BUSINESS CYCLE PHASES IN U.S. STATES

Michael T. Owyang, Jeremy Piger, and Howard J. Wall*

Abstract—The U.S. aggregate business cycle is often characterized as a series of distinct recession and expansion phases. We apply a regime-switching model to state-level coincident indices to characterize state business cycles in this way. We find that states differ a great deal in the levels of growth that they experience in the two phases: Recession growth rates are related to industry mix, whereas expansion growth rates are related to education and age composition. Further, states differ significantly in the timing of switches between regimes, indicating large differences in the extent to which state business cycle phases are in concord with those of the aggregate economy.

I. Introduction

There is a long tradition among macroeconomists, exemplified by the work of Burns and Mitchell (1946), of characterizing the U.S. aggregate business cycle as a series of distinct phases. This tradition is carried on today by the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER). The NBER produces a single set of turning points defining the two most obvious business cycle phases—expansion and recession—as well as various summary statistics regarding the behavior of economic activity within these phases. Harding and Pagan (2002) provide a modern example of aggregate business cycle analysis from Burns and Mitchell's perspective.

Despite the considerable effort devoted to dating national recessions, little corresponding work has been done at the regional or state level. Primarily, the literature has looked for comovements in regional growth after splitting growth rates into their components—trend, cycle, national, and/or regional (Quah, 1996; Clark, 1998; Carlino & Sill, 2001; Kouparitsas, 2001). In this sense, research has been in the spirit of the macroliterature examining growth cycles (that is, deviations from trend), which is the primary alternative to the Burns-Mitchell–NBER analysis. To date, though, the literature has not studied regional business cycle phases, which need not necessarily be in sync with national phases.[1]

To remedy this, we use the state coincident index data of Crone (2002), based on Stock and Watson (1989), to present evidence regarding the timing and characteristics of state-level business cycle phases. We are particularly interested in two questions: (1) How similar are the states in their growth rates in recession and expansion, and what might explain the differences in growth rates? (2) To what extent have states' recession and expansion experiences been in sync with each other's and with those of the country as a whole?

As the NBER chronology is available only for U.S. aggregate economic activity, alternative methods must be used to identify business cycle turning points in regional data. One popular approach is the algorithm given by Bry and Boschan (1971), which is designed to identify turning points between periods of expansion and contraction in the level of a time series. Bry and Boschan's procedure identifies local minima and maxima in the series, enforcing that business cycle phases are of some minimum length. An alternative, newer entrant into the field of business cycle dating is the Markov regime-switching model of Hamilton (1989). Hamilton specifies a parametric time series model in which the mean growth rate switches between high- and low-growth regimes. The timing of these regimes and the within-regime growth rates are then estimated from the data.

Both Bry and Boschan's and Hamilton's approaches have been shown to produce a reasonably accurate replication of the NBER chronology when applied to aggregate data.[2] Bry and Boschan's algorithm has the virtue of being very transparent, as it takes the form of a simple data-driven rule for dating turning points. However, for state-level data, Hamilton's approach has the advantage over the Bry and Boschan's of not requiring that recessions be absolute declines in economic activity. With regional data, it is quite possible that a given region might experience positive growth rates during recession, as the average growth rate for that region might be higher than the national average. Preliminary analysis suggests this is true for several U.S. states, and that in these cases Bry and Boschan's algorithm has difficulty identifying business cycle phases.[3] As a result, we focus our analysis here on business cycle phases identified using a Markov-switching model similar to that of Hamilton (1989).

In the next section, we outline the Markov-switching model that we use. We describe our estimation and data in section III. In section IV we address question (1); in sections V, VI, VII, and VIII we address question (2). Section IX concludes.

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* Federal Reserve Bank of St. Louis.

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[1] An exception is Guha and Banerji (1998/1999), who use employment data to suggest that the business cycle phases of California, New York, Illinois, and Florida have been different from those of the United States as a whole.

[2] See for example Boldin (1994), Chauvet and Piger (2003), and Harding and Pagan (2002).

[3] Indeed, Harding and Pagan (2002) have shown that the business cycle dates emerging from the Markov-switching model can be approximated by a simple algorithmic dating rule, providing easier comparison with Bry and Boschan's algorithm. A primary difference that becomes apparent from this comparison is that the magnitude of growth rates needed to trigger a regime shift in Hamilton's model will change from state to state, whereas they remain constant across states in Bry and Boschan's algorithm.

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II. Dating Business Cycle Phases Using a Markov-Switching Model

Hamilton's (1989) Markov-switching model identifies business cycle phase shifts as shifts in the mean growth rate of a parameteric statistical time series model for economic output. That is, different business cycle phases are treated as arising from different models. Here we specify a simple model for the growth rate of some measure of economic activity, y_t:

$$y_t = \mu_{S_t} + \varepsilon_t,$$
$$\varepsilon_t \sim N(0,\sigma_\varepsilon^2), \qquad (1)$$
$$\mu_{S_t} = \mu_0 + \mu_1 S_t, \qquad \mu_1 < 0,$$

where the growth rate has mean μ, and deviations from this mean growth rate are created by the stochastic disturbance ε_t. To introduce recession and expansion phases, allow the mean growth rate in (1) to switch between two regimes, where the switching is governed by a state variable, $S_t = \{0,1\}$. Because S_t is unobserved, estimation of equation (1) requires that we place restrictions on the probability process governing S_t. We assume that S_t is a first-order two-state Markov chain. This means that any persistence in the regime is completely summarized by the value of the state in the last period. Under this assumption, the probability process driving S_t is captured by the transition probabilities $\Pr[S_t = j \mid S_{t-1} = i] = p_{ij}$.

The model in equation (1) implies that, when S_t switches from 0 to 1, the growth rate of economic activity switches from μ_0 to $\mu_0 + \mu_1$. Because $\mu_1 < 0$, S_t switches from 0 to 1 at times when economic activity switches from higher-growth to lower-growth states, or vice versa.[4] Hamilton applied this model to the growth rate of the U.S. gross national product and found the best fit when $\mu_1 > 0$ and $\mu_0 + \mu_1 < 0$, suggesting that the model identified regimes when the economy was expanding as opposed to when it was contracting. The estimated probability that $S_t = 1$ conditional on all the data in the sample, denoted $\Pr[S_t = 1 \mid \Omega_T]$, corresponded very closely to the recession dates established by the NBER Business Cycle Dating Committee. This was particularly striking in that Hamilton estimated his model with only one variable describing economic activity.

The model in equation (1) could be complicated on various dimensions, such as allowing for dynamics, which would improve the model's fit of the data. We choose to focus on the simple shifting-mean model in equation (1), as our primary goal is to date regime shifts between high- and low-mean-growth regimes. More highly parameterized models that improved the statistical fit would be useful if our goal were instead to determine whether the data-generating process for the state-level data was linear or nonlinear, an interesting question that we do not address here. In this regard, however, it is interesting to note that Diebold and Rudebusch (1996) find substantial evidence of nonlinearity for the U.S. aggregate coincident index.

[4] This identifying restriction is necessary for normalization, as without it one can always reverse the definition of the state variable and obtain an equivalent description of the data.

