# Regional Economies: Separating Trends from Cycles

*Gerald Carlino and Keith Sill**

The United States is made up of diverse regions that, although linked, respond differently to changing economic circumstances. Some regions react more strongly than others to nationwide forces, such as changes in monetary and fiscal policies, changes in relative prices, and technological innovations. Typically, the overall fluctuations in income and employment are used to gauge how regions respond during business cycles. One problem with this approach is that it assumes that the long-run trends in regional income or employment are constant.

Recently, many economists have adopted the view that trends also change during business cycles. The failure to remove the variable trends in regional income and employment may result in inaccurate measures of how regions respond during business cycles.

We used a new technique to distinguish business cycles from changes in trend for the eight major regions in the United States as defined by the Bureau of Economic Analysis (BEA). Our findings confirm that business cycles, as measured by the ups and downs in per capita income, do differ across regions. Despite these differences, our approach identifies a core group of regions that display very similar cyclical patterns. Only the Southwest region exhibits a very different cyclical pattern from the rest of the United States.

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## TWO VIEWS OF BUSINESS CYCLES

Generally, business cycles are defined as common fluctuations of aggregate economic variables, such as personal income, employment, and output, around their trend values.[1] Until recently, economists held the traditional view that the changes in income and output that occur during business cycles are temporary events. However, many economists now believe that part of the change that occurs during business cycles is permanent.

**Traditional View.** Over time, a nation's or region's economy grows as its population increases, as firms acquire new plant and equipment, as new methods of production are introduced, and as the stock of human capital increases. This increased availability of resources allows a region's economy to produce more goods and services, resulting in an upward trend in income and output. The traditional view holds that trend growth is constant over time. Thus, over time, income and output move up in a completely predictable way.[2]

But the level of income is not always at its trend but fluctuates around its trend during business cycles. According to the traditional view, all changes in economic activity during the business cycle are temporary. After the national or regional economy recovers from a recession, it returns to the level of income and output that it would have achieved had the recession not occurred. Although recessions create short-run problems, they have no significant long-run effects on the nation or its regions.

**New View.** Recently, some economists have questioned the traditional view and suggested that some changes during business cycles may not be temporary. In a 1982 paper, Charles Nelson and Charles Plosser showed that some permanent change in output and employment results from unexpected shocks to the economy.[3] According to the new view, any change in income or output can be divided into two parts, the trend component and the cyclical component, neither of which is constant over time.

According to the new view, the trend is variable: economic shocks affect both short-run cycles and long-run trends. Because the trend varies in response to economic shocks, it can be permanently altered by shocks. The change in trend is permanent in that there is no natural mechanism that will return the economy to its previous trend following a shock. The economy would have to experience offsetting shocks for its trend to be unaffected—an unlikely event.

Many economists believe that a substantial fraction of the change in real income during the 1973-75 recession resulted from a change in the long-run trend. However, the 1973-75 recession was unusual in that it was associated with a fourfold increase in the price of oil. Declines in economic activity in recessions not associated with such severe oil-price shocks may have smaller effects on long-run trends. Nonetheless,

[1]The peaks and troughs of national business cycles are dated by the National Bureau of Economic Research (NBER) by considering the comovement in many different economic indicators, such as gross domestic product, industrial production, personal income, sales, employment, and unemployment. By looking at changes in a variety of economic variables, the NBER minimizes the chance of making an erroneous conclusion based on mismeasurement. Unfortunately, many of these indicators are not available on a monthly basis at the regional level. Therefore, it is not possible to date the peaks and troughs of business cycles at the regional level. Attempts have been made to identify business-cycle dates for some states (see the article by Ted Crone).

[2]The traditional view recognizes that trend growth can, and does, change over time. However, the forces that give rise to changes in trend growth are viewed as occurring very infrequently, i.e., at much longer intervals than a typical business cycle. See the paper by John Boschen and Leonard Mills for a more detailed discussion.

[3]Economists use the term shock to refer to unanticipated changes in variables. Examples include unanticipated changes in monetary and fiscal policy, extreme environmental conditions (particularly the weather in agricultural regions), and events that alter the world price of energy.

some portion of these declines may be permanent in that they are unlikely to be offset.

## REGIONAL STUDIES BASED ON THE TRADITIONAL VIEW

Studies of regional business-cycle theory and measurement date from the early work of Glenn McLaughlin in 1930 and continue with the work of Rutledge Vining in the 1940s, George Borts in 1960, and Richard Syron in 1978. In 1980, Bruce Domazlicky surveyed much of this literature and concluded that "all of the early authors used fairly simple methodology...and... none of the studies was comprehensive as most were limited to a single state or a few selected cities." In addition, this research contains a notable shortcoming: the authors measure the impact of shocks region by region without accounting for feedback among regions. For example, shocks can directly affect the New England region, but because New England trades with the Mideast region, shocks that directly affect New England affect the Mideast indirectly and vice versa.

