should be negative. If long recessions are followed by strong recoveries, the estimate of α_2 should be positive.

Table 2 reports estimates of this model using the Federal Reserve's industrial production index and its three principal components—total manufacturing, durables manufacturing, and nondurables manufacturing. Results are reported both with and without the length-of-recession variable on the right-hand side. The sample includes 14 recessions, starting with the January 1920–July 1921 recession and ending with the July 1981–November 1982 recession, as determined by the NBER business-cycle chronology. For each production category, there is a statistically significant relationship between the size of the peak-to-trough decline and growth in the twelve months after the trough. The size of the bounce-back effect is strongest for durables manufacturing. Recession length makes no difference to the strength of the recovery in total industrial production but does seem to be important for manufacturing. Within manufacturing, recovery in the durable goods sector seems to be more affected by the length of the recession than is the recovery in the nondurables sector. For all sectors, including the length of the recession as an additional variable on the right-hand side lessens the bounce-back effect but does not eliminate it.

Because the sample period includes the Great Depression, one of the most severe contractions ever in U.S. economic activity, the results in Table 2 may be overly influenced by this extraordinary event. Table 3 reports results from estimation of equation 1 when the Great Depression is excluded from the sample. As might be expected, there is some loss of statistical significance, but the results are broadly similar to those in Table 2. The length of the recession is no longer significant in explaining growth during the first twelve months of recovery. This is not too surprising, because the Great Depression, with forty-three months from peak to trough, is by far the longest recession in the period covered by our analysis.[11]

How robust are the results?

How robust are our findings of a bounce-back effect? We have already examined the sensitivity of the findings to the inclusion of the Great Depression in the sample and have seen that the results are not sensitive to its exclusion. In this section, we will consider the robustness of our results to a variety of other potential criticisms. First, we will consider growth over horizons other than the twelve months after the trough date. Specifically, we will consider whether growth in the first six months of an expansion is also significantly related to the severity of the preceding recession. Second, we will increase the number of recessions we look at by examining the behavior of an alternative industrial production index constructed by Miron and Romer (1990) that covers the period 1884–1940. We also consider the behavior of this index when it is spliced to the Federal Reserve production index in 1919. Finally, we consider the sensitivity of our results to use of the official NBER chronology by looking at the dates suggested by Romer (1992) and the dates obtained using the algorithm developed by Bry and Boschan (1971).

The bounce-back effect at the six-month horizon. To examine whether the bounce-back effect can be found at the six-month horizon as well, we estimated an obvious variant on equation 1, redefining the dependent variable to be growth in the first six months after the trough. The results are reported in Table 4. We only report the results obtained when length of recession is not included in the model, as the significance of this variable seems to hinge completely on including the Great Depression in the sample. Growth in the first six months of the recovery is significantly correlated with the peak-to-trough change in activity, but excluding the Great Depression from the sample seems to reduce the strength of the correlation a lot more than we find for growth over the twelve-month horizon.

The bounce-back effect in the Miron–Romer industrial production series. It is possible to extend the sample period further to include the period before World War I by using the industrial production index recently constructed by Miron and Romer (1990). Their index covers the period 1884–1940, overlapping with the Federal Reserve index for twenty-one years, from 1919 to 1940. This period of overlap includes five recessions. The Miron–Romer index was designed to improve upon the older Babson and Persons indexes, which made heavy use of indirect proxies for industrial activity (such as imports and exports in the case of the Babson index and bank clearings in the case of the Persons index). Miron and Romer note that their series has turning points (that is, peaks and troughs) that are "grossly similar to but subtly different from existing series" (p. 321).

The Miron–Romer index is less comprehensive than the Federal Reserve index and, according to the NBER chronology, produces two anomalous observations. Specifically, the Miron–Romer index shows industrial production *increasing* in two of the pre–World War I recessions, the recessions of December 1895–June 1897 and September 1902–August 1904. This finding can be interpreted as a drawback of the series or as suggesting a need to reconsider the dating of pre–World War I business cycles by using the improved index.

[11] The Great Depression is not, however, the longest recession in the NBER chronology. The longest U.S. recession on record was from October 1873 to March 1879, lasting sixty-five months. This recession is not included in our analysis because reliable measures of aggregate production at the required frequency are not available that far back.