III. Data and Estimation

Our data are the monthly state coincident indices described in Crone (2002), which, at the time of writing, are available for 1979:01–2002:06. One of the major hurdles in state-level analysis is the unavailability of suitable data. Aggregate business cycle models usually use a broad measure of economic activity such as gross domestic product, but this is not feasible for examining state business cycles, because the corresponding measure—gross state product—is available at only a yearly frequency and with a lag of 2 years. Because of these problems, the state and regional studies cited above use personal income as their broad measure of an economy's performance. Personal income is not suitable for our purposes, however, because it does not fluctuate very much with the business cycle. In contrast, the state coincident indices we use here display substantial business cycle variability.[5]

The model in equation (1) is estimated using the multi-move Gibbs-sampling procedure implemented by Kim and Nelson (1998) for Bayesian estimation of Markov-switching models.[6] Briefly, the Gibbs sampler iteratively draws from the conditional posterior distribution of each parameter (including the S_t for $t = 1, \ldots, T$) given the data and the draws of the other parameters of the model. These draws form an ergodic Markov chain whose distribution converges to the joint posterior distribution of the parameters given the data. In simulating this posterior distribution, we discard the first 2,000 draws to ensure convergence. Descriptive statistics regarding the sample posterior distributions are then based on an additional 10,000 draws.

Bayesian estimation requires that we specify prior distributions for the model parameters. The prior for the switching mean parameters, $[\mu_0, \mu_1]'$, is Gaussian with mean vector $[1, -1]'$ and a variance-covariance matrix equal to the identity matrix I. The transition-probability parameters, p_0 and p_1, have beta prior distributions, given by $\beta(9,1)$ and $\beta(8,2)$ respectively.[7] The variance parameter, σ_ε^2, has an improper inverted-gamma distribution.[8]

[5] Although the model is applied to a single economic time series for each state, it provides a richer picture of the economy than one might assume. This is because each coincident index series captures the comovement of several underlying economic variables, meaning that our model can be interpreted as capturing regime shifts in a common factor underlying several series. Diebold and Rudebusch (1996) make this point in discussing the U.S. aggregate coincident index.

[6] See Casella and George (1992) and Kim and Nelson (1999) for detailed descriptions.

[7] These priors would imply means of 0.9 and 0.8 and standard deviations of 0.09 and 0.12, respectively.

[8] This prior distribution is improper in the sense of O'Hagan (1994, p. 245), in that it specifies a distribution with infinite moments. However,

TABLE 1.—STATE GROWTH RATES IN RECESSION AND EXPANSION

State	Recession	Coverage Interval	Expansion	Coverage Interval	State	Recession	Coverage Interval	Expansion	Coverage Interval
Alabama	−0.224	(−0.298, −0.145)	0.320	(0.288, 0.353)	Montana	−0.312	(−0.367, −0.263)	0.246	(0.222, 0.271)
Alaska	−0.095	(−0.142, −0.045)	0.864	(0.755, 0.977)	Nebraska	−0.091	(−0.129, −0.053)	0.340	(0.316, 0.363)
Arizona	0.078	(0.036, 0.126)	0.617	(0.583, 0.656)	Nevada	−0.349	(−0.463, −0.242)	0.617	(0.571, 0.662)
Arkansas	−0.165	(−0.215, −0.117)	0.348	(0.322, 0.373)	New Hampshire	−0.162	(−0.240, −0.091)	0.557	(0.525, 0.588)
California	−0.017	(−0.042, 0.008)	0.434	(0.418, 0.449)	New Jersey	−0.014	(−0.052, 0.025)	0.371	(0.351, 0.393)
Colorado	−0.013	(−0.053, 0.025)	0.443	(0.422, 0.464)	New Mexico	0.091	(0.059, 0.124)	0.442	(0.416, 0.468)
Connecticut	−0.112	(−0.159, −0.069)	0.404	(0.378, 0.430)	New York	0.000	(−0.026, 0.024)	0.287	(0.273, 0.301)
Delaware	0.006	(−0.024, 0.036)	0.485	(0.460, 0.512)	North Carolina	−0.222	(−0.272, −0.171)	0.455	(0.427, 0.481)
Florida	−0.038	(−0.074, −0.001)	0.423	(0.406, 0.441)	North Dakota	−0.360	(−0.552, −0.214)	0.208	(0.156, 0.259)
Georgia	−0.016	(−0.062, 0.029)	0.482	(0.459, 0.506)	Ohio	−0.179	(−0.212, −0.147)	0.266	(0.250, 0.282)
Hawaii	−0.092	(−0.129, −0.051)	0.366	(0.331, 0.404)	Oklahoma	−0.782	(−0.961, −0.602)	0.223	(0.191, 0.255)
Idaho	−0.345	(−0.423, −0.271)	0.501	(0.462, 0.538)	Oregon	−0.330	(−0.392, −0.272)	0.449	(0.422, 0.477)
Illinois	−0.331	(−0.371, −0.292)	0.371	(0.347, 0.396)	Pennsylvania	−0.319	(−0.381, −0.254)	0.3056	(0.277, 0.337)
Indiana	−0.425	(−0.494, −0.355)	0.367	(0.337, 0.399)	Rhode Island	−0.255	(−0.318, −0.197)	0.428	(0.393, 0.462)
Iowa	−0.166	(−0.232, −0.117)	0.260	(0.233, 0.282)	South Carolina	−0.205	(−0.265, −0.145)	0.451	(0.421, 0.482)
Kansas	−0.425	(−0.515, −0.335)	0.237	(0.216, 0.260)	South Dakota	−0.172	(−0.228, −0.120)	0.380	(0.350, 0.407)
Kentucky	−0.432	(−0.496, −0.366)	0.328	(0.303, 0.353)	Tennessee	−0.150	(−0.209, −0.093)	0.413	(0.384, 0.442)
Louisiana	−0.385	(−0.439, −0.333)	0.184	(0.162, 0.207)	Texas	−0.163	(−0.228, −0.062)	0.354	(0.332, 0.381)
Maine	−0.089	(−0.147, −0.031)	0.509	(0.459, 0.563)	Utah	−0.009	(−0.056, 0.029)	0.466	(0.440, 0.489)
Maryland	−0.112	(−0.163, −0.065)	0.448	(0.411, 0.481)	Vermont	−0.212	(−262, −0.161)	0.443	(0.415, 0.472)
Massachusetts	−0.558	(−0.657, −0.459)	0.509	(0.465, 0.553)	Virginia	−0.037	(−0.071, −0.001)	0.370	(0.352, 0.387)
Michigan	−0.928	(−1.059, −0.804)	0.397	(0.347, 0.447)	Washington	−0.349	(−0.433, −0.264)	0.580	(0.521, 0.637)
Minnesota	−0.286	(−0.354, −0.206)	0.381	(0.354, 0.408)	West Virginia	−1.656	(−2.373, −1.196)	0.388	(0.256, 0.507)
Mississippi	−0.078	(−0.107, −0.048)	0.338	(0.317, 0.357)	Wisconsin	−0.248	(−0.324, −0.185)	0.324	(0.298, 0.350)
Missouri	−0.145	(−0.175, −0.116)	0.304	(0.286, 0.321)	Wyoming	−1.246	(−1.335, −1.155)	0.284	(0.255, 0.315)

90% coverage intervals are shown in parentheses.

IV. Within-Regime Growth Rates

Our first set of results, the state-level monthly growth rates in the two regimes, are presented in table 1 along with their 90% coverage intervals.[9] For each state, the difference between regimes is economically large and statistically important, indicating that the regimes are well separated. For every state, the expansion growth rate is positive, and for every state except Arizona, Delaware, and New Mexico, the recession growth rate is negative. Note, though, that a recession growth rate of zero is within the coverage interval for Delaware and five states whose estimated recession growth rates are negative: California, Colorado, Georgia, New Jersey, and Utah.