Recently, interest in regional business cycles has been renewed, and the authors of these new studies have employed vector autoregression (VAR) techniques. VAR, a statistical technique for examining interactions among variables, is widely used for gathering evidence on business-cycle dynamics. In a regional VAR, the representative variable for each region (e.g., personal income or employment) depends on its own past values as well as past values of the corresponding variable for all the other regions in the model. By considering the system as a whole, rather than one equation at a time, the researcher can trace the effects of a change in a particular region on all other regions. For example, if income growth in New England rises, income growth in all other regions will be affected, since developments in New England will eventually affect other regions. Moreover, after the initial effect, continuing feedback will occur in all other regions, with the subsequent effects becoming smaller and smaller.

Using VAR methods, Carolyn Sherwood-Call and Brian Cromwell have analyzed comovements in economic variables among selected states in the west.[4] Their goal was to explore the extent to which fluctuations in the growth of personal income (Sherwood-Call) and employment growth (Cromwell) in western states are driven by forces specific to a state or by comovement with California. They found that the economy of California has important spillover effects on other western states.[5]

In 1995, Gerald Carlino and Robert DeFina extended the work of Sherwood-Call and Cromwell by analyzing the linkages in per capita income growth among all U.S. regions. Their VAR included eight equations, one for real income growth in each region. For each equation, a region's real income growth depended on past values of its own and the other regions' real income growth. They found that a high degree of comovement exists among the U.S. regions and that the codependence is not limited to regions adjacent to each other.

While the papers by Sherwood-Call, Cromwell, and Carlino and DeFina take into account the interrelations among regions, the analysis in these papers looks at fluctuations in regional growth as opposed to business-cycle differences across regions.

## REGIONAL BUSINESS CYCLES: THE NEW VIEW

**Sorting Out Trends from Cycles.** As discussed earlier, some economists believe that

[4]Comovement, or codependence, refers to fluctuations in national and regional incomes that are correlated and synchronous with each other.

[5]Some studies have focused more narrowly on specific metropolitan areas. A study by Ed Coulson and another by Ed Coulson and Steve Rushen use VAR models of the economies of the Philadelphia (Coulson) and Boston (Coulson and Rushen) metropolitan areas to quantify national, industry-specific, and local influences.

business cycles are fluctuations in aggregate income and output around a trend that grows at a constant rate. (Although there is no universally accepted trend growth rate among economists, many economists believe that the rate for the United States as a whole currently ranges between 2.0 to 2.5 percent per year in real terms, or between 1.0 and 1.5 percent per year in real per capita terms.) Other economists view the economy as one where shocks could affect both the trend and the cyclical component.

In a 1996 working paper, we took the latter view and examined the degree of cyclical and long-run comovement present in regional per capita income. We used per capita personal income rather than total income to control for differences in population growth among regions. In our study, we used quarterly data on real per capita personal income from 1948-93. A newly developed technique called common features analysis is used to look at the degree of short-run, or cyclical, and long-run, or trend, comovement among the eight regions defined by the BEA (see Appendix A for a breakdown of the regions).[6]

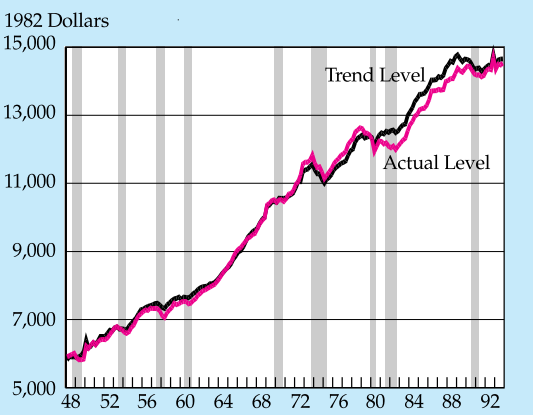
The percent change in the actual levels of regional real per capita incomes is broken down into estimated percent changes for both the trend and cyclical components for each of the nine postwar recessions (see Appendix B). The 1957-58 recession is an example in which both the cyclical and trend components generally declined for all regions. For instance, the decline in real per capita income of 3.7 percent in the Mideast region during the 1957-58 recession consists of a drop of 2.5 percent in the cyclical component and of 1.2 percent in the trend. But in some downturns, such as the 1948-49 recession, the trend components rose, which served to lessen the magnitude of the negative cyclical movement in real per capita incomes.

