Are Long Expansions Followed by Short Contractions?

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The great expansion of the 1980s is the longest peacetime expansion on record. Does knowing how long an economy grows during an expansion reveal anything about how long the following contraction is going to last? More generally, is there any relationship between the lengths of neighboring expansions and contractions?

Economists have occasionally asserted the existence of such relationships. As Arnold Zellner of the University of Chicago noted in a research paper published in 1990:[1]

> *". . . in much of the literature . . . the hypothesis is made, implicitly or explicitly, that there exists some relationship between what occurs in the expansion phase of a business cycle and what happens in the following contraction phase. . . The hypothesis tentatively offered in explanation of this negative relation is that long expansion phases may be indicative of strong growth forces at work in the economy. The influences of these trend forces may persist in such a way as to allow the adjustments of the contraction phase to take place in a shorter time than if the growth forces had not been operating or were operating with diminished efficiency." (p. 1).*

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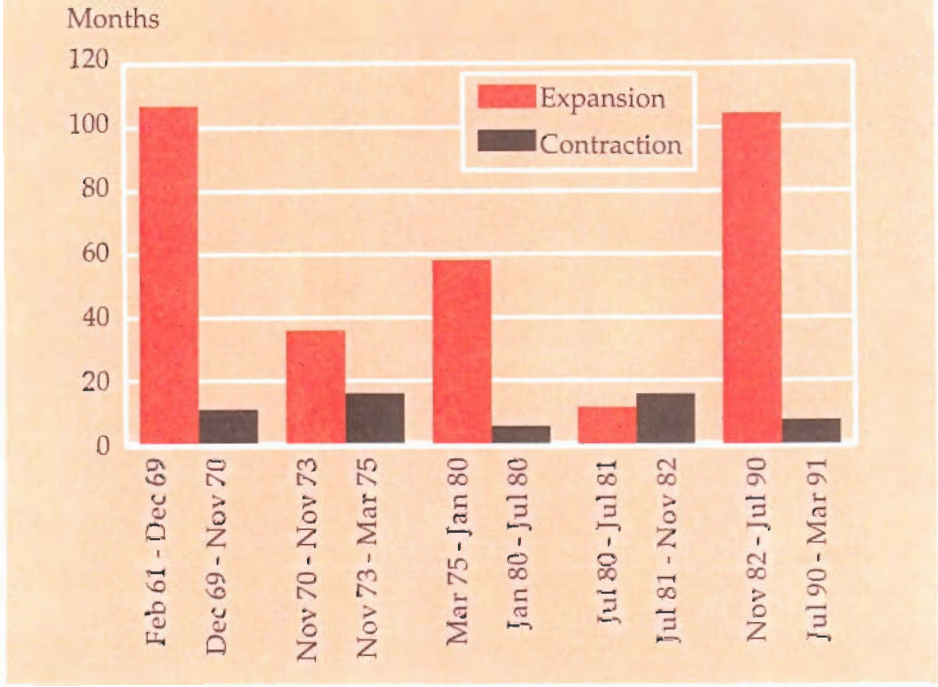
[1]Complete references to papers cited in this article may be found in the "References" section.

Using data from 1854 to shortly after World War II, Zellner found evidence that long expansions tend to be followed by short contractions. Based upon statistical analysis, he argued that for each additional month that the economy expands, we can expect a reduction of one-half month in the length of the following contraction. The economy has changed significantly since World War II, however, so we'd like to see if Zellner's findings are still applicable to today's economy.

FIGURE 1
Lengths of Last Five Expansions and Contractions



We know, as a by-product of recent research examining business-cycle lengths, that expansion lengths are approximately unrelated to lengths of previous and subsequent expansions.[2] Similarly, contraction lengths are approximately unrelated to the lengths of previous and subsequent contractions. However, this recent work doesn't look at the relationship between the length of an expansion and the length of the contraction that follows, leaving open the possibility that the length of a contraction *does* depend on the length of the previous expansion, as suggested above.