As is obvious from the table, there are large cross-state differences in each regime. For example, whereas the median recession growth rate across the states is −0.18% per month, there are five states—Massachusetts, Michigan, Oklahoma, West Virginia, and Wyoming—whose economies contract at more than 3 times this rate during a recession. In addition, there are eleven states whose economies contract by less than one-third of this rate during a recession. There is something of a regional pattern to the state-level recession growth rates. In particular, the manufacturing states in the western Great Lakes area are all among those that contract the fastest while in recession. Those that contract the slowest during recession are in the southern Rocky Mountain area—Arizona, Colorado, New Mexico, and Utah—and the mid-Atlantic area—Delaware, New Jersey, and New York.

The cross-state differences in growth rates during expansion are also large. Whereas the median monthly growth rate is 0.38%, five states have expansion growth rates more than 15 basis points above this (Alaska, Arizona, Nevada, New Hampshire, and Washington), and three (Louisiana, North Dakota, and Oklahoma) have expansion growth rates more than 15 basis points below this. The high-growth states tend to be located in the West, New England, and the Southeast.

As a first step in explaining these cross-state differences in growth rates, we regressed them on several industrial, demographic, and tax variables. We included the states' employment shares in manufacturing; construction and mining; and finance, insurance, and real estate. We also included two education variables: the share of a state's population aged 25 and older with a high school diploma (but no college degree) and the share of the same population with a bachelor's degree. To control for state-level age differences, we include the share of a state's population that is of prime working age (18–44). Finally, we also include the maximum marginal tax rates on wages and salaries and on capital gains, combining the state and federal rates generated by the NBER's TAXSIM model.

Our regression results are reported in table 2 and suggest that there are significant differences between regimes in the types of factors that determine growth rates. On the one hand, state-level differences in recession growth rates tend to depend on the predominance of recession-sensitive in-

this prior yields a proper posterior distribution (Albert and Chib, 1993; O'Hagan, 1994, p. 292).

[9] Our estimate of a growth rate is the mean of its posterior distribution.

TABLE 2.—REGRESSION RESULTS FOR RECESSION AND EXPANSION GROWTH RATES

	Recession Growth Rate		Expansion Growth Rate	
	Coeff.	S.E.	Coeff.	S.E.
Constant	0.424	1.225	−1.394*	0.591
Employment share of manufacturing	−0.014*	0.008	0.002	0.004
Employment share of mining and construction	−0.077*	0.030	0.001	0.013
Employment share of finance, insurance, and real estate	0.027	0.035	0.003	0.014
Share of 25+ population with HS diploma only	−0.011	0.009	0.006*	0.003
Share of 25+ population with a bachelor's degree	0.006	0.018	−0.002	0.006
Share of population between ages of 18 and 44	0.020	0.022	0.039*	0.013
Max. marginal tax on wages and salaries (state+federal)	−0.004	0.033	0.012	0.021
Max. marginal tax on capital gains (state+federal)	−0.010	0.047	−0.029	0.028
Root MSE	0.283		0.101	
R^2	0.332		0.416	

Standard errors are White-corrected.
*Statistically significant at the 10% level.

dustries, but not on demographics or tax rates. Specifically, a state whose share of employment in manufacturing is 1 standard deviation higher would tend to see a yearly recession growth rate that is approximately 1 percentage point lower. Similarly, a 1-standard-deviation-higher share of employment in construction and mining would tend to mean a 2-percentage-point-lower yearly recession growth rate. None of the other variables have coefficients that are statistically different from 0.

On the other hand, state-level differences in expansion growth rates appear to be related to differences in demographics, but not to industrial composition or tax rates. A 1-standard-deviation-higher share with a high school diploma is related to a yearly expansion growth rate approximately one-third of a percentage point higher. Interestingly, states with a higher share of population with a bachelor's degree have no statistically significant growth advantage. A state's age profile also appears to matter. A 1-standard-deviation-higher share aged 18–44 is associated with an expansion growth rate that is approximately 1 percentage point higher. This result, however, might simply be a reflection of the tendency of prime-aged workers to migrate to high-growth states.

V. State-Level Regime Switching

In addition to the growth rates in the two regimes, the model produces for each state and month the estimated probability that the state is in a recession. To illustrate some of the variety at the state level, figure 1 presents the monthly recession probability over the sample period for six selected states—California, Florida, Maryland, Missouri, New Mexico, and Texas. These states were selected because each is roughly representative of a subgroup of states. There is a great deal of state-level variety not illustrated in figure 1, however, and the complete set of monthly state recession probabilities is available at http://research.stlouisfed.org/wp/more/2003-011/.

For reference, the charts in figure 1 include shaded areas to indicate periods of national recession as determined by the NBER. Although short, the sample period provides a rich variety of experiences. It included four national recessions of varying lengths and causes punctuated by three expansions—one short and two long.[10]

The first thing to notice about the state recession probabilities is that, for each period, they tend to be close to 0 or 1, indicating that at any point in time it is usually a simple matter to say whether each state's economy is in its recession or expansion phase. The second thing to notice is that the phases tend to last for at least several periods, meaning that the model is detecting persistent changes in the mean growth rates. And, finally, though state-level recessions tend to be associated with national recessions, there is still a great deal of state-specific variation in the timing and length of recessions.[11] Specifically, individual states can (i) switch into or out of recession long before or long after the nation as a whole does, (ii) be in expansion during the entire time that the nation is in recession, and (iii) experience a recession that is not associated with any national recession.

Given that it is the largest and most economically diverse state, it is not very surprising that California's recession-expansion history is similar to that of the nation as a whole. Specifically, its economy experienced all four national recessions and no idiosyncratic recessions. Its most obvious deviation from the national experience was its extremely long recession associated with the national 1990–1991 recession. California remained in recession until March 1994.