The trend and cycle components for the nation are weighted averages of trend and cycle estimates at the regional level. The regions' share of national real personal income are used as weights.[7] Figure 1 shows the actual level of real per capita income (black line) for the na-

[6]The common trends/common cycles approach is developed in papers by Farshid Vahid and Robert Engle, Robert Engle and Sharon Kozicki, and Robert Engle and João Issler. The common trends/common cycles approach assumes that the data under analysis are nonstationary and, therefore, contain stochastic trends. In a 1996 working paper, we tested regional per capita income data and found evidence for stochastic trends consistent with the new view that shocks to income can have permanent effects. In fact, we find that regional per capita incomes share common stochastic trends, called cointegration. Thus, over the long run, the growth paths of regional per capita incomes tend not to drift too far apart. In the short run, regional per capita incomes can and do diverge. However, our analysis finds similarities in this divergence, which are called common cycles.

[7]The trend and cyclical components for the nation were also computed as unweighted averages of the regional trend and cyclical estimates. We found very little differences between the weighted and unweighted versions. We used the weighted average versions in this article.

**FIGURE 1**
**Actual and Trend Levels Of Real Per Capita Income**
**United States**



tion and the estimated trend (color line). The deep recession of 1973-75 illustrates the potentially permanent effect of business-cycle fluctuations on real per capita income. Following the traditional view, we can imagine extending the trend line for the nation between 1948 and 1973 out to 1993. The permanent effect of the 1973-75 recession can now be seen. The level of per capita real personal income never returns to its earlier path after the 1973-75 recession. That is, for all future dates, the level of per capita income is below the level that would have been achieved had the 1973-75 recession not occurred.

The 1973-75 recession is of interest for several reasons. First, it was the most severe recession of the postwar period. With the exception of the Far West region, declines in real per capita income were larger in the 1973-75 recession than those in any other postwar recession. At the national level, real per capita income fell 6 percent during the 1973-75 recession, two-thirds greater than the drop of 3.6 percent in the 1957-58 recession, the second largest downturn of the postwar period. Second, a comparison of the trend and cyclical components indicates that the effects of the 1973-75 recession led to permanent declines in trend growth for all regions (details are in Appendix B). Like those for the nation, our estimates indicate that following the 1973-75 recession, per capita personal incomes at the regional level never returned to earlier trends.

**Differences in Volatility of Cycles Across Regions.** One measure used by economists to assess the severity of business-cycle fluctuations is volatility—the extent of the ups and downs in per capita income caused by business cycles. Using standard deviations we have summarized differences in the volatility of cycles across regions (Figure 2).[8] The first column reports the standard deviation of the regional cyclical components for 1948-93. The data reveal considerable differences among regions in the volatility of the cyclical components. For example, the cyclical component in the most volatile region (Great Lakes) is more than six times as great as that in the least volatile region (Far West). Business cycles in the New England, Mideast, Great Lakes, Plains, and Rocky Mountain regions tend to be more volatile than national cycles. The cyclical component in the Southeast, Southwest, and Far West regions tends to be less volatile than that of national cycles.

With the exception of the Rocky Mountain and Far West regions, the volatility of the cyclical component of regional per capita income dramatically increased after 1972. Specifically, volatility increased at least 50 percent in the New England, Great Lakes, Southeast, and

**FIGURE 2**
## Volatility of Regional Business Cycles For Selected Years*

| Region | 1948-93 | 1948-72 | 1973-93 |
|---|---|---|---|
| New England | 2.0% | 1.4% | 2.5% |
| Mideast | 2.8 | 2.0 | 3.3 |
| Great Lakes | 3.8 | 2.6 | 4.6 |
| Plains | 3.1 | 2.9 | 3.2 |
| Southeast | 1.3 | 0.8 | 1.6 |
| Southwest | 1.5 | 1.2 | 1.8 |
| Rocky Mountain | 2.0 | 2.1 | 1.8 |
| Far West | 0.6 | 0.6 | 0.6 |
| United States | 1.8 | 1.2 | 2.1 |

*Standard deviation of business-cycle component of quarterly per capita income

[8]The standard deviation is the positive square root of the variance and is commonly used to express dispersion. The variance is the mean squared deviation from the expected value. Recall that the trend in each region's per capita income has been removed so that the standard deviation of the detrended series measures the volatility of a region's business cycle.

