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CONVERGENCE OR DIVERGENCE? A STUDY OF REGIONAL BUSINESS CYCLE PATTERNS AMONG U.S. CENSUS REGIONS

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The convergence hypothesis postulates that the economic regions of the U.S. have become more similar over the course of this century due to the extensive national integration of regional economies and major population movements among regions. Although many scholars have studied the trends in regional welfare measures, few have studied the trends or differences in regional cycles. Yet these latter are of great interest to economic science because the movements toward greater or lesser homogeneity in regional cycle patterns reflect underlying trends in regional economic structures and in the relations among regions. Moreover, the question is important for national economic policy: Increasing homogeneity of regional cycles implies that a uniform macroeconomic policy may cope fairly with national cycles in all regions. But increasing divergence of regional cycle experiences implies, instead, that a uniform national policy may affect regions differently, in ways that are unexpected and perhaps undesired. Public policy discussions likely will be complicated by increased sensitivity to the differential regional impacts of stabilization and development policies. An example is the current concern about the development of a bicoastal economy (Redman, *et al.*, 1992).

Several early studies of regional cycles report conflicting results. Richard Victor and Georges Vernez (1981) note "a century-old trend toward reduction in cyclical behavior disparities among areas of the country" (p. 6). On the other hand, Richard Syron (1978) measures regional employment changes relative to national cycle movements for U.S. Census regions since World War II and fails to find any support for increasingly similar cycle movements. Syron remarks that "If anything, regions seem to be becoming more dissimilar" (p. 32). Using different procedures, Howard Friedenberg and Robert Bretzfelder (1980) also

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fails to find any narrowing of differences in business cycle behaviors among nine regions in the 1948–1979 period.

This paper asks again whether U.S. Census regions are exhibiting increasing or decreasing homogeneity of business cycle behaviors in the post-World War II period. We employ a more extensive series than previous studies of monthly data, from 1947 through 1989, on nonagricultural jobs in the economy. We examine Census regions rather than smaller geographic areas to conform with the past work done by Syron and by Friedenberg and Bretzfelder. But our analysis differs from the earlier studies by focusing on the "co-movements" of regional cycles (Carolyn Sherwood-Call's term, 1988, p. 16) and by comparing results for two different periods in the post-World War II era. We use several statistical measures different from those employed in earlier studies: We present a correlation coefficient measure of the co-movement of regional cycles, we look at the month by month standard deviations across regions of their cyclical employments, and we develop elasticities that compare the regional cycle extremes to the national extremes for successive business cycles. The two measures of monthly co-movements suggest increasingly diverse regional experiences in the post-World War II period. By contrast, the elasticity measure implies increasingly uniform regional cycle behavior at peaks and troughs.

The purpose of this paper is to measure whether there is increasing or decreasing homogeneity of regional economic cycles. This is a sufficient task for one paper; providing convincing causal explanations for observed convergence or divergence is reserved for future research.

Economic Integration and Homogeneity of Regional Cycles

Technological advances over the past century have led to the development of strong economic linkages among regions. The growth of highway, air transport, and communication systems has increased accessibility to all parts of the country from any given locale. Information, persons, and goods now flow among regions and cities more rapidly and at less cost compared to 50 or 100 years ago. Thus, firms and industries have expanded their market and supply areas from regional to national, and even to multinational, levels. Production and other facilities can be located in widespread regions without losing effective management and control. Changes in demand in any part of the country rapidly impact production and employment levels of supplying firms in other, distant regions. Finance is no longer regional; firms now can tap national or international markets for dollars.

Additionally, the federal government consciously has adopted fiscal and monetary policies that influence the whole economy, while social and economic regulation is applied (more or less) uniformly

across the regions of the country. To a great extent, the federal government has subordinated the formerly important roles of state and local governments, especially with respect to welfare assistance and income transfer programs, compared to 50 or 100 years ago.