Table 4
Rate of Growth During First Six Months of Recovery

	Constant	Change from peak to trough	$\bar{R}^2$
Including the Great Depression			
Industrial production	.39	–.63***	.62
	(3.11)	(.14)	
Manufacturing	.71	–.65***	.61
	(3.51)	(.15)	
Durables manufacturing	–7.90	–1.08***	.61
	(8.45)	(.25)	
Nondurables manufacturing	2.68**	–.68***	.81
	(1.15)	(.10)	
Excluding the Great Depression			
Industrial production	4.12	–.32*	.25
	(2.94)	(.17)	
Manufacturing	4.82	–.32*	.25
	(3.17)	(.17)	
Durables manufacturing	3.91	–.44*	.29
	(5.78)	(.21)	
Nondurables manufacturing	3.48***	–.49***	.67
	(.99)	(.11)	

* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

NOTE: All data were seasonally adjusted. The sample period is January 1919–December 1991, which includes 14 recessions, not counting the 1990–91 recession. Peak and trough dates are from the official NBER business-cycle chronology. The dependent variable is the rate of growth during the first six months of recovery (defined as trough to trough plus six months). Figures in parentheses are standard errors.

The results from estimating the model by using the Miron–Romer index are reported in Table 5. The first four rows of this table report the results obtained using the raw (not seasonally adjusted) series. Again, we find evidence of a significant bounce-back effect in industrial production. The inclusion of recession length as an additional explanatory variable makes no difference to this finding, nor does excluding the Great Depression. Table 5 also reports the results of combining the Federal Reserve and Miron–Romer indexes (seasonally adjusted). We followed Romer (1992) in splicing the two series in 1919 to obtain a single series on industrial production for the period 1884–1990. This gives us a sample of 24 recessions for examining the bounce-back effect. The principal difference between these results and those in Tables 3 and 4 is that length of recession is no longer significant in

Table 5
Rate of Growth During First Twelve Months of Recovery: Results Using the Miron–Romer Index

	Constant	Change from peak to trough	Length of recession	$\bar{R}^2$	Number of recessions
		Miron–Romer Index			
Including the Great Depression	12.48** (4.80)	–.79*** (.20)	—	.50	15
	9.39 (9.86)	–.76*** (.23)	.20 (.55)	.47	15
Excluding the Great Depression	12.42** (5.00)	–.82*** (.24)	—	.45	14
	.16 (15.03)	–.82*** (.24)	.77 (.89)	.44	14
		Combined Federal Reserve/Miron–Romer Index			
Including the Great Depression	9.62*** (2.17)	–.65*** (.12)	—	.54	24
	6.10 (3.71)	–.60*** (.13)	.27 (.23)	.55	24
Excluding the Great Depression	9.94*** (2.30)	–.60** (.16)	—	.38	23
	3.99 (5.73)	–.64*** (.16)	.40 (.35)	.39	23

* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

NOTE: Peak and trough dates are from the official NBER business-cycle chronology. The dependent variable is the rate of growth during the first twelve months of recovery (defined as trough to trough plus twelve months).
Estimates in the first four rows were obtained using the non-seasonally-adjusted Miron–Romer index. The sample period is January 1884–December 1940, which includes 15 recessions. Estimates in the second four rows were obtained using the combined Federal Reserve/Miron–Romer series, which is seasonally adjusted, not counting the 1990–91 recession. The sample period is January 1884–December 1991, which includes 24 recessions.
Figures in parentheses are standard errors.

explaining the strength of the recovery, even when the Great Depression is included in the sample.

The bounce-back effect in alternative business-cycle chronologies. Romer (1992) has questioned whether the dates for the prewar cycles in the official NBER chronology are strictly comparable to those for the postwar period. Romer documents evidence that the prewar dates are based on detrended data while the postwar dates reflect cycles in unadjusted data. Consequently, the prewar NBER chronology tends to overstate the length of contractions and understate the length of expansions. Romer corrects the NBER chronology by formalizing the rule that the NBER used in dating the postwar cycles and applying it to industrial production for the prewar period to come up