Simple graphical analysis seems to indicate that the relationship has remained intact over the last five business cycles (Figure 1). The long expansion (106 months) of the 1960s was followed by a short contraction of only 11 months. The shorter expansion (36 months) in the early 1970s was followed by a somewhat longer contraction of 16 months. The next expansion in the late 1970s (58 months) was longer, and the following contraction was shorter (6 months). Then there was a very short expansion from July 1980 to July 1981 (12 months) followed by a long contraction (16 months). Finally, the great expansion of November 1982 to July 1990 was followed by a brief contraction that ended in March 1991. However, we don't want to rely too heavily on casual evidence gleaned from graphical analysis. Therefore, in the remainder of this article, we provide a replication of Zellner's prewar results, examine their validity in the postwar period, and provide a somewhat critical assessment of the overall methodology.

[2]See the articles by Diebold and Rudebusch (1990, 1991, 1992) and Diebold et al. (forthcoming).

BUSINESS CYCLES BEFORE WORLD WAR II

The National Bureau of Economic Research (NBER), a nonprofit, nongovernmental research institute, determines when business cycles begin and end in the United States. A business cycle is defined as beginning when an expansion begins and ending (after a contraction) when the next expansion begins. The NBER has established a list of dates of when business cycles began and ended; the list is called a business-cycle chronology (Table). An expansion begins when business activity has bottomed out and is beginning to rise; a contraction begins at the peak of the business cycle, when business activity starts declining.

Zellner used the prewar NBER business-cycle chronology from December 1854 to October 1949 (the first 23 cycles in the Table) in his research.[3] Zellner tested the data and used statistical techniques that related the length of a contraction to the length of the preceding expansion.[4] Following

TABLE

The NBER Business-Cycle Chronology

Cycle Number	Expansion Begins	Length (months)	Contraction Begins	Length (months)
PREWAR				
1	Dec. 1854	30	June 1857	18
2 *	Dec. 1858	22	Oct. 1860	8
3 *	June 1861	46	Apr. 1865	32
4	Dec. 1867	18	June 1869	18
5 *	Dec. 1870	34	Oct. 1873	65
6 *	Mar. 1879	36	Mar. 1882	38
7	May 1885	22	Mar. 1887	13
8	Apr. 1888	27	July 1890	10
9	May 1891	20	Jan. 1893	17
10	June 1894	18	Dec. 1895	18
11	June 1897	24	June 1899	18
12	Dec. 1900	21	Sep. 1902	23
13	Aug. 1904	33	May 1907	13
14	June 1908	19	Jan. 1910	24
15	Jan. 1912	12	Jan. 1913	23
16	Dec. 1914	44	Aug. 1918	7
17 *	Mar. 1919	10	Jan. 1920	18
18	July 1921	22	May 1923	14
19	July 1924	27	Oct. 1926	13
20 *	Nov. 1927	21	Aug. 1929	43
21 *	Mar. 1933	50	May 1937	13
22 *	June 1938	80	Feb. 1945	8
23	Oct. 1945	37	Nov. 1948	11
POSTWAR				
24	Oct. 1949	45	July 1953	10
25	May 1954	39	Aug. 1957	8
26	Apr. 1958	24	Apr. 1960	10
27 *	Feb. 1961	106	Dec. 1969	11
28	Nov. 1970	36	Nov. 1973	16
29	Mar. 1975	58	Jan. 1980	6
30	July 1980	12	July 1981	16
31**	Nov. 1982	104	July 1990	8
32**	Mar. 1991			

Note: An asterisk (*) indicates that the cycle is a "major" cycle. Double asterisks (**) on the last two cycles indicate that we have yet to determine whether these cycles are major or minor.

[3] I use the terms "prewar" and "postwar" rather loosely; the last contraction used by Zellner in fact ends in 1949, but I will refer to this as a prewar contraction.

[4] Zellner used data for the U.S. and Great Britain; in this article, I focus only on the U.S. data.

the lead of early economists like Hansen (1951) and Gordon (1952), Zellner classified cycles as "major" or "minor," based on both duration and amplitude. Minor cycles are of shorter duration and smaller amplitude.