Further, regional differences attributable to geographical asymmetries in the history of settlement and economic development have diminished. The settlement of the United States moved from the East Coast to the Mississippi, then jumped to the West Coast, with the center of the country filled last. The South was devastated during the Civil War, a time when the North was rushing headlong into economic and technological development. It might be expected, therefore, that the Midwest and South would become increasingly similar to the North and Pacific regions as they have caught up economically over the past century.

These developments imply that the U.S. economy has become more integrated and more like the unitary economy implicitly assumed in macroeconomics textbooks. Neoclassical theory implies that regional differences in per capita earnings and returns on capital should induce compensatory labor flows that eventually will reduce these differences. Thus the convergence hypothesis: that measures of economic welfare and activity for the different regions should have converged during the past 100-plus years toward similar values. Benjamin Chinitz (1986), for example, celebrates the convergence in measurements of population, employment, and per capita incomes in the West, South, and North superregions. Both Lynn Browne (1980) and Orley Amos (1983) note a substantial and continuing decline in regional per capita income differences from 1929 to 1979. Since the late 1970s, however, increasing income differentials among states and regions have appeared and have been subjected to examination (Coughlin and Mandelbaum, 1988; Garnick, 1990; Husted, 1991; Carlino, 1992; Redman, *et al.*, 1992).

It seems intuitively plausible to conclude that the regions of a strongly integrated economy also may exhibit similar cyclical employment patterns. This conclusion also appears to be supported by the well-known employment shift from cyclically-prone heavy industries, which are geographically concentrated, to the widespread and historically more stable service sector. On the other hand, the principle of comparative advantage suggests that as the country's regions are able to obtain needed consumer goods and production inputs from each other more reliably, they may tend to develop more specialized economies based on their economic advantages of resource endowments, location, spurts of technological innovation, and historical accident and thus exhibit increasingly dissimilar cycle patterns. An alternative form of this thesis is suggested by Goldstein (1986) who argues that an increasing international division of labor may be exacerbating regional economic differences. A similar conclusion may be

implied by the growth pole theory discussed by Orley Amos (1990). Several earlier empirical studies yield conflicting results. It remains an open theoretical question whether regions are exhibiting increasing or decreasing homogeneity of cycle behaviors.

The Concept and Measurement of Homogeneity

In what ways can we think of regional business cycles becoming more alike? The cyclic movements of two regional economies can be said to converge to the extent they assume the same pattern, numerically measured, for a given economic variable (such as income or employment). Convergence does not mean that the cyclic movements are becoming attenuated or dampened or that economic growth will tend increasingly to follow a smooth trend line. Convergence could occur even as cyclic movements become more exaggerated as long as different regions move toward an identical pattern of cycles.

Regional business cycles can be said to show a more uniform pattern to the extent that they turn up or down in step, that they exhibit turning points in the same month for a monthly series. As a consequence, regions will show the same time periods for their recessions and recoveries. It also is required that all regional cycles show the same amplitudes, measured as proportional peaks above trend and nadirs below trend, for any national cycle. We specifically define *business cycles* as percent movements around the least-squares long-term trend line for each region (or the nation). This definition is adopted because we are interested in comparing short-run cyclical movements across regions apart from long-term growth trends while avoiding the complications of differences in absolute scale of regional economies.

It is conceivable, however, that region A may improve linearly through a national recovery to a peak 12 percent above trend, while region B may improve exponentially to a peak also 12 percent above trend. Following Victor Zarnowitz (1985), therefore, we distinguish business cycle analysis (of turning points, amplitudes, and lengths of regional cycles) from growth cycle analysis (of smaller movements within business cycles, essentially of rates of change). A growth cycle dimension of convergence is that regions show the same rates of recovery and downturn. That is, they must show the same patterns of intracycle behavior or, using Carolyn Sherwood-Call's terminology (1988), a high degree of co-movement. Given these conditions, it follows that there would be a uniform national business cycle; there would be no distinguishable regional cycles. Conversely, divergence in regional cycles (around long-term trends) may appear as increasingly scattered turning points (around the national turning point), as increasingly different peaks or troughs (in percentages above or below their

trends), and as increasingly different lengths of time from trough to peak or peak to trough.