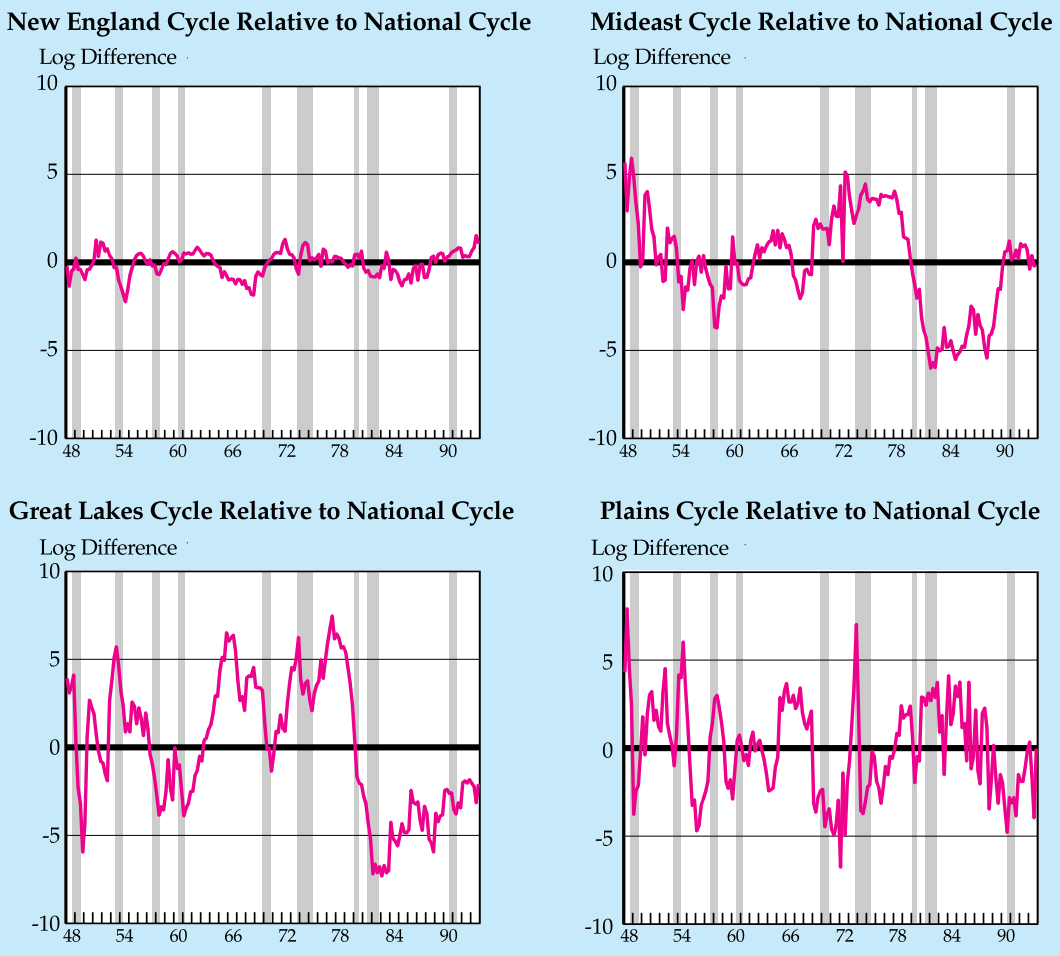
Southwest regions.[9] The increase in volatility after 1972 may be related to the adverse impact of the oil-price shock of 1979 and the back-to-back recessions of 1980-81 and 1981-82. In general, the largest cyclical declines in regional real per capita income occurred during this period.

In addition, we looked at the cyclical component of each region *relative* to the national cycle (Figure 3). If the amplitude and timing of a region's cycles are similar to those of national cycles, the relative graph should be close to zero over time. With the exception of the New En-

[9]Volatility of the cyclical component fell in the Rocky Mountain region and was unchanged in the Far West after 1972.

**FIGURE 3**

## Relative Regional Cycles*




*Graphs show the logarithm of the ratio of cyclical components of per capita income in the region to the cyclical components in the nation

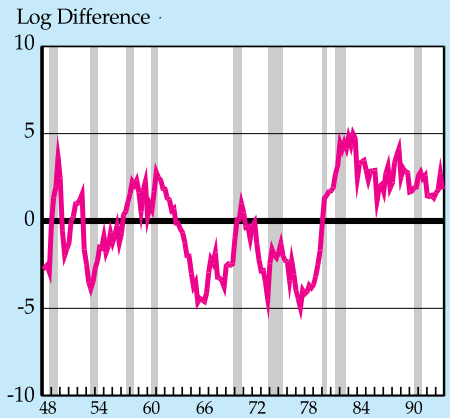
gland region, the graphs show a great deal of divergence from the national cyclical pattern. This divergence supports the view that not all regional economies are related to the national economy in the same way. The finding that the New England region diverges little from the national pattern during postwar cycles suggests that most of the differences between the actual performance of the New England region and the nation are driven by permanent differences in their long-term growth rates.