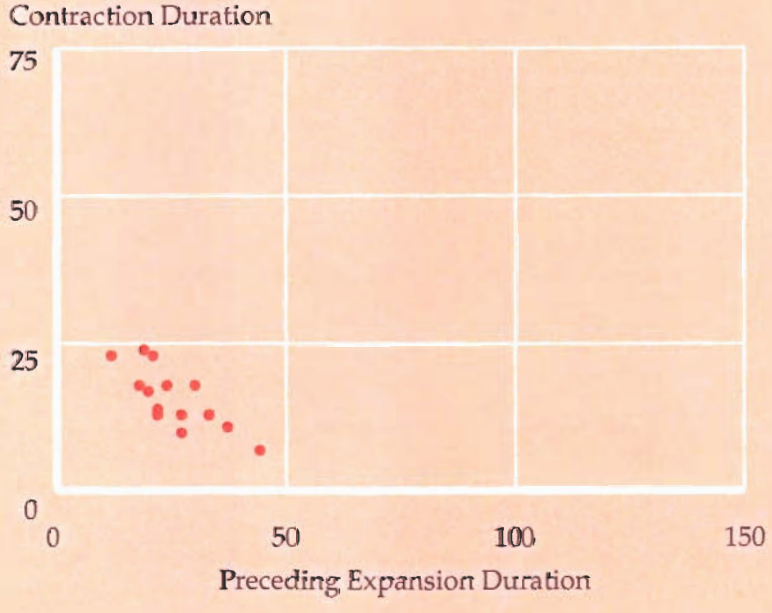
Looking just at minor cycles, Zellner argued that, on average, an additional month of expansion tends to be associated with roughly a half-month reduction in the duration of the following contraction. Frequently, major cycles contain wars. The economy behaves differently in wartime than in peacetime, so I focus on minor cycles. Using data that correspond roughly to the data used by Zellner, but which have been revised somewhat, I was able to replicate Zellner's results closely.[5] The replication shows that, for minor cycles, an additional month of expansion is associated with a half-month shorter contraction, as did Zellner's study.

The average minor contraction in the prewar period lasted 13 months. To forecast the length of a contraction, rather than assuming that the contraction will last 13 months, the results imply that a better forecast can be formed by taking the length of the preceding expansion into account. A contraction can be expected to last 28 months minus one-half times the length of the previous expansion.[6] So if an expansion were average and lasted 30 months, a forecast of the length of the following contraction would be 28 - (½ x 30) = 13 months, which is the average length of a contraction. But if an expansion were longer, like the 37-month expansion from 1945 to 1948 (cycle number 22 in the Table), the forecast would be 28 - (½ x 37) = 9½ months; in fact, the contraction lasted 11 months, so the prediction was fairly accurate. If the expansion were shorter than 30 months, like the 20-month expansion of 1891 to 1893 (cycle number 9), the forecast would be 28 - (½ x 20) = 18 months, which is very close to the actual length of 17 months.

INCORPORATING BUSINESS CYCLES AFTER WORLD WAR II

What happens when we examine minor business cycles since World War II?[7] The most

FIGURE 2
Prewar Relationship for Minor Cycles



[5]For those interested in the technical details, the results discussed in this article are reported in detail in the Appendix.

[6]The numbers in this formula come from using statistical (regression) techniques on the data, as reported in the Appendix.

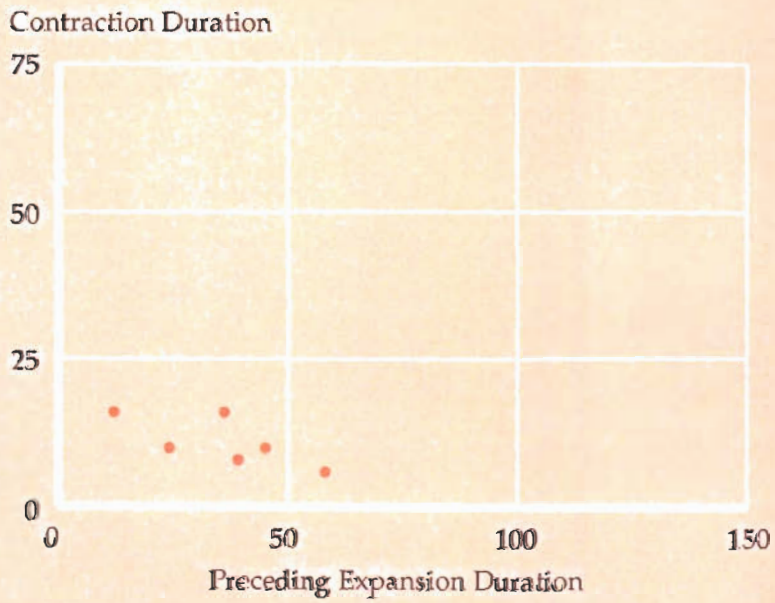
obvious feature of the postwar results is that the negative prewar relationship between the length of an expansion and the length of the following contraction seems to remain intact. There are a number of apparent differences, however. First, an additional month of expansion is now associated with only a one-fifth-month-shorter contraction. Second, the "fit" of the postwar relationship is poorer than that of its prewar counterpart; that is, the association of long expansions with short contractions is not as reliable. Graphs showing the length of an expansion plotted against the length of the following contraction in the prewar (Figure 2) and postwar (Figure 3) periods demonstrate how this relationship has deteriorated. There is still a negative relationship between the length of an expansion and the length of the following contraction, but less confidence should be attached to the postwar relationship because of both the greater dispersion of the data points around the fitted line and the smaller number of data points. To the extent that there are differences between the prewar and postwar relationships, they are likely due to the same factors that caused the postwar lengthening of expansions relative to contractions, as documented in Diebold and Rudebusch (1992). These factors include different patterns of postwar supply shocks and postwar policy and nonpolicy structural changes (for example, "automatic stabilizers" and the shift away from agriculture).

