REGIONAL SPOTLIGHT

The State of the States

Even if the U.S. economy is thriving, some states can be in recession, and vice versa. But identifying state cycles is not so easy.

BY PAUL R. FLORA

Of the five U.S. recessions since 1979, Florida's economy continued to expand throughout three of them. In contrast, Alaska has had eight recessions since 1979, but only three of them occurred during a national recession. In fact, over the past 37 years, only eight states have been in recession during — and only during — all five of those U.S. recessions.[1] Whether a state's economy hews closely to the expansions and contractions of the U.S. business cycle depends on a variety of factors, including the state's industry mix and demographic trends. Florida's economy, for instance, has been propelled by rapid population growth as one of the main Sun Belt destinations for domestic migration and as a gateway state for tens of thousands of Latin American immigrants each year. Energy price shocks have frequently buffeted Alaska's economy, which relies heavily on the volatile and risk-prone oil industry.

Understanding a state's unique trends as well as the geographic distribution of state recessions is of great interest to households, firms, and policymakers. Tracking state cycles helps clarify the underlying causes of national recessions,[2] informs policymakers regarding appropriate monetary policy,[3] and aids in recognizing in real time an emerging national recession.[4]

However, as this article will show, the greater volatility of state data and other complications make determining business cycles for an individual state more difficult than for the U.S. economy. Since 2005, the Federal Reserve Bank of Philadelphia has facilitated state business cycle research by producing coincident indexes of economic activity for all 50 states and the nation. Over the past decade, researchers have used the indexes to identify individual state business cycles.

With an additional 11 years of data since the indexes were first published, and with the Great Recession behind us, I explore a method for using our indexes to pinpoint the onset and end dates of state business cycles and assess its results: What do the state coincident indexes now tell us about state cycles? And have any states entered a recession lately?

HOW ARE BUSINESS CYCLES DETERMINED?

Unfortunately, no official entity exists for dating the peaks and troughs of economic activity for each of the 50 states. For the overall U.S. economy, however, the National Bureau of Economic Research (NBER), a private organization, began publishing its determination of the timing of peaks and troughs in economic activity in 1929, becoming the unofficial but widely accepted arbiter of the nation's business cycles.

Within the NBER framework of alternating peaks and troughs in economic activity, "a recession is a period between a peak and a trough, and an expansion is a period between a trough and a peak." A recession is marked by a "significant decline in economic activity" lasting at least a few months, while an expansion is a typically longer period of increasing economic activity.[5]

Using judgment rather than a rule, the NBER's Business Cycle Dating Committee decides when the last turning point in a cycle occurred by examining an assortment of quarterly and monthly data, but only after waiting until the risk of significant data revisions has abated. The

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NBER waited 15 months before pronouncing that June 2009 was the trough month in which the Great Recession ended.[6]

For the states, a lack of comparable data represents the greatest challenge for determining individual state business cycles. Most critically, quarterly state GDP has been available only since 2015 and is still considered an experimental measure. When it is released, state GDP lags the comparable national data by three months. Of the 10 monthly indicators recently used by the NBER, only three are available for the states on a monthly basis: employment as measured by Bureau of Labor Statistics payroll and household surveys, and aggregate hours worked. All three are employment-related, so potential signals from other economic factors that are typically included in national aggregates of economic activity such as corporate profits are missed.

Our state coincident indexes were designed to compensate for the lack of comparable data by modeling the overall underlying growth of a state's economy using available data. Three monthly variables (nonfarm payroll employment, average hours worked in manufacturing, and the unemployment rate) plus one quarterly variable (real wages and salaries) are used to estimate an underlying (sometimes called a hidden) fifth variable that represents a state's gross domestic product.[7] However, divining state business cycles is further complicated by two additional challenges.

First, the smaller size of state economies and the smaller sample sizes used to estimate state economic indicators generate greater data volatility and noisier trends, making it more difficult to discern true peaks and troughs. The second problem results from the longer lags in reporting state variables and the greater revisions to state estimates, which allow any false signals to persist until annual revisions are conducted to update the data. Thus, just as the NBER does in declaring national cycle dates, it is better to wait before pronouncing state peaks and troughs. Still, studies have demonstrated that examining state business cycles in real time is a potential — though not risk-free — way to assess the probability that the nation is currently in recession — an assessment that is beyond the scope of this article.[8]

BUT HOW TO DETERMINE A STATE CYCLE?