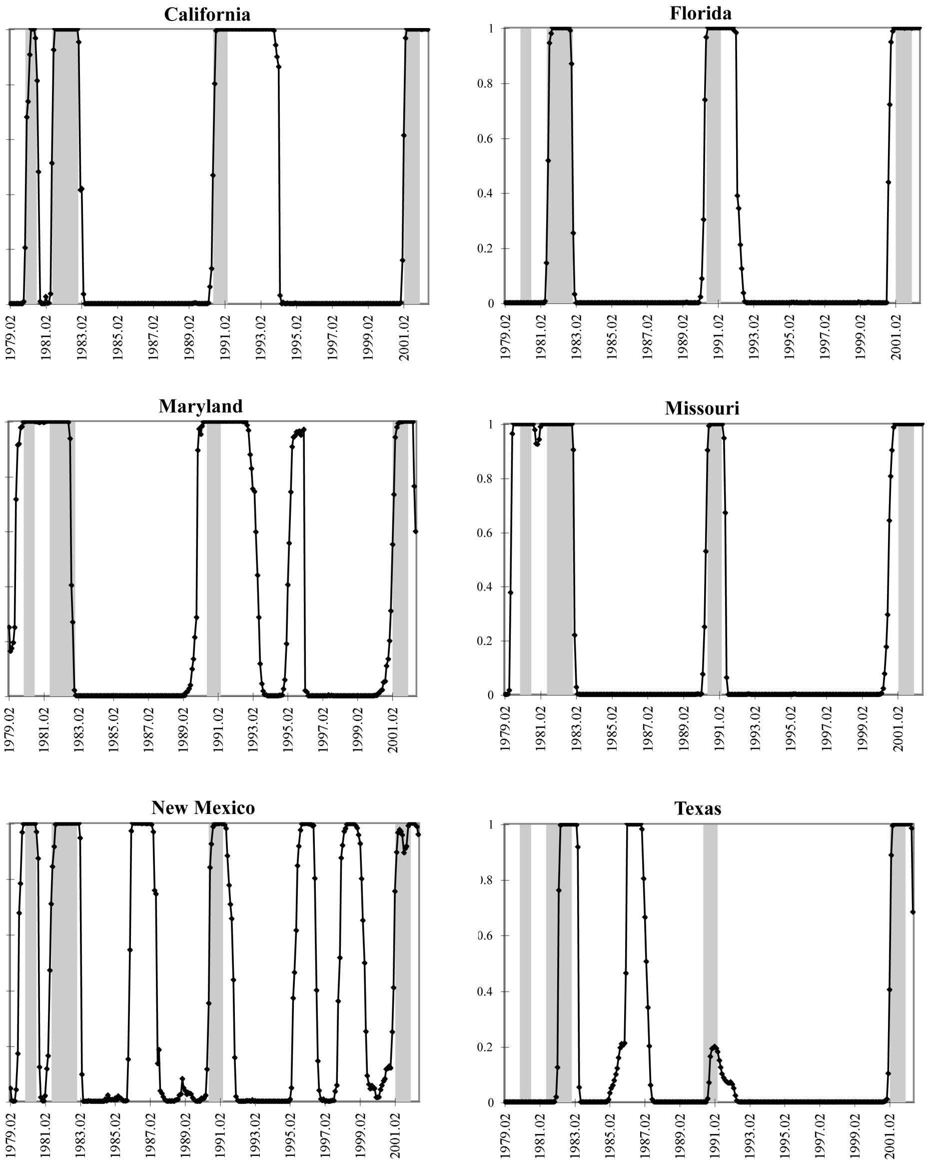
Because Florida and Missouri are also diverse economies, they might be expected to follow the national economy quite closely. Each state, however, has experienced significant business cycle idiosyncrasies. Namely, Florida did not experience the 1980 recession and did not switch out of the 1990–1991 recession until approximately a year after the country as a whole. Missouri, on the other hand, saw one long recession between July 1979 and December 1982, never seeing the brief expansion phase between the 1980 and 1981–1982 national recessions. More recently, Missouri switched into recession in August 2000, seven months before the national economy did.

Maryland is a state whose recession experience has elements of those of many other states, but it has a business cycle that is very different from that of the nation as a whole. Like Missouri, Maryland saw one long recession from 1979 into 1982, and, like California, it saw a much longer recession in the early 1990s than did the country,

[10] The dates of the national recessions are 1980.01–1980.07, 1981.07–1982.11, 1990.07–1991.03, and 2001.03–2001.11.

[11] Note that we adopt the admittedly arbitrary convention that a state is in recession when its recession probability exceeds 0.5.

FIGURE 1.—MONTHLY RECESSION PROBABILITIES FOR SELECTED STATES, 1979.02–2002.06



National NBER recessions are indicated by shaded areas.

although Maryland's also began earlier. Most interestingly. Maryland experienced a mid-1990s recession that was not experienced by the national economy.

New Mexico's recent recession history is among the most peculiar, in that it experienced three nonnational recessions in addition to four recessions that were roughly in line with national recessions. Recall, though, that New Mexico's business cycle is also peculiar in that its recession growth rate is positive.

Because of the importance of the energy sector, the business cycle of Texas was often out of sync with the country as a whole. It did not experience a recession in 1980 and missed the first half of the 1981–1982 recession. It had an energy-related recession in the mid-1980s that was also experienced by several other states—but not the country—and it was not in recession again until 2001.

As mentioned above, the business cycle experience of these six states is far from exhaustive of the state-level variety of switches into and out of recession. Although we will not discuss them in detail, notably interesting business cycles have been experienced by Alaska, Arizona, Delaware, Hawaii, Maine, Montana, Washington, and any Plains or energy-intensive state.

To provide a more general picture of how the states' business cycles relate to each other and to that of the national economy, we constructed tables 3 and 4, which condense our monthly results into quarters. The tables indicate with a black bar when a state was in recession in any month within a quarter over the sample period. In addition, the shaded regions indicate when the national economy was in a recession. From these tables, one can see

TABLE 3.—STATE RECESSIONS AND EXPANSIONS BY QUARTER, 1979.I–1990.IV

Year	1979				1980				1981				1982			
Quarter	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Alabama					■	■	■		■	■	■	■	■	■	■	■
Alaska	■	■	■	■	■	■										
Arizona					■	■	■		■	■	■	■	■	■	■	■
Arkansas			■	■	■	■	■	■	■	■	■	■	■	■	■	■
California					■	■	■		■	■	■		■	■	■	■
Colorado						■	■						■	■	■	■
Connecticut						■	■				■	■	■	■	■	■
Delaware	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Florida											■	■	■	■	■	■
Georgia					■	■	■			■	■	■	■	■	■	■
Hawaii							■	■	■	■	■	■	■	■	■	
Idaho	■		■	■	■	■	■			■	■	■	■	■	■	■
Illinois				■	■	■	■	■	■	■	■	■	■	■	■	■
Indiana			■	■	■	■	■			■	■	■	■	■	■	■
Iowa				■	■	■	■		■	■	■	■	■	■	■	■
Kansas					■	■					■	■	■	■	■	■
Kentucky			■	■	■	■	■			■		■	■	■	■	■
Louisiana	■	■											■	■	■	■
Maine	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Maryland			■	■	■	■	■	■	■	■	■	■	■	■	■	
Massachusetts			■	■	■	■	■		■		■	■	■	■	■	■
Michigan						■				■	■	■	■	■		
Minnesota			■	■	■	■	■			■	■	■	■	■	■	■
Mississippi			■	■	■	■	■	■	■	■	■	■	■	■	■	■
Missouri			■	■	■	■	■	■	■	■	■	■	■	■	■	■
Montana			■	■	■	■	■			■	■	■	■	■	■	
Nebraska			■	■	■	■	■	■	■	■	■	■	■	■	■	■
Nevada					■	■	■			■	■	■	■	■	■	■
New Hampshire						■	■					■	■	■	■	
New Jersey	■	■				■	■					■	■	■		■
New Mexico			■	■	■	■	■				■	■	■	■	■	■
New York					■	■	■					■	■	■	■	■
North Carolina				■	■	■	■				■	■	■	■	■	■
North Dakota				■	■	■	■						■	■	■	■
Ohio	■	■	■	■	■	■	■				■	■	■	■	■	■
Oklahoma	■	■	■											■	■	■
Oregon					■	■	■	■	■	■	■	■	■	■	■	■
Pennsylvania				■	■	■	■			■	■	■	■	■	■	■
Rhode Island	■	■	■	■	■	■	■			■	■	■	■	■	■	■
South Carolina			■	■	■	■	■		■	■	■	■	■	■	■	■
South Dakota	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Tennessee			■	■	■	■	■			■	■	■	■	■	■	■
Texas	■	■												■	■	■
Utah			■	■	■	■	■	■	■	■	■	■	■	■	■	■
Vermont				■	■	■	■				■	■	■	■	■	■
Virginia	■	■			■	■	■		■	■	■	■	■	■	■	■
Washington				■	■	■	■	■	■	■	■	■	■	■	■	■
West Virginia			■	■	■	■	■		■	■			■	■	■	■
Wisconsin				■	■	■	■		■	■	■	■	■	■	■	■
Wyoming														■	■	■