Although there appears to be some change in the magnitude of the relationship between the length of an expansion and the length of the following contraction, it may nevertheless be of interest to examine the results obtained from pooling the prewar and postwar data. This is because we can't be certain that a postwar shift occurred, particularly in light of the fact that the qualitative nature of the Zellner relationship appears to remain intact. Moreover, because there have been so few business cycles since World War II, it is hard to draw any reliable statistical conclusions from the postwar data alone.

Pooling the prewar

[7]The 1982-1991 cycle is omitted because it probably would not be judged a minor cycle using the criteria of Hansen (1951) and Gordon (1952), an important element of which is the overall duration of the cycle.

FIGURE 3
Postwar Relationship for Minor Cycles



and postwar data, we estimate that a one-month-longer expansion yields a one-third-month-shorter contraction. Plotting the length of an expansion against the length of the following contraction for the pooled data (Figure 4) shows this relationship very clearly. As expected, the pooled estimate lies between the separate prewar and postwar estimates.

Looking at all the minor cycles since 1854, the average contraction lasted just under 13 months. As before, rather than assuming that a contraction will last 13 months, the results indicate that a better forecast could be formed by taking account of the length of each expansion. A contraction can be expected to last 24 months minus one-third times the length of the previous expansion. So if an expansion lasted 33 months, the contraction would be expected to last 24 - (1/3 x 33) = 13 months, which is the average length of a contraction. But if an expansion were longer, like the 58-month expansion from 1975 to 1980 (cycle number 29 in the Table), a shorter contraction of 24 - (1/3 x 58) = 5 months would be expected; in fact, the contraction lasted six months—a fairly accurate prediction. If the expansion were shorter than 33 months, like the 12-month expansion of 1980 to 1981 (cycle number 30), the forecast would be for a contraction of 24 - (1/3 x 12) = 20 months; that's not too far from the actual length of 16 months.