Table 6
Alternative Prewar Business-Cycle Chronologies

NBER dates		Romer dates		Bry–Boschan dates	
Peak	Trough	Peak	Trough	Peak	Trough
March 1887	April 1888	February 1887	July 1887	—	—
July 1890	May 1891	—	—	November 1891	September 1893
January 1893	June 1894	January 1893	April 1894	—	—
December 1895	June 1897	December 1895	January 1897	October 1895	August 1896
—	—	—	—	April 1897	June 1898
June 1899	December 1900	April 1900	December 1900	April 1900	October 1900
—	—	—	—	August 1901	June 1902
September 1902	August 1904	July 1903	March 1904	—	—
May 1907	June 1908	July 1907	June 1908	—	—
January 1910	January 1912	January 1910	May 1911	February 1910	December 1910
January 1913	December 1914	June 1914	November 1914	December 1912	January 1914
—	—	May 1916	January 1917	—	—
August 1918	March 1919	July 1918	March 1919	May 1918	March 1919
January 1920	July 1921	January 1920	July 1921	January 1920	March 1921
May 1923	July 1924	May 1923	July 1924	May 1923	June 1924
October 1926	November 1927	March 1927	December 1927	March 1927	December 1927
August 1929	March 1933	September 1929	July 1932	May 1929	July 1932
May 1937	June 1938	August 1937	June 1938	May 1937	June 1938
—	—	December 1939	March 1940	—	—

SOURCES: Moore and Zarnowitz (1986), Tables A.3, A.5.
Romer (1992), Table 3.
Authors' calculations.

with an alternative set of dates.[12] These dates are shown in Table 6. One key difference with the official NBER dates (reproduced in Table 6 for ease of comparison) is that the average length of pre–World War II contractions is shorter (11.4 months, as opposed to 17.8 months in the NBER chronology), and the average length of pre–World War II expansions is longer (30.3 months, as opposed to 24.9 months in the NBER chronology).[13] The two chronologies are in agreement for only two reces-

[12] *This rule is explained in the Appendix.*

[13] *Note that these statistics compare the average length of contractions and expansions during the period for which the two chronologies overlap. The statistics on the average length of prewar contractions and expansions reported in Table 1 are the averages over* all *contractions and expansions in the NBER chronology for the prewar period.*

sions, those of 1920–21 and 1923–24. They are also in agreement on either the peak or the trough dates for a number of other recessions. Finally, note that Romer's chronology excludes one recession that is included in the NBER chronology, the 1890–91 recession, while including two others that are omitted from the NBER chronology, those in 1916–17 and 1939–40. One other noteworthy feature of Romer's chronology is that she dates the trough of the Great Depression in July 1932, which shortens the length of that downturn from forty-three months to thirty-four months.

Table 6 also contains business-cycle dates obtained from application of the algorithm devised by Bry and Boschan (1971) to industrial production for the entire period.[14] The Bry–Boschan algorithm is somewhat more complex than the rule devised by Romer and picks slightly different cycles from those picked by Romer and those in the official NBER chronology. The Bry–Boschan algorithm picks two cycles (1897–98 and 1901–2) that are not included in the NBER chronology and misses four (1887, 1893–94, 1903–4, and 1907–8) that are. The Bry–Boschan algorithm also misses the 1916–17 and 1939–40 cycles, two cycles picked by the Romer algorithm but not included in the NBER chronology. The algorithm does capture some of the same peak and trough dates as the Romer algorithm and the NBER chronology. Interestingly, the Bry–Boschan algorithm places the trough of the Great Depression in July 1932 (the same as Romer) but dates its onset in May 1929, four months earlier than Romer and three months earlier than the NBER.

Table 7 reports the results of estimating equation 1 with the Romer and Bry–Boschan business-cycle dates. For consistency, we used the dates picked by these algorithms for the postwar period as well, rather than the NBER dates. The differences between the three chronologies for the postwar period are minor, as both the Romer and Bry–Boschan algorithms are designed to match as closely as possible the NBER dating for this period. Both chronologies suggest a statistically significant bounce-back effect. In every case, the coefficient estimate on the change in output from peak to trough is significant at the 1-percent level. The length of the recession is not significant in either chronology, even when the Great Depression is included. Excluding the Great Depression does significantly lower the explanatory power of the basic model, as indicated by the drop in the $\bar{R}^2$, and the size of the bounce-back effect, as indicated by the drop in the absolute value of the coefficient estimate, but does not eliminate it.