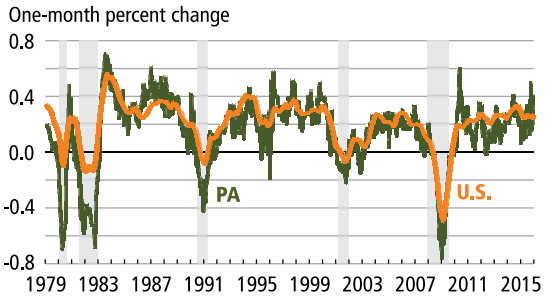
Undertaking the task of identifying peaks and troughs for 50 individual states over a 37-year period calls for establishing a set of simple, straightforward criteria that capture the spirit of the NBER dating committee.

Criteria for the states are established by first examining how our national coincident index has performed relative to

FIGURE 1

U.S. Index Aligns Well with NBER Recessions

Pennsylvania's as well, but state indexes are inherently more volatile.



Sources: Federal Reserve Bank of Philadelphia; National Bureau of Economic Research.

NBER-determined cycles.[9] Our national coincident index, which was created at the same time as the state indexes for comparison purposes, is relatively well behaved, capturing all five NBER recessions as uninterrupted declines in activity, interspersed with uninterrupted increases in activity, or expansions (Figure 1).[10] The durations of the declines range in length from four months in the 1980 recession to 18 months in the Great Recession. The depths of the recessions (calculated as the simple sum of the monthly percent changes during each recession period) ranged from -0.24 in the 1980 recession to -4.55 in the Great Recession.[11]

As the 1980 recession was the shortest and shallowest national recession since 1979, its characteristics were used as the minimum criteria for determining state recessions: a minimum duration of four months and a minimum decline equal to or exceeding a simple variance measure computed for each state. Brief, one-time economic shocks that may result from a labor strike, factory closing, or natural disaster are less likely to be labeled a recession because a duration threshold is applied. Similarly, longer patches of slight declines avoid a recession label by virtue of a variance threshold.

For the nation, the average absolute value of the monthly percent changes in the national index was 0.24, the same as the aggregate change during the nation's smallest recession. Thus, the minimum decline for a state recession and minimum increase for a state expansion are established as the average absolute value of the monthly percent changes in each state index. Using a state-specific variance acknowledges the potential for state business cycles to have smaller or greater amplitudes than the nation's cycle.[12] (See the accompanying notes on *Determining State Peaks and Troughs* for examples of how the criteria are applied.)

Determining State Peaks and Troughs

Criteria

A state business cycle peak is determined as the last month in which the index has a positive monthly change prior to a period of at least four months in which the sum of the monthly changes is negative and its absolute value equals or exceeds the simple variance in that state's coincident index.

A state business cycle trough is determined as the last month of a qualifying recession (and one with a negative monthly change) prior to a period of at least four months in which the sum of the monthly changes is positive and its absolute value equals or exceeds the simple variance.

A period with offsetting monthly changes (a net change of zero for two or more months) at the start of a qualifying recession is treated as part of the prior expansion. Likewise, a period of two or more months of no net change at the end of a qualifying recession is treated as part of the subsequent expansion.

Examples

The very different experiences of five states and the U.S. during the double-dip U.S. recessions of the early 1980s are representative.

- Connecticut avoided both recessions. It did experience a seven-month decline (shaded yellow) during the second U.S. recession that was too shallow to qualify as a recession.
- Florida avoided both recessions. Although its growth rate was well below its norm, the state economy continued to expand.
- Illinois experienced one long recession. While the U.S. enjoyed a brief intervening expansion, Illinois was one of two states that declined throughout. Three other states escaped that fate by virtue of a bare minimum four-month expansion.
- New Hampshire avoided the first recession because of an insufficient duration, although it had a sufficiently deep decline (shaded yellow). Eight other states avoided the first recession with little or no decline, but not the second, while Alaska experienced the first and avoided the second.
- Pennsylvania followed the nation into and out of both recessions — one of 36 states to do so.