Data Transformation Procedures

The data series used in this study is the nonagricultural employment (establishment) series published by the Bureau of Labor Statistics, U.S. Department of Labor, in its Bulletin 1370-13 and updated in its *Monthly Employment and Earnings.* The data are monthly employment numbers for each of the 50 states, except Hawaii and Alaska, from January 1947 to July 1989. Because the original information is obtained from reports by establishments of the number of employed persons (rather than from the household information of the *Current Population Survey*), there is double-reporting of employed persons to the extent that some individuals hold more than one job. The employment counts do not include agricultural employment, self-employed persons, and some other groups.

More correctly, the data series provide counts of the numbers of filled nonagricultural jobs in each state rather than numbers of employed persons. As a measure of economic activity rather than economic welfare, the series is appropriate to the purposes of this paper.

Data on Puerto Rico and the Virgin Islands were excluded as well as data on Hawaii and Alaska; we focused on the contiguous 48 states and the District of Columbia. Data for Minnesota did not begin until January 1950, while Michigan data did not begin until January 1956. An allocation procedure was used to fill the missing data for the two states. For the ten years following December 1955, for example, we computed the ratio of Michigan employment to total employment in the East North Central region and then determined a reasonable ratio to extrapolate Michigan employment backward to January 1947 based on the employment levels in the other four states. An analogous procedure was used for Minnesota. The computed ratios change little and slowly for both states in the ten year period following the beginning of the data series for each state, so the extrapolated employment counts should be reasonable. The state employment series were aggregated into the nine Census region series. These were summed to form a national employment series.[1] The composition of the nine Census regions is shown in an appendix.

We then constructed an adjusted cycle series for each Census region to measure cyclic movements of employment around the long-

[1]Because our study focused on the contiguous 48 states and the District of Columbia, we formed a national employment series by adding the nine Census employment series. We did not use the separately estimated national employment series (which never equals the sum of the independently estimated state series).

term employment trend line. First, we chose an 11-month-moving-average transformation to eliminate seasonal patterns and reduce random variations in the employment series while avoiding an excessive loss of end data points. Least-squares trend lines were fitted to the transformed moving average series. (A cubic equation proved to fit every region best.) Finally, we calculated the percent movements around the trend values for each month in the series. In every region, therefore, the adjusted cycle employment is represented in unit free terms as the percent that a region's moving average employment was above or below that month's predicted trend value.[2] By this procedure we have corrected for differences in absolute scale across both regions and time periods and are able to compare regional cycle patterns directly.[3]

Statistical Analysis Procedures

Growth cycle co-movements are defined as the tendency of regions to move in step with each other month by month, both in direction and magnitude of movements. The co-movements were measured by calculating Pearson correlation coefficients for pairs of Census

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[2]Notice that we define a cycle series for each region as the percentage movement of the moving-average employment around the region's long-run trend line rather than as short-run movements of employment from peak to trough to peak. This implicitly assumes that the factors causing cyclical employment movements are different from those giving rise to the long-run growth trend line. If there is variability in regional employment movements around the growth trend line, then the causes presumably are due to regional differences in their economic structures. (See, for example, Howland, 1984; Connaugton and Madsen, 1984.) This procedure also allows us to examine growth cycle movements across time and across regions.