To summarize, our finding of a bounce-back effect in industrial production is common to a variety of measures of industrial production, is found at the six-month as well as the twelve-month horizon, and is robust to potential shortcomings in the NBER chronology for the prewar period. Some other robustness tests (such as controlling for secular trend) are reported in Balke and Wynne (1992) and reinforce those reported here. The robustness of the bounce-back effect merits taking it seriously as a stylized fact about the business cycle.

The economics of the bounce-back effect

Having established the existence of a bounce-back effect, we should provide an economic interpretation of what is going on. We argue that the bounce-back effect tells us more about the dynamic response of the economy to shocks than about the nature or source of shocks themselves. Three simple observations about the behavior of firms and households help in understanding macroeconomic dynamics. First, households and firms not only look at current economic conditions when deciding how much to work, save, consume, and invest but also take into consideration the likely course of economic activity in the future. Second, households prefer continuity in their consumption patterns from year to year, rather than wild movements. And third, saving and investment decisions made today have implications for what can be done tomorrow through their effect on capital accumulation, just as decisions made yesterday have implications for what can be done today. The bounce-back effect is a manifestation of the dynamic response of the economy, as a result of these three factors, to a shock that brings about a recession.

One interpretation of what happens when the economy goes into recession is that the maximum level of output that can be attained with

[14] *The Bry–Boschan algorithm is described briefly in the Appendix.*

Table 7
Results Using Alternative Business-Cycle Chronologies

	Constant	Change from peak to trough	Length of recession	$\bar{R}^2$	Number of recessions
		Romer Dating			
Including the Great Depression	7.01* (3.60)	–.90*** (.18)	–.03 (.33)	.59	25
	6.81** (2.53)	–.89*** (.14)	—	.61	25
Excluding the Great Depression	12.55** (4.60)	–.73*** (.20)	–.40 (.38)	.35	24
	8.67*** (2.78)	–.70*** (.19)	—	.34	24
		Bry–Boschan Dating			
Including the Great Depression	–1.09 (3.60)	–.71*** (.18)	.46 (.33)	.71	21
	2.05 (2.89)	–.90*** (.13)	—	.69	21
Excluding the Great Depression	8.69* (4.90)	–.60*** (.17)	–.17 (.37)	.38	20
	6.93** (2.87)	–.57*** (.15)	—	.41	20

* Significant at the 10-percent level.
** Significant at the 5-percent level.
*** Significant at the 1-percent level.

NOTE: All data were seasonally adjusted. The sample period is January 1884–December 1991, which includes 25 recessions in the Romer chronology and 21 recessions in the Bry–Boschan chronology. The dependent variable is the rate of growth during the first twelve months of recovery (defined as trough to trough plus twelve months).
Figures in parentheses are standard errors.

existing resources of capital and labor temporarily falls. Such a change might come about, for example, as a result of a temporary increase in oil prices. This is the type of shock typically emphasized in New Classical real business cycle models. Or alternatively, a coordination failure results in productive resources becoming idle and output falling below potential. This story is more characteristic of New Keynesian analyses of the causes of recessions. During the period of lower output, households try to maintain their consumption levels by saving less. Part of this behavior translates into less investment by businesses and reduced purchases of consumer durables by households. The result of these spending decisions of households and firms is that when the economy hits the trough, stocks of business capital and household capital are below their "normal," or desired long-run, levels. This discrepancy between actual and normal levels of capital is then associated with an investment boom and an increase in purchases of consumer durables when the economy turns the corner. In some cases, the discrepancy in and of itself can be enough to bring a recession to an end and set the expansion in motion. The larger the discrepancy between actual and normal capital stocks at the trough, the faster the economy will grow in the months after the trough because of the greater amount of ground that has to be regained.

This explanation merely touches on some of the key elements of the more fully articulated theories essential for a complete understanding of the business cycle. In Balke and Wynne (1992), we carry out a detailed analysis of a prototypical real business cycle model and find that it performs reasonably well in generating the bounce-back phenomenon but does not capture other features of the business cycle.