It is important to note that peaks also represent the maximum for that cycle. For example, June 1981 was a peak month for Pennsylvania, with a subsequent trough in February 1983. June 1981 is the cycle maximum, not February or April, because the cumulative change from March 1981 through June 1981 is positive. Likewise, troughs represent a minimum for that cycle.

There were seven instances in which the depth was sufficient to qualify as a recession, but the duration was too short. Only the New Hampshire episode fell within a national recession. In addition, a 2006 bank merger in Delaware generated a three-month decline, a 1998 General Motors strike in Michigan caused a deep, two-month decline, and Florida's index declined sharply for one month following 9/11. The remaining three cases involved the energy states of Alaska, South Dakota, and West Virginia.

A spreadsheet showing onsets and end dates of all recessions since 1979 for all 50 states can be viewed at: https://www.philadelphiafed.org/-/media/research-and-data/publications/regional-spotlight/2016/Q4-state-peaks-and-troughs.xlsx.

TABLE 1
Results

	Monthly percent change in each coincident index					
	CT	FL	IL	NH	PA	US
State Absolute Average	**0.29**	**0.36**	**0.29**	**0.35**	**0.25**	**0.24**
Feb-79	0.39	0.57	0.06	0.54	0.20	0.33
Mar-79	0.40	0.59	0.18	0.61	0.17	0.32
Apr-79	0.41	0.60	0.39	0.55	0.17	0.31
May-79	0.42	0.62	0.04	0.39	0.09	0.30
Jun-79	0.41	0.47	**0.14**	0.37	0.09	0.28
Jul-79	0.41	0.65	(0.04)	0.19	0.02	0.25
Aug-79	0.39	0.50	(0.13)	0.32	0.04	0.23
Sep-79	0.37	0.68	(0.42)	0.36	0.08	0.21
Oct-79	0.35	0.68	(0.18)	0.44	(0.01)	0.19
Nov-79	0.33	0.69	(0.42)	0.54	**0.04**	0.17
Dec-79	0.29	0.70	(0.18)	0.41	(0.06)	0.15
NBER Peak Jan-80	0.24	0.57	(0.30)	0.33	(0.11)	0.12
Feb-80	0.18	0.61	(0.55)	0.30	(0.36)	**0.06**
Mar-80	0.12	0.30	(0.53)	0.15	(0.52)	(0.00)
Apr-80	0.07	0.32	(0.85)	(0.16)	(0.69)	(0.07)
May-80	0.04	0.31	(0.55)	(0.22)	(0.64)	(0.10)
Jun-80	0.03	0.47	(0.67)	(0.02)	(0.55)	**(0.07)**
NBER Trough Jul-80	0.05	0.30	(0.59)	0.09	**(0.50)**	0.00
Aug-80	0.09	0.60	(0.25)	0.35	0.11	0.09
Sep-80	0.13	0.56	(0.30)	0.45	0.02	0.16
Oct-80	0.17	0.56	(0.25)	0.60	0.48	0.22
Nov-80	0.20	0.55	(0.28)	0.51	0.20	0.25
Dec-80	0.21	0.54	(0.10)	0.55	0.38	0.24
Jan-81	0.22	0.52	(0.18)	0.32	0.03	0.22
Feb-81	0.21	0.51	0.04	0.37	0.11	0.23
Mar-81	0.19	0.48	(0.12)	0.40	(0.06)	0.24
Apr-81	0.18	0.46	(0.06)	0.40	0.06	0.24
May-81	0.16	0.43	0.01	0.43	(0.11)	0.21