[3]One reviewer suggested that by subtracting the trend estimate from the moving average series we were departing from the multiplicative model implicit in the moving average transformation. But we have not. Let E_m denote the moving average series and E_t the trend series. We form the cycle series E_c by writing

$$E_c = E_m - E_t.$$

The adjusted cycle series E_a is formed by dividing by the trend series:

$$E_a = \frac{E_c}{E_t} = \frac{(E_m - E_t)}{E_t} = \frac{E_m}{E_{t-1}}$$

This procedure leaves us with a multiplicative model, but it has the advantage of correcting for the problem of different scales of economic activity across time and across regions. Multiplying E_a by 100 yields a percentage series that shows, independent of scale, the percent by which a region's moving average employment series is above or below trend. Thus, we are able to compare directly the adjusted employment cycle series across time and regions.

regions, using the adjusted cycle series. Thirty-six correlations were calculated (for 36 region pairs) for 1947–1967 and again for 1967–1989; for each period, the mean of the 36 correlation coefficients was computed. This procedure allows two interesting comparisons. We can observe the change from the first period to the second in the number of region pairs exhibiting statistically significant co-movement. The two means also can be compared to measure the overall increase or decrease in co-movements from the first period to the second.

Next, a standard deviation series of 507 monthly observations was derived by calculating standard deviations of adjusted cycle employment values across the nine regional series for each month. This series was regressed on time to determine if there was a statistically significant trend toward increasing or decreasing deviation values. A statistically significant negative coefficient on time would imply decreasing dispersion of amplitudes and thus increasing convergence, while a positive coefficient would imply a contrary conclusion. Two regressions on time were performed: one for the first 20 year period March 1947 to March 1967 and one for the second 22 year period April 1947 to May 1989. This allowed examination of differences in the movement of standard deviations in the two subperiods.

Finally, we compared regional cycle extremes to extremes in the national cycles. At each NBER peak or trough, the percent by which a region's peak or trough employment[4] exceeds or falls short of predicted regional trend values was divided by the corresponding percent excess or shortfall for the national employment. This gives an elasticity that may be interpreted as measuring the correspondence of regional cycle movements to national movements. If the sequence of the averages of these regional elasticities for successive peaks (and troughs) appears to be converging to the value +1, it would suggest the mean regional deviation from trend at its peak or trough is approximating the national experience. The corresponding sequence of standard deviations of regional elasticities gives information about whether all the regions increasingly are exhibiting the same peak or trough experience or whether the sequence of mean elasticities is masking increasingly divergent behavior among the regions.

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[4]A region's peak (trough) may lead or lag by several months the NBER-designated national peak (trough). For example, while the NBER established November 1973 as a national expansion peak, the Northeast region peaked three months earlier. The West North Central region peaked in July 1974, eight months after the national peak. This is not surprising both because regions show different cycle behaviors and because we look at a specific (transformed) variable establishment employment, while the NBER uses a variety of criteria to determine the peaks and troughs of national cycles.

As part of the statistical analysis, we wondered whether the regions' cyclical behavior differed in the two periods March 1947 to March 1967 and April 1967 to May 1989. The first period was marked by conversion from a war economy to a civilian economy, followed by the Korean War. The 1950s and early 1960s were relatively mild years without sharp economic fluctuations and, from today's perspective, very low inflation rates. Following the 1960–1961 recession the country entered the long expansion of 1961–1969. But 1967–1989 was a different era of turbulence and major change in the country. By 1967 the Vietnam War was in full force and the United States was experiencing accelerating inflation as well as social conflict. A wage and price freeze was imposed in 1971. The 1970s proved to be a stormy decade marked by a severe recession and equally severe price inflation with high interest rates. The 1980s began with another severe recession, with a prolonged, if not always vigorous, expansion beginning at the end of 1982. This second 22 year period was also an era of marked changes in the labor market with the influx of the baby boom generation and steady increases in women's labor force participation rates. Finally, it was also a period of increasing international competition and growing linkages between regions and metropolitan areas in the U.S. with regions overseas. Intuitively, it would be interesting to see if regional cycle behaviors consistently converged or diverged in the two periods or showed different patterns in the two periods.