**Similarities of Cycles Across Regions.** In spite of the differences in the volatility of cycles across regions, we find a high degree of correlation among the cyclical components for many regions (Figure 4). Four of the eight regions

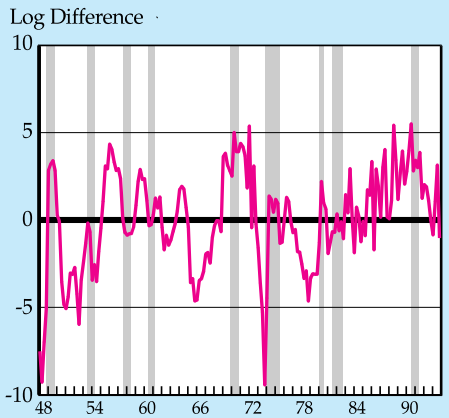
**FIGURE 3 (continued)**

## Relative Regional Cycles*

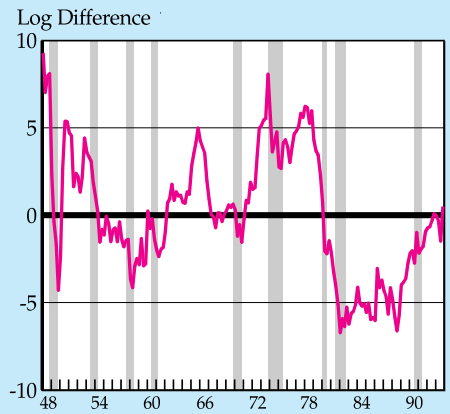
**Southeast Cycle Relative to National Cycle**



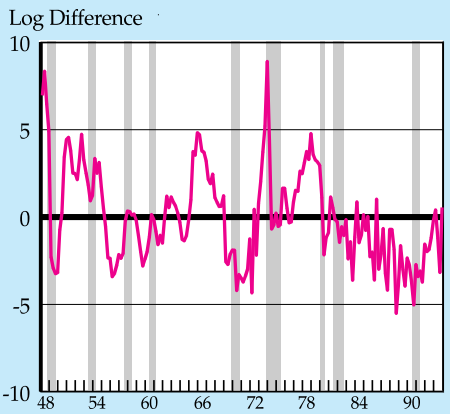

**Southwest Cycle Relative to National Cycle**




**Rocky Mountain Cycle Relative to National Cycle**




**Far West Cycle Relative to National Cycle**




*Graphs show the logarithm of the ratio of cyclical components of per capita income in the region to the cyclical components in the nation

FIGURE 4

## Simple Correlations Among the Regional Cyclical Components

1948 - 93

| | US | New England | Mideast | Great Lakes | Plains | Southeast | Southwest | Rocky Mt. |
|---|---|---|---|---|---|---|---|---|
| **New England** | 0.9386 | | | | | | | |
| **Mideast** | 0.9333 | 0.9426 | | | | | | |
| **Great Lakes** | 0.9606 | 0.8823 | 0.8183 | | | | | |
| **Plains** | 0.7265 | 0.5679 | 0.6103 | 0.6529 | | | | |
| **Southeast** | 0.9600 | 0.8952 | 0.8239 | 0.9991 | 0.6320 | | | |
| **Southwest** | -0.8933 | -0.9694 | -0.8686 | -0.8393 | -0.6469 | -0.8517 | | |
| **Rocky Mt.** | 0.5950 | 0.7215 | 0.6898 | 0.4274 | 0.6428 | 0.4377 | -0.8218 | |
| **Far West** | 0.6877 | 0.6612 | 0.6935 | 0.7194 | 0.0639 | 0.7283 | -0.4685 | 0.0011 |

(New England, Mideast, Great Lakes, and Southeast) have pairwise correlations that in every instance are greater than .80.[10] Moreover, the cyclical components in these four regions are highly correlated with the national cyclical component. The degree of correlation increases from about .93 for both the New England and Mideast regions to about .96 for both the Great Lakes and Southeast regions.

There is a moderate amount of correlation between the Plains and Rocky Mountain regions (correlation coefficient of .64). There is essentially no correlation of the Far West region with the Plains or Rocky Mountain regions.