	Monthly percent change in each coincident index					
	CT	FL	IL	NH	PA	US
Jun-81	0.13	0.41	(0.04)	0.44	**0.20**	0.16
NBER Peak Jul-81	0.11	0.23	(0.22)	0.33	(0.25)	0.11
Aug-81	0.07	0.23	(0.15)	0.31	(0.12)	**0.04**
Sep-81	0.04	0.08	(0.23)	0.15	(0.48)	(0.00)
Oct-81	0.00	0.07	(0.43)	0.12	(0.35)	(0.05)
Nov-81	(0.02)	0.05	(0.26)	**0.04**	(0.56)	(0.10)
Dec-81	(0.04)	0.04	(0.50)	(0.09)	(0.58)	(0.13)
Jan-82	(0.05)	0.03	(0.46)	(0.04)	(0.47)	(0.14)
Feb-82	(0.05)	0.02	(0.62)	(0.18)	(0.37)	(0.13)
Mar-82	(0.04)	(0.00)	(0.58)	(0.07)	(0.44)	(0.13)
Apr-82	(0.03)	0.13	(0.60)	**(0.01)**	(0.40)	(0.11)
May-82	(0.01)	0.11	(0.59)	0.11	(0.42)	(0.10)
Jun-82	0.01	0.13	(0.63)	0.23	(0.50)	(0.11)
Jul-82	0.04	0.16	(0.48)	0.26	(0.53)	(0.13)
Aug-82	0.06	0.04	(0.47)	0.20	(0.51)	(0.13)
Sep-82	0.08	0.09	(0.49)	0.13	(0.52)	(0.12)
Oct-82	0.12	0.12	(0.34)	0.04	(0.68)	(0.07)
NBER Trough Nov-82	0.18	0.16	(0.35)	0.11	(0.32)	**(0.01)**
Dec-82	0.25	0.18	(0.18)	0.29	(0.22)	0.07
Jan-83	0.33	0.31	**(0.05)**	0.46	(0.11)	0.14
Feb-83	0.42	0.61	0.12	0.67	**(0.05)**	0.21
Mar-83	0.52	0.61	0.24	0.83	0.35	0.28
Apr-83	0.60	0.64	0.43	1.05	0.44	0.34
May-83	0.68	0.78	0.43	1.12	0.57	0.40
Jun-83	0.74	0.93	0.61	1.01	0.44	0.45

Sources: Federal Reserve Bank of Philadelphia; National Bureau of Economic Research.
Notes: Declines are shown in parentheses.
The NBER indicates the months in which peaks and troughs occur and the duration (in months) of recessions and expansions. It makes no determination of exactly when during the month a recession or expansion starts or ends.
A spreadsheet showing onsets and end dates of all recessions since 1979 for all 50 states can be viewed at: https://www.philadelphiafed.org/-/media/research-and-data/publications/regional-spotlight/2016/Q4-state-peaks-and-troughs.xlsx.

ASSESSING STATE CYCLES SINCE 1979

Using these criteria, I determined the peaks and troughs for all 50 states, five of which are highlighted, along with the United States, in *Determining State Peaks and Troughs* and all of which are viewable through the accompanying link. The most notable finding is that the Great Recession was so severe that no state economy avoided a recession. The all-encompassing nature of that downturn stands in contrast to the prior four national recessions. In particular, 19 states avoided a contraction during the 1990–1991 recession (Figures 2 and 3). During the double-dip recessions, 11 states avoided the brief 1980 recession, while only three states avoided the deeper, longer recession that followed in 1981–1982. Connecticut and Florida avoided both, while Alaska avoided the second. Eight states avoided the 2001 national recession.

The national economy endured the Great Recession for 18 months, according to the NBER. Our national index also indicated an 18-month duration. However, the peak and trough indicated by our index lag the NBER's dates by four months. For the other four recessions, all peaks and troughs for the U.S. economy had been indicated within two months or less of the NBER determinations.