Year	1983				1984				1985				1986			
Quarter	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Alabama																
Alaska				■	■	■	■	■	■	■	■	■	■	■	■	■
Arizona																
Arkansas																
California																
Colorado	■	■						■	■	■	■	■	■	■	■	■
Connecticut																
Delaware																
Florida																
Georgia																
Hawaii																
Idaho											■	■	■	■	■	
Illinois	■															
Indiana																
Iowa	■							■	■	■	■	■				
Kansas																
Kentucky																
Louisiana	■	■						■	■	■	■	■	■	■	■	■
Maine	■															
Maryland																
Massachusetts																
Michigan																
Minnesota																
Mississippi	■												■	■	■	
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Montana								■	■	■	■	■	■	■	■	■
Nebraska	■								■	■	■	■				
Nevada	■															
New Hampshire																
New Jersey																
New Mexico	■												■	■	■	■
New York	■															
North Carolina																
North Dakota						■	■	■	■	■	■	■	■	■		
Ohio	■															
Oklahoma	■								■	■			■	■	■	
Oregon																
Pennsylvania	■															
Rhode Island																
South Carolina																
South Dakota									■	■	■	■				
Tennessee																
Texas	■	■											■	■	■	■
Utah	■	■										■	■	■	■	■
Vermont																
Virginia																
Washington																
West Virginia	■															
Wisconsin	■															
Wyoming	■	■											■	■	■	■

Year	1987				1988				1989				1990			
Quarter	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Alabama															■	■
Alaska	■	■	■	■	■	■	■				■	■	■	■	■	■
Arizona				■	■	■	■	■	■	■	■	■	■	■	■	■
Arkansas																■
California															■	■
Colorado	■	■			■											■
Connecticut									■	■	■	■	■	■	■	■
Delaware										■	■	■	■	■	■	■
Florida														■	■	■
Georgia														■	■	■
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Kentucky																■
Louisiana	■															
Maine									■	■	■	■	■	■	■	■
Maryland													■	■	■	■
Massachusetts																■
Michigan									■	■	■	■	■	■	■	■
Minnesota																■
Mississippi															■	■
Missouri														■	■	■
Montana	■	■	■													
Nebraska																
Nevada																■
New Hampshire									■	■	■	■	■	■	■	■
New Jersey										■	■	■	■	■	■	■
New Mexico	■	■													■	■
New York										■	■	■	■	■	■	■
North Carolina														■	■	■
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Pennsylvania														■	■	■
Rhode Island										■	■	■	■	■	■	■
South Carolina															■	■
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Tennessee														■	■	■
Texas	■															
Utah	■	■	■													
Vermont										■	■	■	■	■	■	■
Virginia														■	■	■
Washington															■	■
West Virginia															■	■
Wisconsin																■
Wyoming	■															

National NBER recessions are indicated by a gray background.

TABLE 4.—STATE RECESSIONS AND EXPANSIONS BY QUARTER, 1991.I–2002.II

Year	1991				1992				1993				1994				1995				1996				1997				1998				1999				2000				2001				2002	
Quarter	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II
Alabama	■																																						■	■	■	■	■	■	■	■
Alaska	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Arizona	■	■	■	■	■	■	■	■																														■	■	■	■	■	■	■	■	■
Arkansas	■																																						■	■	■	■	■	■	■	■
California	■	■	■	■	■	■	■	■	■	■	■	■	■																												■	■	■	■	■	■
Colorado	■	■																																						■	■	■	■	■	■	■
Connecticut	■	■	■	■	■	■																																		■	■	■	■	■	■	■
Delaware	■	■	■	■	■	■	■	■		■	■	■	■																								■	■	■	■	■	■	■	■	■	■
Florida	■	■	■	■	■																																			■	■	■	■	■	■	■
Georgia	■	■	■	■																			■	■																■	■	■	■	■	■	■
Hawaii				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■									■	■	■	■	■	
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Kansas	■																																													
Kentucky	■																																							■	■	■				
Louisiana																																													■	■
Maine	■	■	■	■	■	■	■	■	■	■									■	■	■	■	■																■	■	■	■	■	■	■	■
Maryland	■	■	■	■	■	■	■	■	■	■									■	■	■	■																			■	■	■	■	■	■
Massachusetts	■																																							■	■	■	■	■		
Michigan	■	■	■																																						■	■	■	■	■	■
Minnesota	■																																								■	■	■	■		
Mississippi	■	■																																		■	■	■	■	■	■	■	■	■	■	■	■
Missouri	■	■																																					■	■	■	■	■	■	■	■
Montana																																														
Nebraska	■	■		■																																		■	■	■	■	■	■	■	■	■
Nevada	■	■	■	■	■																																					■	■	■		
New Hampshire	■	■	■																																						■	■	■	■	■	■
New Jersey	■	■	■	■	■	■																																			■	■	■	■	■	■
New Mexico	■	■	■	■																■	■	■	■	■						■	■	■	■	■	■							■	■	■	■	■	■
New York	■	■	■	■	■	■	■																																		■	■	■	■	■	■
North Carolina	■	■																																					■	■	■	■	■	■	■	■
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Ohio	■	■																																						■	■	■	■	■	■	■
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Oregon	■	■																																						■	■	■	■	■	■	■
Pennsylvania	■	■	■																			■																				■	■	■	■	■	■
Rhode Island	■	■	■	■																																					■	■	■	■		
South Carolina	■	■	■																																				■	■	■	■	■	■	■	■
South Dakota																																							■	■	■	■	■	■	■		
Tennessee	■	■																																					■	■	■	■	■	■	■	■
Texas																																										■	■	■	■	■
Utah																																						■	■	■	■	■	■	■	■
Vermont	■	■		■	■																																				■	■	■	■	■	■
Virginia	■	■	■	■	■																																				■	■	■	■	■	■
Washington	■	■	■	■	■	■	■	■										■	■	■																	■	■	■	■	■	■	■	■	■	■
West Virginia	■																																												■	■
Wisconsin	■																																							■	■	■	■	■	■	
Wyoming																																														

National NBER recessions are indicated by a gray background.

all at once the variety of recession-expansion experiences across the 50 states.

Tables 3 and 4 provide a great deal of information about the business cycles of each of the 50 states. Our present interest is in the general lessons that can be drawn from the results, rather than an exhaustive dissection of each state's business cycle experience over the past 24 years. It is left to the reader to tackle each line and column of tables 3 and 4, not to mention the 50 monthly recession probability charts, at his or her leisure.

Tables 3 and 4 illustrate four notable general results: (i) A large number of states tend to be in recession earlier than and/or longer than the country as a whole. In the case of the 1990–1991 recession, many were in recession at least an entire year before and/or after the national economy had switched. (ii) In 1980, 1990–1991, and 2001, a significant number of states remained in expansion while the nation as a whole was in recession. (iii) The 1981–1982 national recession achieved near-unanimity at the state level. (iv) Fifteen states experienced recession in the mid-1980s when the national economy was in a long expansion phase.

VI. The Persistence of Expansion and Recession

Now consider table 5, which presents the conditional expectation of a state remaining in a regime, along with the expected duration of each regime. Two facts are immediately apparent. First, for every state in either regime, the probability of remaining in the current regime is much greater than the probability of switching to the other one; that is, the regimes are persistent. Second, for most states, the expected expansion duration is much longer than the expected recession duration. This suggests that, though each state experiences relatively short recessionary periods, the baseline regime is expansion.

It is clear from table 5 that there are very large cross-state differences in the expected durations of expansions and recessions. Whereas the median expected duration of an expansion is 52 months, for five states the expected duration of an expansion is at least a year shorter than this. For Alaska and New Mexico, it is more than two years shorter. At the other end, there are 14 states whose expansions are expected to last at least a year longer than that of the median state. For half of these, expansions are expected to last two years longer than the median state's. The cross-state differences in recession durations are similarly large. The median state has an expected recession duration of 17 months, but for five states it is at least half a year shorter, and for 14 states it is at least half a year longer.