Discussion of Results

Correlation Analysis

Table 1 shows the correlation values for pairs of Census regions of the adjusted cycle series (percent movement of cycle employment around trend). As indicated, the analysis was conducted for the two periods March 1947 to February 1967 and March 1967 to May 1989. For the first period all 36 regional combinations were statistically significant at the .01 level of confidence, and the correlations were all positive. For the second period 30 of the 36 regional combinations were statistically significant at the .01 level or higher, with four showing significant negative relationships. Thirty-five of the 36 correlations declined from the first period to the second, in many cases quite dramatically. This is reflected in the fall in the mean of the correlation coefficients from .73 to .41, a 44 percent reduction. This decline is significant at the .005 significance level using a test of differences for paired, dependent samples. These results suggest that regional growth cycles were much less synchronized in the second period of the postwar era.

A closer inspection of Table 1 also reveals some interesting observations. First, all the coefficients were significant at the .01 level or not at all. Second, a few regional pairs exhibited only a relatively modest

decline in correlated growth cycle movements, while most pairs exhibited a substantial decline. Finally, 13 of the 36 region pairs showed a first period correlation of .85 or greater, indicating a substantial degree of association in their month by month movements. Table 2 highlights what happened to these correlation pairs from the first period to the second.

Table 2 shows that four of the pairs continued their strong growth cycle association into the second period. Three other region pairs showed a moderately reduced but nevertheless strong correlation through the second period. The correlations for the remaining six pairs declined considerably. Finally, for one pair of the 36, the growth cycle association increased substantially.

This table raises some interesting questions about these pair correlations: Are the high correlations observed in Table 2 due to the strong influence of a more-or-less uniform national cycle? Why did one-quarter of the pairs in Table 1 see only a slight to modest decline in their correlations? Does this indicate some strong linkages between the regions? If so, what is the nature of these linkages? Do linkages exist in production? In labor movements? And why did the one pair, WNC...PAC, increase dramatically in the face of the broad decline in all other region pairs? Is this an artifactual result? Or did something substantial happen between the two regions? There appear to be some grounds for interesting further research.

Standard Deviation Analysis

A further step in analyzing the data was to calculate standard deviations month by month taken across the nine regional adjusted cycle series. We regressed this monthly series of standard deviations on time (the series of monthly date values). If the coefficient on the time variable is negative (and statistically significant), this would indicate that the dispersion of cycle values among the regions is becoming smaller, suggesting convergence. If the coefficient is positive, we could infer that the dispersion of growth cycle movements is becoming larger. This procedure was performed for the two periods March 1947 to March 1967 and April 1967 to May 1989.

Serial correlation was an obvious problem. A time series plot of residuals from the OLS regression showed them to be trending slowly above, then below zero, indicating serial correlation. This was corrected using the SPSSX maximum-likelihood autoregression procedure. A further examination of the residuals showed them to be normally distributed. Heteroscedasticity was not evident in the residual pattern.

Table 3 gives the results of this analysis. The time coefficient for the first 20 year period shows a negative sign and is statistically significant at almost the .001 level for the ML approach. This implies a

declining standard deviation value with time, which suggests that convergence of cycle behavior among regions was occurring during this period. As the focus of the study moves from 1947–1967 to the 1967–1989 time period, the numeric value of the time coefficient changes in dramatic fashion, from –0.0146 to 0.0027. The new coefficient is significant only at the .34 level, however. This weakly suggests that regional employment cycles exhibited an increasingly different, and divergent, behavior in the second period.

A Chow test was performed on the standard deviation series (following Dutta, 1975) for the two periods March 1947 to March 1967 and April 1967 to May 1989.[5] This procedure is intended to test whether the regression coefficients estimated for separate regressions on the two separate periods are significantly different—whether there is a structural break in the underlying conditions governing the economic behavior being estimated (Intriligator, 1978). The F value was 10.90 which is significant at the .01 level. This supports our expectation that there may have been a significant change in the economy about the mid-1960s.