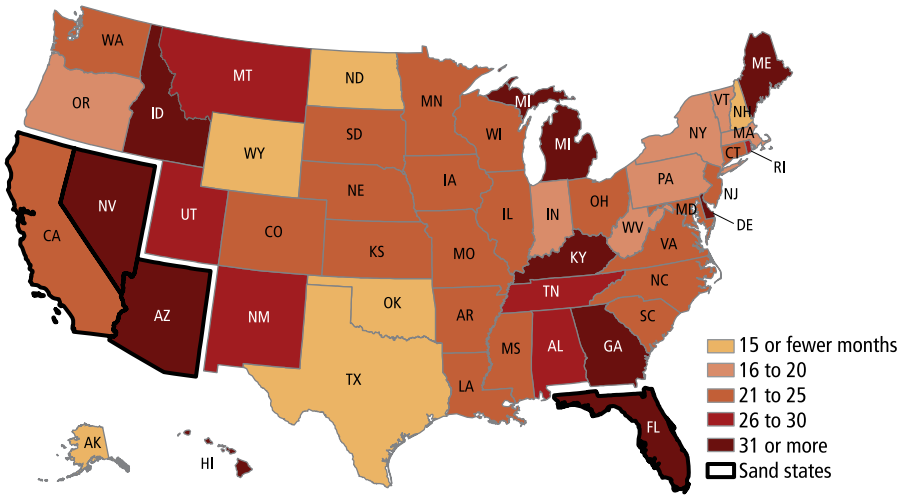
The durations of those state recessions that accompanied the Great Recession ranged from five months in North Dakota to 64 months in Michigan. However, the latter was mired in a long-term structural change (more on that later). The more representative extreme during the Great Recession was Nevada, which endured 52 months of economic decline as its housing market collapsed. On average, recessions lasted a full year longer in the sand states of Arizona, California, Florida, and Nevada than in the other 46 states: 36 months as opposed to 24 months.

While the 1990–1991 recession was much shorter, the distribution of its impact among the states was much more uneven. Of the 31 states in recession, Alaska and Wisconsin began to recover after just six months, while Connecticut and New Jersey endured 37 months of contraction. Sometimes referred to as the bicoastal recession, the 1990–1991

FIGURE 2

No State Avoided the Great Recession of 2007–2009

Length of each state's recession, in months.

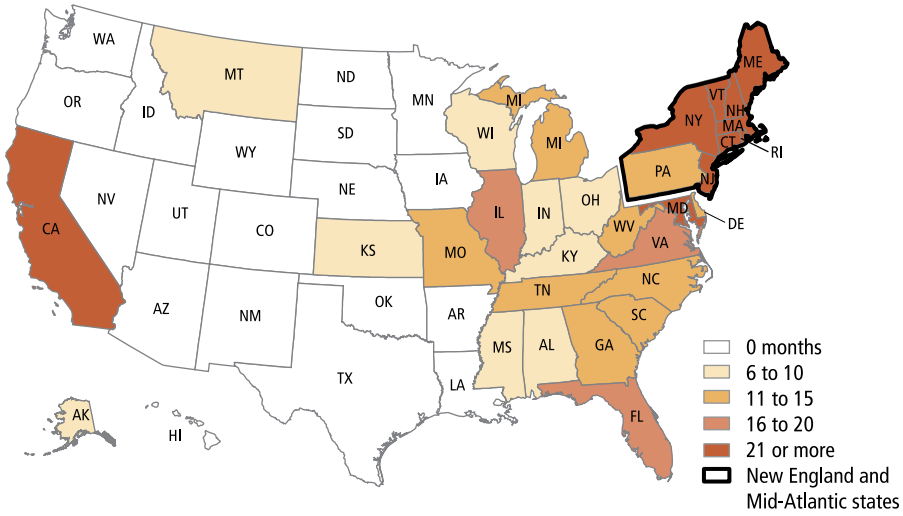


Source: Federal Reserve Bank of Philadelphia.
Note: The duration of a recession is the number of months from the peak to the trough. The Great Recession was 18 months long for the nation as a whole.

FIGURE 3

19 States Avoided the 1990–1991 Recession

Length of each state's recession, in months.



Source: Federal Reserve Bank of Philadelphia.
Note: The duration of a recession is the number of months from the peak to the trough. The 1990–1991 recession was eight months long for the nation as a whole.

recession hit New England and the Mid-Atlantic states especially hard. The average duration of recessions in the nine states in those two regions was 30 months; the average in the other 22 states was just 12 months.