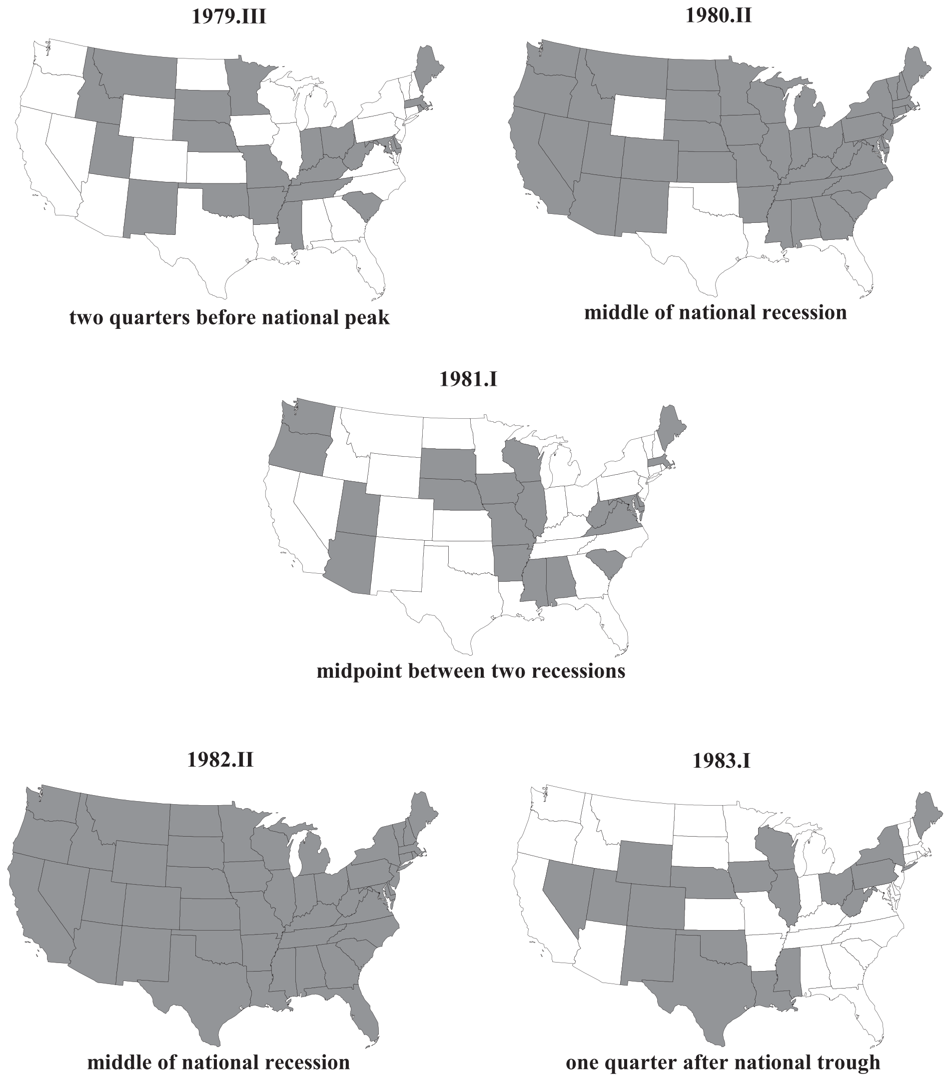
VII. The Geography of National Recessions

The catalog of state-level recessions provided by tables 3 and 4 can be used to provide a geographic perspective on the relationship between state and national recessions. These patterns are illustrated by figures 2–4 for the 48 contiguous states. Below, we use these figures to describe distinct regional patterns to the four national recessions that occurred between 1979 and 2002. In addition, there was a nonnational recession during the mid-1980s, when a large number of states were in recession but the country as a whole was not. Slide shows of the quarter-by-quarter geo-

TABLE 5.—THE PERSISTENCE OF STATE-LEVEL EXPANSIONS AND RECESSIONS

	Expansion		Recession			Expansion		Recession	
State	Probability of Remaining	Expected Duration	Probability of Remaining	Expected Duration	State	Probability of Remaining	Expected Duration	Probability of Remaining	Expected Duration
Alabama	0.975	50	0.913	14	Montana	0.980	64	0.923	16
Alaska	0.939	23	0.979	62	Nebraska	0.971	42	0.939	20
Arizona	0.971	43	0.964	36	Nevada	0.975	50	0.908	13
Arkansas	0.983	84	0.948	27	New	0.977	54	0.925	17
California	0.975	50	0.947	23	New Jersey	0.970	42	0.928	17
Colorado	0.967	35	0.931	17	New Mexico	0.949	22	0.930	16
Connecticut	0.975	51	0.943	22	New York	0.974	48	0.941	21
Delaware	0.977	63	0.966	38	North Carolina	0.977	54	0.928	17
Florida	0.982	75	0.943	23	North Dakota	0.968	43	0.855	9
Georgia	0.970	40	0.918	14	Ohio	0.982	72	0.928	17
Hawaii	0.968	42	0.962	34	Oklahoma	0.984	91	0.848	8
Idaho	0.975	49	0.913	14	Oregon	0.982	77	0.938	21
Illinois	0.981	69	0.955	30	Pennsylvania	0.972	44	0.906	13
Indiana	0.976	53	0.920	15	Rhode Island	0.979	64	0.931	17
Iowa	0.975	51	0.929	18	South Carolina	0.976	53	0.933	18
Kansas	0.985	95	0.862	9	South Dakota	0.983	89	0.936	19
Kentucky	0.975	47	0.876	9	Tennessee	0.976	52	0.936	19
Louisiana	0.983	76	0.931	19	Texas	0.982	73	0.917	16
Maine	0.970	43	0.960	32	Utah	0.978	61	0.955	30
Maryland	0.973	47	0.951	25	Vermont	0.970	40	0.923	15
Massachusetts	0.974	48	0.920	15	Virginia	0.977	54	0.940	21
Michigan	0.973	45	0.898	12	Washington	0.973	45	0.947	23
Minnesota	0.978	57	0.904	12	West Virginia	0.978	63	0.886	11
Mississippi	0.972	44	0.947	23	Wisconsin	0.977	55	0.900	12
Missouri	0.981	67	0.954	29	Wyoming	0.988	132	0.895	13

FIGURE 2.—NATIONAL RECESSIONS 1980.I–1980.III AND 1981.III–1982.IV



graphic distribution of state-level recessions for each of these periods are available at http://research.stlouisfed.org/wp/more/2003-011/.