The data also reveal a negative correlation between the Southwest region and the nation and all other regions as well. The negative correlation is probably related to James Hamilton's finding that all but one of the previous eight national recessions were preceded by an oil-price shock and that the fortunes of the energy-producing Southwest region are often opposite to those of the energy-consuming regions.

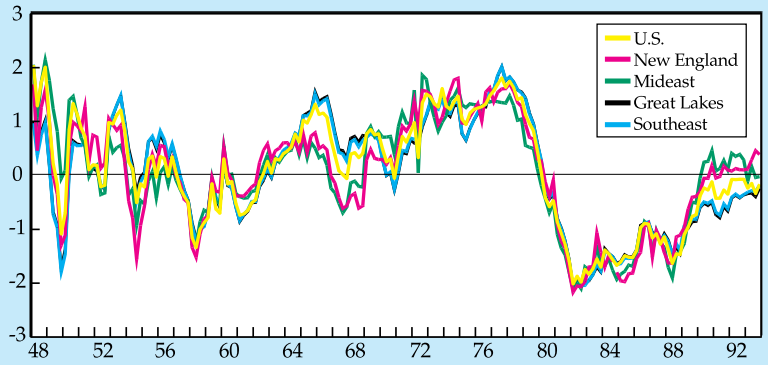
Finally, to control for differences in the amplitude of regional cycles and to provide an understanding of the commonality of the timing and duration of regional cycles, each region's cyclical component is divided by its standard deviation.[11] Figure 5 presents the standardized cyclical component of the regions along with the standardized cyclical component for the nation. Panel A shows the regions that have highly codependent cycles. We refer to this grouping as the core region. Not surprisingly, this grouping consists of the same four regions (New England, Mideast, Great Lakes, and Southeast) whose cyclical components were found to be highly correlated. While some differences still remain in the amplitude of the regional cycles, these regions appear to be similar with respect to turning points and the dura-

[10]The correlation coefficient measures the degree of association between two regions. It takes on values between -1 and +1. For example, a correlation coefficient of unity indicates perfect positive correlations between two regions, while a coefficient of negative one indicates perfect negative correlation. A correlation coefficient of zero indicates no association between regions. A relatively high correlation coefficient, such as .8 or .9, indicates a strong association between regions.

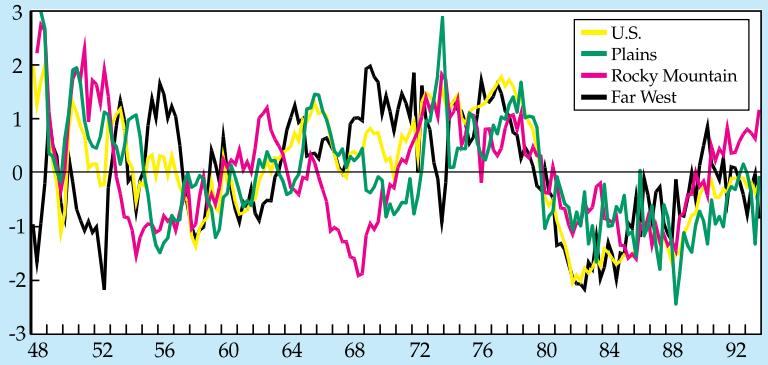
[11]Dividing each region's cyclical component by its standard deviation does not change the general cyclical pattern; it simply makes it easier to compare the commonality of turning points and the commonality in duration of regional cycles.

**FIGURE 5**

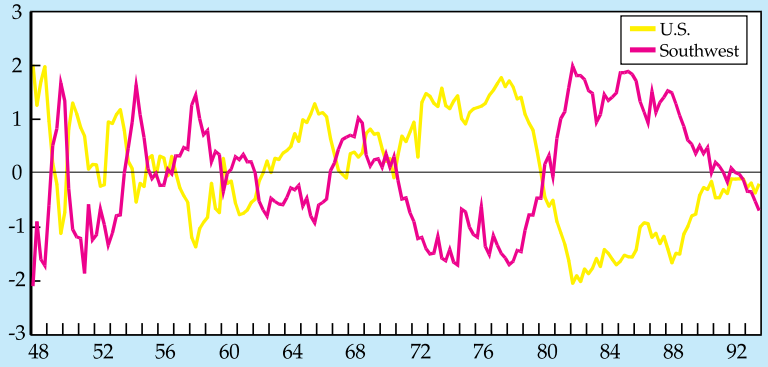
**Panel A: Standardized Cyclical Component***




**Panel B: Standardized Cyclical Component***




**Panel C: Standardized Cyclical Component***




* Logarithm of a region's cycle divided by its standard deviation

tion of their cycles.