Many of the 19 states that avoided the 1990–1991 national recession had hit bottom just a few years earlier as part of a series of mid-1980s state recessions that struck 14 farm and energy states, predominately located in the nation's heartland. The farm states suffered early in the 1980s as increased planting and greater yields collided with trade disruptions and a stronger dollar. Farmland values followed agricultural prices and profits in a downward spiral, and many farms went bankrupt. *Rolling recessions* became a popular descriptor, as 10 of those 14 states would later avoid the 1990–1991 U.S. recession, while Alaska, Mississippi, Montana, and West Virginia would succumb a second time.

The timing and duration of the farm and energy state recessions were somewhat idiosyncratic. Farm states tended to be hit earlier but adjust more quickly, such as Iowa, with a July 1984 peak and a February 1985 trough. With a dependence on agriculture, metal mining, and energy extraction, Montana was the first state to enter a recession during this period, with a February 1984 peak, and it was the last to emerge, with a September 1987 trough.

Hawaii and Michigan have had recessionary periods lasting in excess of five years that may be more accurately described as secular declines due to long-term structural change.

The sense many people had of a "jobless" recovery following the eight-month 2001 national recession gains credence after examining state recessions rather than just the U.S. Of the 42 states that experienced a recession, only 15 had a single, relatively brief recession like the national one. Recessions extended 12 to 18 months longer in 14 states. During that same postrecession period, a dozen more states experienced a second recession following a brief interlude of expansion. Often the anomaly, West Virginia did not begin its 18-month recession until the national recession had ended.

When is a recession not a recession? Following our criteria, Hawaii and Michigan have had recessionary periods lasting in excess of five years that may be more accurately described as secular declines due to long-term structural change.

Hawaii, which avoided the 1990–1991 recession, peaked instead in December 1991. An 81-month recession ensued that corresponded to the massive asset bubble burst and recession that enveloped Japan. The nearly seven years it took for Hawaii to hit bottom represents the painful adjustment as business and personal investment from Japan dropped sharply.

While the nation underwent the relatively shallow eight-month recession of 2001, Michigan was in the midst of a much deeper 21-month recession. Michigan's economic activity had peaked in April 2000 and hit bottom in January 2002. Like many other states during the jobless recovery, Michigan experienced a short, shallow expansion of seven months then entered another 11-month recession — hitting a second trough in July 2003. However, unlike other states, Michigan's next expansion was equally short and shallow, again lasting just seven months and peaking in February 2004. Michigan did not hit bottom again until June 2009, when the Great Recession ended. Essentially, Michigan gained little from the six-year national expansion. Rather, the state suffered significant employment losses as its manufacturing sector restructured and retooled over more than a decade.

HOW HAVE STATES FARED SINCE THE GREAT RECESSION?

Aside from a few late echoes following the Great Recession — as in the jobless recovery in the wake of the 2001 recession — six energy states were in recession for at least part of 2015: Alaska, Louisiana, North Dakota, Oklahoma, West Virginia, and Wyoming. For Alaska and West Virginia, these were their second recessions since the Great Recession. Most of these state economies have been severely hurt by the fall in oil prices. West Texas crude dropped 75 percent (annualized) from $105.80 per barrel in June 2014 to $47.50 per barrel in January 2015. West Virginia's economy, which expanded again in the latter half of 2015, has suffered due to coal industry conditions.

These six states are among the top eight states in terms of the share of total wages attributable to the natural resources and mining sectors. Wyoming leads the pack, with Louisiana eighth. New Mexico and Texas are sixth and seventh (Table 2).

The current energy state downturn resembles the previously discussed farm and energy slump that sent 14 states into recession at some point from 1984 to 1987 (Figure 4). Back then, West Texas crude oil had dropped 93 percent

TABLE 2

Recession States in 2015 Highly Dependent on Energy

Location quotients* for state natural resources and mining sectors. Recession states are shaded.

	Total annual wages	Annual average employment
Wyoming	10.53	6.52
Alaska	8.17	3.84
North Dakota	7.26	4.41
Oklahoma	5.26	2.82
West Virginia	4.41	2.69
New Mexico	4.11	3.19
Texas	3.58	1.97
Louisiana	3.31	1.97
Montana	3.04	2.02
Idaho	2.35	2.80
U.S.	1.00	1.00

Source: Bureau of Labor Statistics Quarterly Census of Employment and Wages.
*A location quotient represents the proportionate contribution that wages or employment from a given economic sector makes to a state's total economy relative to that sector's contribution within the nation's economy.