Elasticity Analysis

Regional peaks are compared to national peaks in Tables 4 and 5. Table 4 gives the peak-adjusted cycle employment values for the U.S. and for each region for each of the eight post-World War II economic cycles. Looking at the national cycle which peaked in November 1948, we see that the adjusted cycle employment in the Middle Atlantic (MA) region peaked at 1.612 percent above the trend value. The U.S. peak occurred at 0.602 percent below its predicted trend value in November 1948.[6] Remembering that these numbers represent percent deviations

[5]In response to a reviewer's query, we did not run a series of tests to find the optimizing date for a structural break; we frankly doubt that a few months one way or the other would affect the result. We could have assumed a break in 1965, the beginning of the country's large scale involvement in Vietnam, but the effects of the build-up and the social turbulence were not being felt until a year or two later. We could have assumed 1969, the end of the long 1960s expansion, as one reader suggested, but by then the momentum of economic and social change had been well established. The year 1967 seems a reasonable compromise. It was also the approximate mid-point of the 40 year data series with which we initially worked. More importantly, it was not the point of this research to identify and explain the existence of a structural break. We believe there are reasonable grounds for suspecting a significant change in the economy about 1967, and this simple application of the test supports our intuition.

[6]The elasticity analysis compared regional peaks (troughs) for each business cycle, in whatever month they occurred, to the national peak (trough). Thus, we took the ratio of the Middle Atlantic peak value in July 1948 against the national peak value which occurred in November 1948; we did not take the Middle Atlantic employment value in

from the least-squares trend line, dividing 1.612 by –0.602 then yields an elasticity equal to –2.679 which is shown on the second line (labeled *Elas*) for the Middle Atlantic region.[7] This signed number tells us that at its peak, the Middle Atlantic region showed a variation from trend 2.679 times as great as the national series and in the opposite direction. Thus, the calculated elasticities may be regarded as comparing the proportional regional cycle peaks to the national peaks; each elasticity measures the percent of a region's divergence from trend at its own peak for each percent of national divergence from the national trend value.

One observation to make from Table 4 is that some cycles peak weakly while others peak strongly. Looking at the peak in November 1948, we see that the national cycle peaked below its long-term trend value, as did six of the nine regions. Only the Northeast, Middle Atlantic, and Pacific regions peaked above the long-term trend. The only other similar situation occurred in April 1960. In that cycle five of the regions peaked even further below trend than did national employment. On the other hand, July 1953, August 1957, and January 1980 were all strong peaks, with some individual regions peaking as much as 7 percent to almost 10 percent above trend.

A further observation is the difference in regional performances in any cycle. For the first four peaks, the West South Central region showed extreme performances, being further above or below trend than any other region and having large elasticity values in each instance. Its performance was much more tame the next three cycles, but it returned to form in the January 1981 peak. A similar pattern is observed on the part of the Mountain region. On the other hand, the East South Central region showed tepid performances in 1948, 1960, and 1969, but tended to peak at values that greatly exceeded trend in 1953, 1957, 1973, and 1980. In 1981 the region did not peak, but continued on an upward trend even during the recession.

Table 5 summarizes the information in Table 4. A mean elasticity (of the regional elasticities in the column for each cycle peak) near +1 implies that on average the regions mimicked the national cycle; that is, the regional peaks were about the same percent above or below trend as the national cycle. Notice the mean elasticities for the first and fourth

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November 1948 against the national value. Generally, the months in which regional peaks (troughs) occur are distributed around the month in which the national series attains its peak (trough).

[7]The calculated elasticity has the mathematical form of an elasticity but compares percent differences from trend (for the regional peak/trough against the national peak/trough), not percent changes. It should not be taken to represent a causal relation (as is assumed, for example, with ordinary demand elasticities).

cycles (November 1948 and April 1960) differ greatly from +1, but are close to +1 for the second and third cycles. For the second group of four cycles, the elasticity means are all positive but increase steadily. The first two peaks in the second group are less intense on average than the national peaks, but the average regional peak is more intense than the national peak in the last two cycles. The average of the first four mean elasticities is slightly less than the average of the means for the second four peaks, though both are close to +1. The first four cycle mean is close to +1 because of the offsetting negative mean elasticity for April 1960, which is due to the especially contrary behavior of employment in the West South Central and Mountain regions and, to a much lesser extent, in the Pacific region.