Examination of the 1991–92 recovery

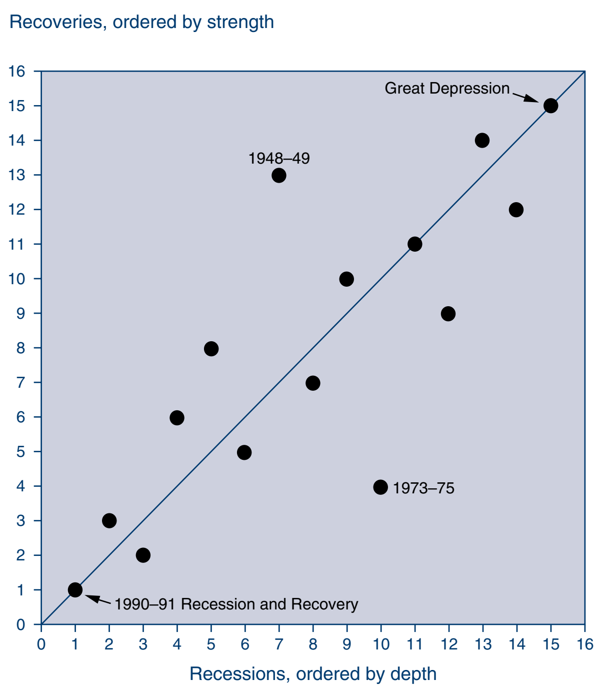
The most recent business-cycle peak was in July 1990. If we date the trough of this cycle as May 1991, as many analysts are doing (although the official trough date has yet to be announced by the NBER), the peak-to-trough decline in industrial production amounts to 3.6 percent. Industrial production bottomed out in March 1991, after declining 5.0 percent since July 1990. This compares favorably with either the average decline of 17.1 percent for all the recessions covered by the Federal Reserve's index of industrial production or the average decline of 8.8 percent for the post–World War II recessions. Based on our estimates in Table 2, we would expect industrial production to have grown 10.5 percent—8.24 – (0.63)(–3.6)—from the tentative trough date in May 1991 through May 1992. In fact, industrial production grew only 2.3 percent over this period, substantially less than the rate predicted by our simple model. If we take the actual peaks and troughs in industrial production, the decline from September 1990 to March 1991 is 5.2 percent, and predicted cumulative growth in industrial production from March 1991 to March 1992 is 11.5 percent—8.24 – (0.63)(–5.2)—as opposed to a realized rate of 2.5 percent. Thus, our bounce-back equation dramatically overpredicts the strength of the recovery, suggesting that the present recovery is abnormally slow, even after taking into account the shallowness of the recession.

However, because of the historical variability of the growth rate of industrial production during recoveries, the current recovery is still well within the 95-percent confidence interval implied by the bounce-back model. For the forecast growth rate over the twelve months since May 1991, the standard error associated with the forecast is 6.9 percentage points. This means that based on the coefficient estimates in Table 2, the 95-percent confidence interval associated with the forecast value of the growth rate of industrial production from May 1991 to May 1992 is 10.5 ± (1.96)(6.9)—that is, from –3.0 percent to 24.0 percent. Thus, the current recovery, while substantially weaker than predicted, is nonetheless consistent with the bounce-back model.

An alternative perspective on how this recovery compares with others is given in Figure 2. This figure is a scatter plot of the peak-to-trough decline in industrial production over the course of recession against growth in the first twelve months of the recovery, with the recessions and recoveries now ranked in order of severity and strength. Thus,

Figure 2
Rank Ordering of Recessions and Recoveries, as Measured by Industrial Production

(NBER Business-Cycle Dates)



SOURCES OF PRIMARY DATA:
Board of Governors, Federal Reserve System.
Moore and Zarnowitz (1986).

the horizontal axis ranks recessions in order of severity, with 1 being the least severe and 15 being the most severe. The vertical axis ranks recoveries in terms of their strength, with 1 being the least strong and 15 being the most strong. That the points are clustered around the 45-degree line is simply another way of demonstrating the bounce-back effect: typically, severe recessions are followed by strong recoveries. As we saw in Figure 1, the most severe recession in the sample covered by the Federal Reserve's industrial production index, the Great Depression, was also followed by the most robust recovery in that sample. What we see from Figure 2 is that the 1990–91 recession was the least severe since 1919 in terms of the decline in industrial production and, also, the recovery in the twelve months since the tentative trough date of May 1991 is the weakest since 1919. In other words, the behavior of the industrial sector in the most recent recession and recovery episode is very much in line with historical experience.