(annualized) from $30.80 in November 1985 to $12.60 in March 1986. Besides the current six, Colorado, Idaho, Iowa, Mississippi, Montana, Nebraska, New Mexico, and Texas had also been in recession.

As with the nation's mid-1980s experience with an energy recession, the current state recessions in six energy states do not indicate a nationwide problem. The misfortunes of businesses and households from those six states are linked to significantly lower energy prices, which represent a substantial consumer benefit for everyone else. Thus, the nation's economy typically grows faster, even as regions tied to energy production retrench. Similarly, we can draw distinctions within our Third District between those manufacturing firms that supply the energy sector and those that supply consumers, either directly or indirectly. Producers of food products and building materials, such as windows for new homes, have enjoyed lower input prices and lower production costs. Conversely, producers of heavy industrial equipment used by shale gas firms in Pennsylvania and by energy firms worldwide have suffered a sharp decline in orders.

FINAL OBSERVATIONS

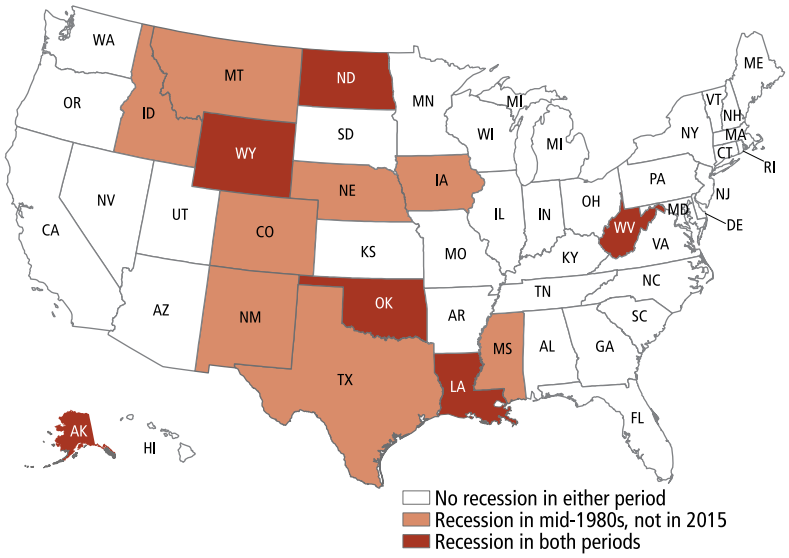
Based on my analysis of the 50 state coincident indexes, just six energy states were in recession during 2015, and as was the case in the mid-1980s, this energy state recession posed no risk to the national expansion.

However, as new data continually arrive and previous data are revised, our indexes may reveal somewhat different trends. Nevertheless, the economic data we've seen through most of 2016, and our knowledge of the direction and extent of potential data revisions, do not alter the conclusion that the nation's economic expansion continues unabated. And most states are following along. ■

FIGURE 4

Latest Energy State Recession Less Widespread

Instances of state recession, by recession period.



Source: Federal Reserve Bank of Philadelphia.

NOTES

[1] These states are Georgia, Kansas, Missouri, New Jersey, Ohio, South Carolina, Vermont, and Virginia.

[2] See the research by Michael Owyang and his colleagues.

[3] See the article by Gerald Carlino and Robert DeFina.

[4] Ted Crone's 2006 *Business Review* article goes into detail.

[5] The NBER's Business Cycle Dating Committee defines a recession as a "significant decline in economic activity" lasting a few months to more than a year, but it uses a variety of indicators as well as its members' judgment to decide what constitutes significant: "The Committee does not have a fixed definition of economic activity. It examines and compares the behavior of various measures of broad activity: real GDP measured on the product and income sides, economy-wide employment, and real income. The Committee also may consider indicators that do not cover the entire economy, such as real sales and the Federal Reserve's index of industrial production (IP). The Committee's use of these indicators in conjunction with the broad measures recognizes the issue of double-counting of sectors included in both those indicators and the broad measures. Still, a well-defined peak or trough in real sales or IP might help to determine the overall peak or trough dates, particularly if the economy-wide indicators are in conflict or do not have well-defined peaks or troughs." For more details on the NBER's approach to determining national business cycles, see its Business Cycle Dating Committee website, including its frequently asked questions at www.nber.org/cycles/recessions_faq.html.