A. *The 1980 and 1981–1982 National Recessions*

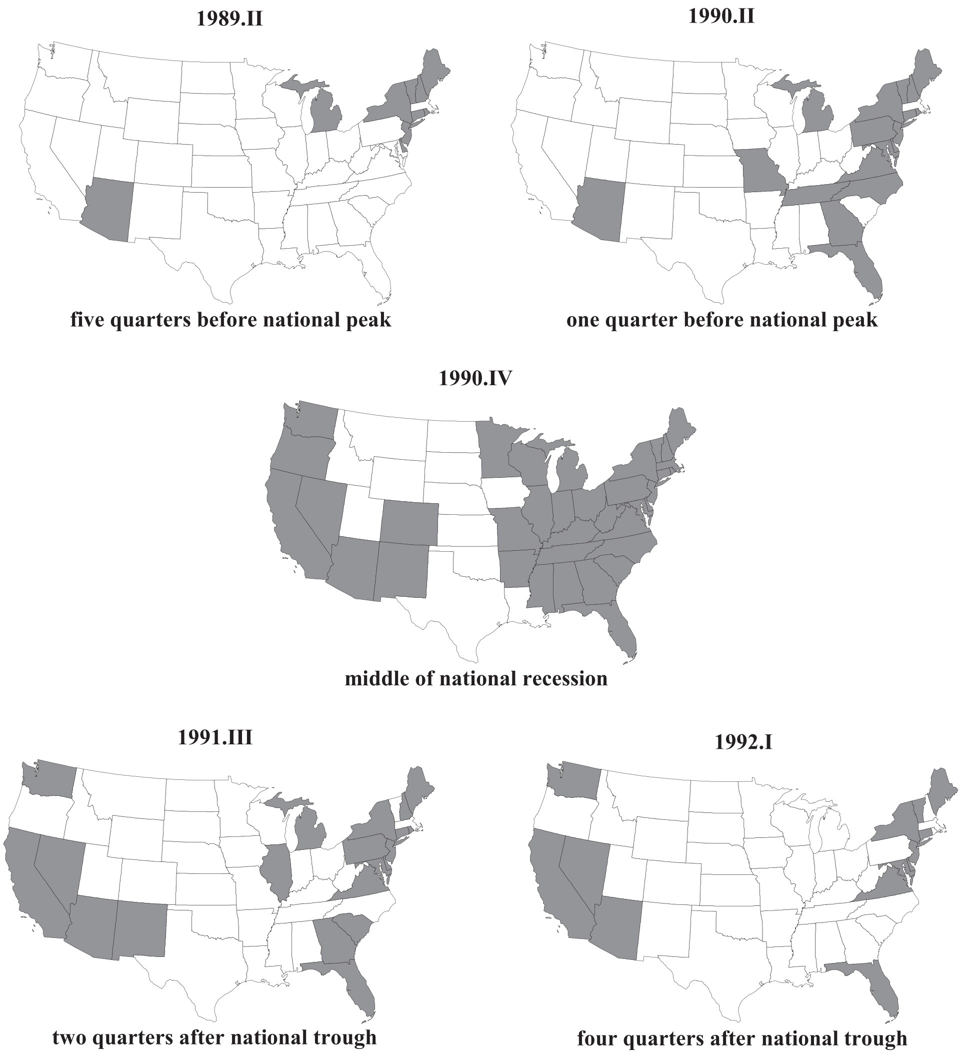
The two national recessions of the early 1980s occurred with only one year separating them, so we present them as one long event. Given that 12 of the contiguous states never left the first recession before the second one began nationally, this is particularly appropriate in the present context. As the first map in figure 2 shows, 22 states spread across the country were in recession in the third quarter of 1979—two quarters before the national recession began. Except for the far west of the country, every region had some states that were in recession this far ahead of the country. By the midpoint of the recession in the second quarter of 1980, nearly all states had entered recession. The exceptions were the oil states of Texas, Oklahoma, and Louisiana, along with Florida and Wyoming. The national recession ended in the third quarter of 1980, but two quarters later, 20 states were still in recession. These included most of the states in the Mississippi and Missouri valleys, as well as the southern mid-Atlantic states. Of these 20 states, 12 never switched out of the 1980 recession and experienced one long recession spanning the two national recessions.

The second national recession of the early 1980s was even more geographically widespread than the first: All 48 contiguous states were in recession at its midpoint in the second quarter of 1982. Once the recession ended at the national level, it ended fairly quickly across the states. Although there were 18 states still in recession one quarter later (located in the Southwest, in the southern Rocky Mountains, and around the Great Lakes), this was reduced to five by the next quarter.

B. *The 1990–1991 National Recession*

The national recession of 1990–1991 exhibited particularly distinct geographic patterns. As shown by figure 3,

FIGURE 3.—NATIONAL RECESSION 1990.III–1991.I



most of the states in the Northeast, along with Michigan and Arizona, were in recession at least five quarters before the national recession began. By the quarter just prior to the national recession, another eight states (primarily down the east coast) had switched into recession. In the middle of the national recession, nearly the entire eastern half of the country was in recession, as were the far western states. On the other hand, most states between Montana and Texas were still in expansion.

A well-known feature of the 1990–1991 national recession was its lingering effects in some parts of the country, a feature borne out by our results. Two quarters after the end of the national recession, there were 20 states—nearly all on the eastern and western edges of the country—that had not yet switched into expansion. Furthermore, even four quarters after the recession had ended at the national level, at the state level it had merely receded to the Northeast and was continuing in most of the West and Southwest, where it lasted for several more quarters.

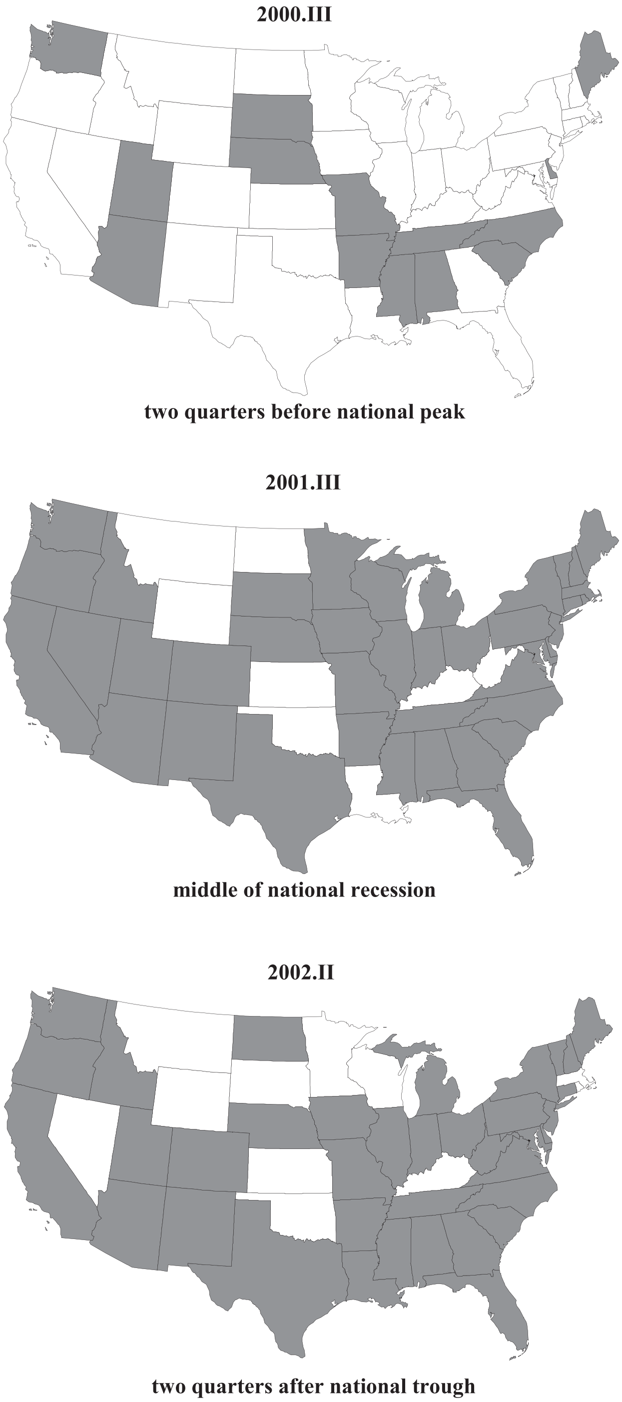
C. The 2001 National Recession

The most recent national recession, which began in the first quarter of 2001, began in parts of the country well before that. As figure 4 shows, there were 14 states, including much of the South, that were already in recession by the third quarter of 2000. By the next quarter the recession had spread throughout the Midwest and was experienced almost nationwide at its midpoint. Except for scattered switches into expansion, 37 states were still in recession in the second quarter of 2002 despite the fact that, according to the NBER, the national recession had ended two quarters earlier.