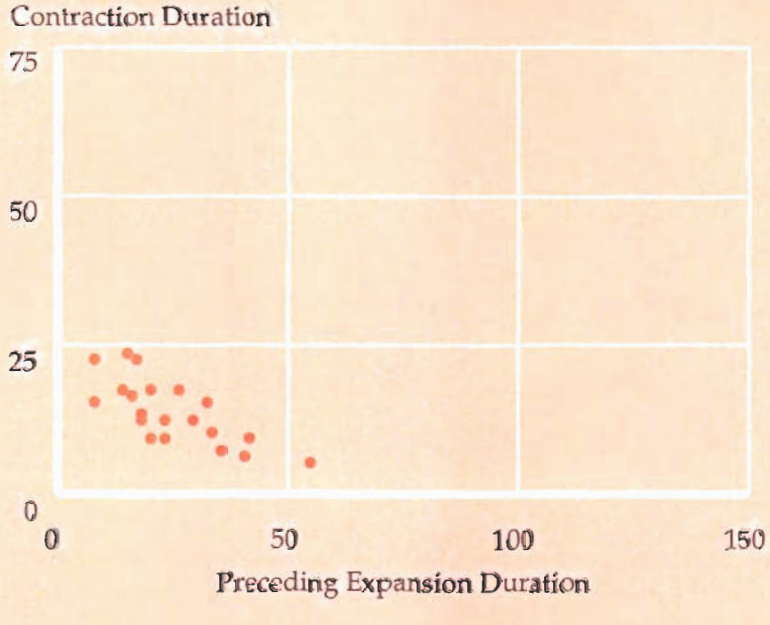
CAVEATS

Several sobering facts should temper one's degree of belief in the findings reported here. First, substantial uncertainty exists regarding the business-cycle chronology itself. In particular, the prewar business-cycle chronology is subject to much greater uncertainty, stemming from the inferior quality and quantity of prewar source data;[8] that is, the NBER business-cycle chronology is only an estimate, or best guess, of the "true" business-cycle chronology, and the confidence we have in our guess is lower in the prewar period.[9]

[8]See the work by Romer (1991) and Watson (1992).

[9]Indeed, some economists, such as Christina Romer of the University of California at Berkeley, have produced business-cycle chronologies that are different from the NBER's—they show contractions and expansions starting and ending on different dates than those in the NBER

FIGURE 4
Pooled Relationship for Minor Cycles



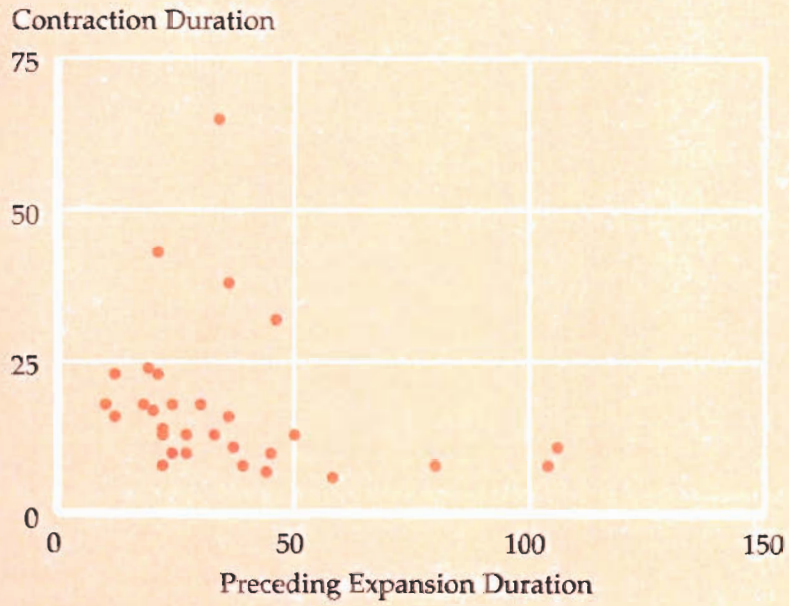
Second, we have used data corresponding only to minor cycles. Minor business-cycle data seem to show a negative relationship between the length of an expansion and the length of the following contraction. But what about major cycles? The data show no relationship between the length of an expansion and the length of the subsequent contraction when we consider major and minor cycles together, as shown in Figure 5. So splitting business cycles into major and minor categories is important to finding a relationship between the lengths of neighboring expansions and contractions.

If the relationship holds only for minor cycles and we want to use it for forecasting purposes, we need to be able to classify cycles as major or minor. Ultimately, however, it's clear that the methods used by Zellner and others to separate minor and major cycles are incompletely specified and highly subjective. The situation is not hopeless, however; at least part of the implicit algorithm used to identify major cycles can be readily inferred. Typically, for example, cycles containing wars are designated as major. And it makes sense that these cycles be excluded from the analysis, since the economy behaves much differently during wartime than during peacetime—the influence of a war on economic activity often dominates any other features of the economy. Wartime major cycles are numbers 3, 22, and 27 (from the Table).