Panel B presents the standardized cyclical component for the Plains, Rocky Mountain, and Far West regions, where there is considerably less codependence of the cycles than among the core group. In addition, the timing of cycles also appears to differ for these regions relative to one another and relative to the nation.

Panel C shows the standardized cyclical component for the Southwest region. Cycles in this region are mostly the mirror image of national cycles. Per capita income in the Southwest appears to be countercyclical, moving in the opposite direction of national per capita income (up in national contractions, down in national expansions).

## CONCLUSION

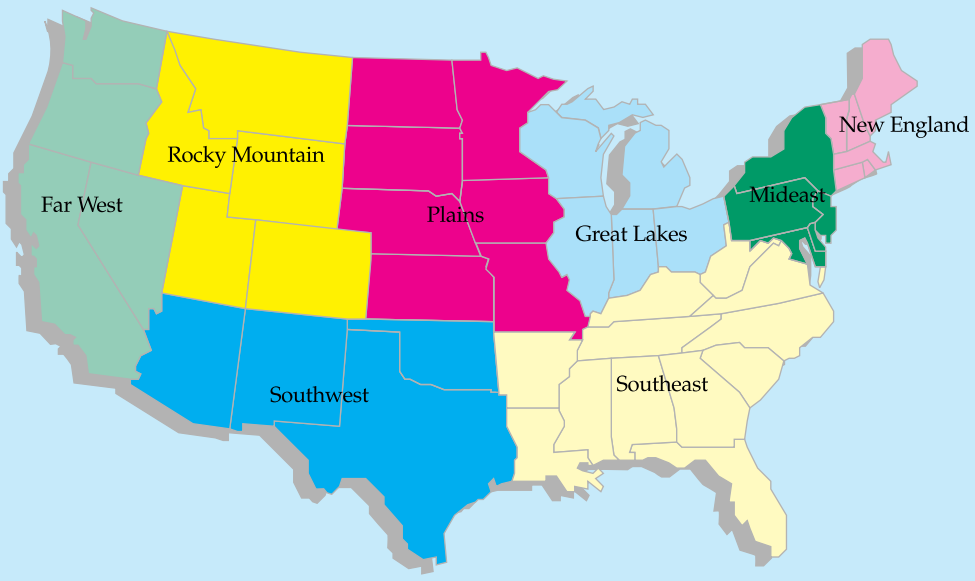
The national economy is a composite of diverse regional subeconomies. Similarly, national business cycles are amalgams of regional cycles. When we consider only national aggregates such as GDP, national income, employment, and in-

dustrial production, a large amount of detail about regional cycles is lost. This loss of regional detail may be unimportant if the divergence of regional cycles from national cycles is small, but often it is large. Large differences in business cycles across regions can make it difficult for national policymakers to bring about satisfactory outcomes in all parts of the country. Attempts at stimulating the economy during national recessions, for example, may lead to tight labor markets in some regions while others lag behind.

We used a new technique to distinguish business cycles from changes in trend. Business cycles as identified by this new technique show considerable divergence across regions. Our analysis reveals considerable differences in the volatility of regional cycles. Allowing for those differences, we find a great deal of comovement in the cyclical response of the core region (New England, Mideast, Great Lakes, and Southeast) and the nation. We find some evidence of comovement among the Plains, Rocky Mountain, and Far West regions and the nation, but to a much lesser extent than in the core. Finally, the cyclical response of the Southwest region is strongly negatively correlated with that of all the other regions and the nation.

In the 1980s, the terms "rolling recovery" and "bi-coastal recession" entered the business vocabulary. These terms suggest that the timing and perhaps the magnitude of ups and downs in economic activity vary across regions. The findings reported in this article not only support the view that business cycles differ across regions but point out that these differences have been present not just since the 1980s but rather for the entire postwar period. Nonetheless, there is enough commonality in their cyclical responses to identify a core group of regions.