D. The 1985–1986 Nonnational Recession

There were four national recessions during the 24-year period we have considered, each with its own geographic dimension. In addition, there was a period in the mid-1980s when a significant number of states experienced a recession that was confined to a distinct geographic swath of the

FIGURE 4.—NATIONAL RECESSION 2001.I–2001.IV



country. Specifically, while the national economy was in expansion, 14 states were in recession during the last quarter of 1985 and/or the first quarter of 1986. These states included nearly every state between Idaho and Louisiana. There was a plunge in oil prices during this period, which, because many of these states have large energy sectors, may explain the root of their recessions. Around the same time, the recessions in the Plains states were likely due to the mid-1980s farm crisis. The rest of the country, however, reveled in the low energy prices and continued with its long expansion.

VIII. Concordance

As we have described above, although there is a general tendency for states to experience recessions that are associated with national recession, state recessions differ from the nation's in length and timing. In addition, states frequently experience recessions that are not associated with any national recessions, or continue to be in expansion throughout periods when the country is in recession. The precise extent to which the state cycles are in sync with the national cycle remains an open question.

Harding and Pagan (2004) measure the degree to which two business cycles are in sync by the percentage of time the two economies were in the same regime—their degree of concordance.[12] Specifically, the degree of concordance between the business cycles of state *i* and the United States is

$$C_{i,\mathrm{US}} = \frac{1}{T}\sum_{t=1}^{T} [S_{it}S_{\mathrm{US},t} + (1 - S_{it})(1 - S_{\mathrm{US},t})], \qquad (2)$$

where t denotes the period and T is the total number of periods. The state-nation concordance measures are reported in table 6. Note that these concordance measures should be interpreted relative to an expected value for $C_{i,\mathrm{US}}$ under the null hypothesis that the business cycles of state i and the United States are uncorrelated, which need not be 0 if one business cycle phase is more persistent than the other. Table 6 also reports these expected concordance measures.

Perhaps not surprisingly, Alaska and Hawaii were, by far, the least in sync with the national economy, having been in the same regime as the country only 22% and 56% of the time, respectively. Of the 48 contiguous states, Maine, Delaware, Arizona, New Mexico, Louisiana, and Maryland were in the same regime as the nation less than 75% of the time. At the other end, eleven states were in sync with the national cycle more than 90% of the time. Minnesota, Wisconsin, Kansas, and Michigan had the highest degrees of concordance, all above 0.92.

We see some clear regional patterns in the concordance numbers. In particular, in addition to the noncontiguous states, all but one state from Montana and North Dakota in the north to Arizona and Texas in the south are in the lower third of states in their concordance with the national business cycle. Note that many of these states experienced recession in the mid-1980s while the country was in expansion and remained in expansion during 1990–1991 while the country was in recession. Washington, Maine, Delaware, and Maryland are somewhat idiosyncratic in that their

[12] We use the same U.S. peak and trough dates as in figure 1 and tables 3 and 4.

TABLE 6.—CONCORDANCE BETWEEN STATE AND NATIONAL BUSINESS CYCLES

State	Concordance	Null Expected Concordance	State	Concordance	Null Expected Concordance
Alabama	0.897	0.691	Montana	0.772	0.693
Alaska	0.217	0.284	Nebraska	0.801	0.631
Arizona	0.715	0.549	Nevada	0.918	0.698
Arkansas	0.861	0.681	New Hampshire	0.858	0.693
California	0.829	0.631	New Jersey	0.824	0.656
Colorado	0.762	0.631	New Mexico	0.719	0.554
Connecticut	0.826	0.641	New York	0.829	0.641
Delaware	0.669	0.531	North Carolina	0.911	0.688
Florida	0.879	0.698	North Dakota	0.790	0.721
Georgia	0.890	0.673	Ohio	0.909	0.688
Hawaii	0.555	0.511	Oklahoma	0.815	0.789
Idaho	0.840	0.691	Oregon	0.907	0.693
Illinois	0.858	0.651	Pennsylvania	0.907	0.683
Indiana	0.911	0.693	Rhode Island	0.847	0.648
Iowa	0.829	0.671	South Carolina	0.879	0.668
Kansas	0.929	0.786	South Dakota	0.801	0.658
Kentucky	0.911	0.733	Tennessee	0.886	0.666
Louisiana	0.741	0.718	Texas	0.820	0.738
Maine	0.662	0.509	Utah	0.762	0.623
Maryland	0.747	0.584	Vermont	0.868	0.661
Massachusetts	0.865	0.693	Virginia	0.871	0.663
Michigan	0.925	0.708	Washington	0.779	0.601
Minnesota	0.943	0.721	West Virginia	0.868	0.733
Mississippi	0.804	0.614	Wisconsin	0.932	0.713
Missouri	0.868	0.653	Wyoming	0.804	0.777

cycles are much less similar to the national cycle than are those of their immediate neighbors. In contrast, most of the South and much of the Rust Belt has tended to be relatively in sync with the national cycle.

This analysis cuts both ways. Whereas our state-level concordance measure shows how similar or dissimilar states are to the nation, it also indicates how the national recessions may be representative of the coastal economies. In other words, table 6 reflects states' relative discordance with the nation and the nation's relative discordance with some states. Thus, one might conclude that the national recessions as measured with aggregate data are less reflective of middle America and more indicative of the East and Far West.

IX. Concluding Remarks

Macroeconomists often characterize the U.S. aggregate business cycle as a series of distinct recession and expansion phases. Little or no attention has been paid, however, to business cycle phases at the state and regional level. To remedy this, we use a regime-switching model and the state coincident index data of Crone (2002) to present evidence regarding state-level business cycle phases.

We find significant differences across states in the growth rates within business cycle phases. We also find that, although state-level recessions are usually associated with national recessions, their peaks and troughs differ greatly and are not in sync with national peaks and troughs. For example, in the case of the 1990–1991 recession, many states were in recession for more than a year before and/or after the national economy had switched. In addition, it is not uncommon for state business cycles to be completely out of sync with the national cycle. For example, although the nation as a whole was in recession in 1980, 1990–1991, and 2001, many states did not experience a recession at all during one or more of these periods. Conversely, 14 of the 48 contiguous states experienced recession in the mid-1980s, when the aggregate economy was in the middle of a long expansion.

In terms of their concordance with the national business cycle, states in the South and much of the Rust Belt tended to be relatively in sync with the national cycle. In contrast, states between Montana and North Dakota in the north to Arizona and Texas in the south tended to be much less in sync with the nation as a whole.

Obviously, for state policymakers, there can be fairly significant benefits to knowing whether your state is in a recession or an expansion. Beyond this, our results also have potentially important implications for national policymaking. For example, if the national economy is in recession, the usual response of the Federal Reserve is to loosen monetary policy to smooth out the national business cycle. However, because the effect of monetary policy varies across states and regions (Carlino & DeFina, 1998, 1999; Fratantoni & Schuh, 2003; Owyang & Wall, 2004), the resulting impact depends on the mix of states in and out of recession at the time the policy is implemented. A similar argument can be applied to the use of fiscal policy to smooth aggregate business cycles.

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