[6] To establish the June 2009 recession trough, the NBER reviewed quarterly estimates of real gross domestic product (GDP) and real gross domestic income (GDI) issued by the Bureau of Economic Analysis to determine the quarter. Then they examined 10 monthly indicators to set the month. These included: Macroeconomic Advisers' monthly GDP, the Stock-Watson index of monthly GDP, the Stock-Watson index of monthly GDI, the average of Stock-Watson indexes of monthly GDP and GDI, real manufacturing and trade sales, the index of industrial production, real personal income less transfer payments, aggregate hours of work in the total economy, payroll survey employment, and household survey employment.

[7] For more details on the construction of the state coincident indexes, see Ted Crone's 2006 paper or our website at: www.philadelphiafed.org/research-and-data/regional-economy/indexes/coincident.

[8] See the 2006 article by Ted Crone and the 2008 report by Jason Novak.

[9] Although we used the state coincident indexes as of June 2016, we did not consider the data beyond December 2015 for the purpose of determining business cycles. In the June 2016 vintage, state employment data after September 2015 are subject to significant potential revisions. However, this vintage also includes first quarter personal income data, which itself incorporates some of the employment data revisions through December 2015.

[10] As such, peaks and troughs from the national index are easily determined. A peak occurs in the last month of growth prior to a sequence of declines in the index, and a trough occurs in the last month of decline prior to a sequence of growth in the index.

[11] For a spreadsheet of the underlying data of these results for all 50 states and the nation over the entire 37 years, see https://www.philadelphiafed.org/-/media/research-and-data/publications/regional-spotlight/2016/Q4-state-peaks-and-troughs.xlsx.

[12] Using a state-specific variance as a threshold rather than the nation's variance is the main conceptual change from the approach used in Ted Crone's 1994 and 2006 articles. This change also accommodates the fact that our state coincident index approach can introduce greater variance. In particular, our process standardizes the input variables to have a mean of 0 and a standard deviation of 1. After estimating, we retrend the result to match the growth of state GDP. However, we do not revariance the indexes; thus, they may fluctuate more or less than their underlying data.

REFERENCES

Carlino, Gerald A., and Robert H. DeFina. "The Differential Regional Effects of Monetary Policy," *Review of Economics and Statistics*, 80:4 (November 1998), pp. 572–587.

Crone, Theodore M. "New Indexes Track the State of the States," Federal Reserve Bank of Philadelphia *Business Review* (January/February 1994).

Crone, Theodore M. "What a New Set of Indexes Tells Us About State and National Business Cycles," Federal Reserve Bank of Philadelphia *Business Review* (First Quarter 2006).

Crone, Theodore M., and Alan Clayton Matthews. "Consistent Economic Indexes for the 50 States," *Review of Economics and Statistics*, 87:4, (November 2005) pp. 593–603.

Federal Reserve Bank of Dallas. "After the Boom: Texas Economy Downshifts in Energy Bust," *Annual Report 2015* (April 2016).

Federal Reserve Bank of Philadelphia. "Predicting Benchmark Revisions of Payroll Employment Estimates in Third District States" *Regional Economic Analysis* (April 23, 2014).

Henderson, Jason. "Is This Farm Boom Different?" Federal Reserve Bank of Kansas City *Main Street Economist*, 5 (2011).

Matthews, Steve. "The U.S. States Where Recession Is Already a Reality." Bloomberg (February 22, 2016).

National Bureau of Economic Research. "The NBER's Business Cycle Dating Committee," www.nber.org/cycles/recessions.html.

Novak, Jason. "Marking NBER Recessions with State Data," Federal Reserve Bank of Philadelphia Research Rap Special Report, April 2008.

Owyang, Michael, Jeremy Piger, and Howard Wall. "Business Cycle Phases in U.S. States," *Review of Economics and Statistics*, 87:4 (November 2005), pp. 604–616.