## APPENDIX A
## Definitions of Regions



## APPENDIX B
# Percent Change in per Capita Income For the Postwar Recessions

| Recessions | New England | Mideast | Great Lakes | Plains | South-east | South-west | Rocky Mt. | Far West | US |
|---|---|---|---|---|---|---|---|---|---|
| **ACTUAL INCOME** | | | | | | | | | |
| 4Q48-4Q49 | -1.3 | -2.1 | -6.9 | -8.9 | -2.7 | 7.5 | -3.3 | 0.5 | -2.9 |
| 3Q53-2Q54 | -2.7 | -2.0 | -5.2 | 2.1 | -2.6 | 0.5 | -2.7 | -1.8 | -2.2 |
| 3Q57-2Q58 | -3.3 | -3.7 | -6.0 | -0.4 | -1.8 | -3.6 | -4.4 | -3.8 | -3.6 |
| 2Q60-1Q61 | 0.5 | -0.4 | -2.2 | 0.7 | -0.5 | -0.6 | 0.0 | 0.0 | -0.6 |
| 4Q69-4Q70 | -0.5 | -0.1 | -3.1 | -0.4 | 1.7 | 1.7 | 2.9 | -1.5 | -0.5 |
| 4Q73-1Q75 | -5.7 | -4.1 | -7.2 | -13.1 | -6.7 | -3.8 | -7.1 | -3.4 | -6.0 |
| 1Q80-3Q80 | -0.7 | -0.9 | -3.0 | -2.8 | -1.1 | -0.8 | -2.5 | -1.6 | -1.6 |
| 3Q81-4Q82 | 1.6 | 1.5 | -2.4 | 0.4 | -1.3 | -1.9 | -1.1 | -1.8 | -0.8 |
| 3Q90-1Q91 | -1.5 | -1.3 | -1.3 | 0.6 | -0.5 | -0.3 | 1.4 | -1.7 | -0.9 |
| **TREND COMPONENT** | | | | | | | | | |
| 4Q48-4Q49 | 4.5 | 4.1 | 3.4 | 0.0 | 0.8 | 2.3 | 2.6 | 0.7 | 2.5 |
| 3Q53-2Q54 | 0.8 | 0.3 | -0.3 | -0.6 | -0.8 | -2.1 | -1.3 | -1.0 | -0.4 |
| 3Q57-2Q58 | -1.2 | -1.2 | -2.6 | -0.3 | -0.6 | -5.1 | -3.4 | -3.2 | -2.1 |
| 2Q60-1Q61 | 1.4 | 0.7 | 0.3 | 0.6 | 0.4 | -1.0 | -0.6 | 0.5 | 0.4 |
| 4Q69-4Q70 | -0.0 | 1.1 | 0.5 | 1.8 | 2.9 | 1.6 | 1.7 | -1.0 | 0.9 |
| 4Q73-1Q75 | -5.5 | -5.0 | -4.5 | -4.8 | -5.9 | -5.2 | -4.5 | -4.5 | -5.0 |
| 1Q80-3Q80 | 0.6 | 0.5 | -0.4 | -0.3 | -0.3 | -2.1 | -1.1 | -1.6 | -0.5 |
| 3Q81-4Q82 | 2.9 | 2.1 | 0.5 | -0.3 | -0.3 | -2.8 | -1.4 | -1.4 | 0.1 |
| 3Q90-1Q91 | -1.5 | -0.8 | -0.7 | -0.5 | -0.3 | 0.2 | 0.1 | -1.3 | -0.7 |
| **CYCLICAL COMPONENT** | | | | | | | | | |
| 4Q48-4Q49 | -5.8 | -6.2 | -10.4 | -8.9 | -3.5 | 5.2 | -5.9 | -0.2 | -5.5 |
| 3Q53-2Q54 | -3.4 | -2.3 | -4.9 | 2.7 | -1.8 | 2.6 | -1.3 | -0.8 | -1.9 |
| 3Q57-2Q58 | -2.2 | -2.5 | -3.4 | -0.1 | -1.2 | 1.5 | -1.0 | -0.6 | -1.7 |
| 2Q60-1Q61 | -0.9 | -1.1 | -2.5 | 0.1 | -0.8 | 0.4 | 0.6 | -0.5 | -1.0 |
| 4Q69-4Q70 | -0.5 | -1.2 | -3.6 | -2.2 | -1.1 | 0.1 | 1.2 | -0.5 | -1.5 |
| 4Q73-1Q75 | -0.2 | 0.9 | -2.7 | -8.3 | -0.8 | 1.4 | -2.6 | 1.2 | -1.0 |
| 1Q80-3Q80 | -1.3 | -1.4 | -2.6 | -2.5 | -0.9 | 1.2 | -1.4 | -0.0 | -1.1 |
| 3Q81-4Q82 | -1.2 | -0.6 | -2.9 | 0.7 | -1.0 | 0.9 | 0.2 | -0.4 | -0.8 |
| 3Q90-1Q91 | 0.0 | -0.5 | -0.6 | 1.1 | -0.2 | -0.5 | 1.3 | -0.4 | -0.2 |

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