In addition to wars, other major events in the economy have led economists such as Hansen (1951) and Gordon (1952) to label certain peacetime cycles as major cycles. Major cycles typically represent larger, longer-term changes in the economy than do minor cycles. The downturns in a major cycle are longer and more severe than those of a minor cycle because they involve large structural changes in the economy. Generally, a major upswing in the economy is a time when there are powerful forces causing economic growth to occur, perhaps due to profitable long-term investment opportunities. Cycles 2, 5, 6, 17, 20, and 21 are the peacetime major cycles.

chronology. Although there are some real problems with the Romer chronology (see Zarnowitz, 1992), which is why we don't examine it here, it does represent a serious reassessment by a knowledgeable expert and serves to highlight the uncertainty inherent in any business-cycle chronology, particularly in the prewar era.

FIGURE 5
Pooled Relationship: Major and Minor Cycles



CONCLUDING REMARKS

I have reported on recent research indicating that, for prewar U.S. minor business cycles, there exists a negative relationship between the length of an expansion and the length of the following contraction. Moreover, it seems that the relationship has stood the test of time—a qualitatively similar, if somewhat less pronounced, relationship holds in the postwar period.

I indicated how such a relationship could be used to forecast a contraction's length based upon knowledge of the previous expansion's length. But I also pointed out—and I hasten to do so again—that potential pitfalls abound. The pitfalls concern primarily the uncertainty inherent in any business-cycle chronology, the lack of precise definitions of major and minor cycles and the associated difficulty of distinguishing them, and the possibility of secular change in the nature of the relationship. Thus, further research is needed to determine the real usefulness of the ideas discussed here.

REFERENCES

Diebold, F.X., and G.D. Rudebusch. "A Nonparametric Investigation of Duration Dependence in the American Business Cycle," *Journal of Political Economy*, 98 (1990), pp. 596-616.

Diebold, F.X., and G.D. Rudebusch. "Shorter Contractions and Longer Expansions," this *Business Review* (November/December 1991), pp. 13-20.

Diebold, F.X., and G.D. Rudebusch. "Have Postwar Economic Fluctuations Been Stabilized?" *American Economic Review*, 82 (1992), pp. 993-1005.

Diebold, F.X., G.D. Rudebusch, and D.E. Sichel. "Further Evidence on Business Cycle Duration Dependence," in J.H. Stock and M.W. Watson, eds., *New Research on Business Cycles, Indicators and Forecasting*. Chicago: University of Chicago Press for NBER (forthcoming).

Gordon, R.A. *Business Fluctuations*. Harper and Brothers, 1952.

Hansen, A.H. *Business Cycles and National Income*. W.W. Norton and Co., 1951.

Romer, C.D. "Remeasuring Business Cycles: A Critique of the Prewar NBER Reference Dates," manuscript, Department of Economics, University of California, Berkeley, 1991.

Watson, M.W. "Business Cycle Durations and Postwar Stabilization of the U.S. Macroeconomy," manuscript, Department of Economics, Northwestern University, 1992.

Zarnowitz, V. Comment on "Remeasuring Business Cycles: A Critique of the Prewar NBER Reference Dates," by C. Romer, manuscript, Graduate School of Business, University of Chicago, 1992.

Zellner, A. "Some Properties of the Durations of Economic Expansions and Contractions," *American Economist*, 34 (1990), pp. 20-27.

APPENDIX

Regression Results
Using the NBER Business Cycle Chronology

Dependent Variable: Contraction Length

	(1) Prewar (Zellner)	(2) Prewar	(3) Postwar	(4) Pooled
Intercept	27.2 (p=.00)	27.6 (p=.00)	17.5 (p=.01)	23.9 (p=.00)
Expansion Length	-.45 (p=.00)	-.47 (p=.00)	-.18 (p=.12)	-.33 (p=.00)
Obs.	15	15	6	21
$\bar{R}^2$	.54	.57	.38	.54

This table shows the results of an ordinary least squares regression of the length of minor contractions on an intercept and the length of the previous expansion.

Column (1) reports the results of Zellner (1990), where the sample consists of prewar minor cycles.

Column (2) reports the results of our replication of Zellner's regression.

Column (3) reports the results for the postwar minor cycles.

Column (4) reports the results for the pooled prewar/postwar sample.

P-values, or marginal significance levels relative to the t-distribution, are given in parentheses below the coefficient estimates. A small p-value indicates high statistical significance.

$\bar{R}^2$ denotes the percentage of variation in minor contraction durations explained by variation in preceding expansion durations, after correcting for the degrees of freedom used in estimation.