It cannot be emphasized strongly enough that this article focuses on the behavior of the industrial sector in recessions and recoveries. In terms of broader measures of aggregate activity, such as total nonagricultural employment or GNP, the picture is somewhat different. While the most recent recession may have been one of the least severe in U.S. history in terms of the decline in industrial production, it is close to the postwar average in terms of the decline in GNP. As for the recovery, GNP growth over the year since the tentative trough date of May 1991 is the weakest in the postwar period. Moreover, while the decline in manufacturing employment between July 1990 and May 1991 was the smallest in the postwar period, the twelve-month period after May 1991 is the only postwar "recovery" in which manufacturing employment declined. Outside the manufacturing sector, service-sector employment posted its weakest increase of any postwar recession except the 1957–58 recession—the only postwar recession in which service-sector employment declined. In the twelve months since May 1991, service-sector employment has grown less than in any other postwar recovery.

The 1990–91 recession and recovery episode generated many puzzles for policymakers that are not yet fully understood. With the passage of time, our understanding of what happened will grow. The sluggish pace of the overall recovery remains a puzzle, but the relatively modest growth in industrial output is consistent with the bounce-back effect that we have shown to be characteristic of previous recessions.

Conclusions

In this article, we have examined how rapidly industrial production recovers in the twelve months after a business-cycle trough. We considered two variables as candidates to explain differences in growth rates between recoveries—the depth and the length of the preceding recession. We found a statistically significant relationship between the rate of growth of output in the twelve months after a business-cycle trough and the size of the decline in output from peak to trough. Furthermore, the bounce-back effect appears to be stronger in durables manufacturing than in nondurables manufacturing. The existence of this bounce-back effect does not depend on including the Great Depression in our sample. However, the length of the recession makes a difference for the strength of the subsequent recovery only if the recovery following the Great Depression is included in the sample.

In Balke and Wynne (1992), we have examined the bounce-back effect in greater detail and have shown that a similar phenomenon seems to characterize the behavior of the Group of Seven countries in the postwar period. In that paper, we also look at the "shape" of cyclical movements in various aggregates and document significant asymmetries between expansions and contractions. In addition, we explore the implications of these findings for some common (linear) statistical and economic models of industrial output.

Given the relative robustness of our finding of a bounce-back effect for the industrial sector, it is important to ask whether the effect characterizes the 1990–91 recession and recovery. If we take May 1991 as the trough date marking the end of the most recent recession, the decline in industrial output from peak to trough was 3.6 percent, making it one of the mildest recessions in terms of lost industrial production. And consistent with the bounce-back effect, the growth in industrial production since May 1991 has been the weakest recovery in the period covered by the Federal Reserve index of industrial production.

Appendix

Rules for Dating Business Cycles

Romer's rules for dating cycles by using industrial production

1. A fluctuation counts as a cycle if the cumulative loss in the log of output between the peak and the return to peak exceeds 0.44—that is, 44 percentage-point months of output.
2. The second or later of multiple extremes is chosen as the turning point if the cumulative loss or gain in output is less than 0.11.
3. The first month after a peak or trough counts as a horizontal stretch if the cumulative loss or gain in output is less than 0.008.

The Bry–Boschan algorithm for picking turning points in a time series

1. Eliminate extreme values of raw series (greater than ± 3.5 standard deviations) and replace by values from a Spencer curve. A Spencer curve is a symmetric filter with declining weights.
2. Calculate a twelve-month moving average with the adjusted series. Find the local maximums and minimums. Use dates as tentative peak and trough dates, being sure that peaks and troughs alternate.
3. Calculate a Spencer curve with the adjusted series. Find the highest (lowest) values of Spencer curves within five months of the peaks (troughs) identified from the twelve-month moving average. Be sure that the new peak and trough dates alternate and that cycle duration is at least fifteen months.
4. Calculate a four-month moving average with the adjusted series. Identify the highest (lowest) values within five months of the peaks (troughs) identified from the Spencer curve. Be sure that the peak and trough dates alternate and that cycle duration is at least fifteen months.
5. Using the raw series, adjusted for extremes, find the highest (lowest) values within four months of the peaks (troughs) identified from the four-month moving average. Be sure that no peak or trough is within six months of the beginning or end of the sample, that peaks and troughs alternate, that cycle duration is at least fifteen months, and that expansion and contraction phases are at least five months long. The resulting peak and trough dates represent the final turning points.

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