A more informative indicator of regional behaviors vis-à-vis the national cycle would be a standard deviation measure of the dispersion of regional elasticities for each cycle peak.[8] The standard deviations appear to be highly variable. The deviations of elasticities are large for the first and fourth peaks, but small for the second and third peaks. In the second four cycles we again see some variation, but not nearly as much as in the first group. The mean of the second four standard deviations is 56 percent less than the mean standard deviation of the first four peaks. This implies there was less variability among the regions in their peak behaviors with respect to national peaks over the second half of the post-World War II era. On the other hand, the variability in the second period is understated by the standard deviation values because there was, in each of the two last cycles, one region that showed no peak but continued to exhibit steadily increasing adjusted cycle employment values.

The data on troughs (in Tables 6 and 7) tend to support a similar conclusion. The interpretation of the mean trough elasticities is analogous to the interpretation of the mean peak elasticities. Five of the trough mean elasticities lie close to +1; the remaining three differ noticeably from +1 and by about as much as the difference for peak elasticities. The four cycle mean of mean elasticities declined 11 percent from the first four cycles to the second four.

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[8]The procedure used to calculate these standard deviation was modified from the usual definition. It is of interest to measure the dispersion of regional elasticities around the value +1 because this value would indicate that the regional peak (trough) exactly matched the national peak (trough): that the region's deviation from trend above or below would exactly match that of the national series. Thus, the standard deviation is calculated as the square root of the mean squared deviation from 1, not from the mean of the regional elasticities. This procedure is acceptable because we are not trying to estimate an unbiased population parameter, but to trace the progress over time of the dispersion of regional employment cycle experiences.

The standard deviation of trough elasticities for each cycle may be a more informative measure. The standard deviations vary considerably from trough to trough, with no apparent time pattern. There was a sharp 45 percent decline in the four trough mean of standard deviations from the first to the second half of the post-World War II period, indicating that the dispersion of trough elasticities showed less variation from cycle to cycle in the second period.

The data on both peaks and troughs tell similar stories. During the first 20 years after World War II regional employment tended to show more extreme values at peaks and troughs than the national employment series and a greater dispersion around the national peak and trough values. This tendency was especially pronounced around the 1948 and 1960 peaks and the 1954 trough. The last four cycles showed regional employment extremes behaving more consistently with national employment peaks and troughs, with less variability in regional extremes. Thus, with regard to the dimension of elasticity, regional cycle behavior seems to be exhibiting a tendency toward convergence.

Summary of Results and Recommendations for Further Research

The results of this paper are somewhat ambiguous. The measurement of regional co-movements, using means of pairwise Pearson correlation coefficients, strongly suggests increasingly dissimilar growth cycle movements from 1967 to 1989 compared to the 1947 to 1967 period. The time series regression of monthly standard deviations of relative amplitudes showed a statistically significant negative coefficient on time for the first 20 years which then changed to a weak, positive, and nonsignificant coefficient for the last 22 years. This trend weakly implies support for increasingly divergent regional growth cycle behaviors in the second period. On the other hand, measurement of the elasticities of regional cycle peaks and troughs relative to their corresponding national peaks and troughs shows that the four cycle mean standard deviation of elasticities for both peaks and troughs declined substantially from the first period to the second period. This implies convergence in the behavior of regions at their business cycle extremes.

The studies cited above (and ours) have looked mostly at Census regions; it would be interesting to look carefully at regions below the Census level (for example, BEA regions, states within Census regions, and SMAs). Could our results be artifactual, a function of choosing to work with large Census regions? The more interesting question is why regional business cycle activity is showing increasing diversity, by at least some measurements. Further research is needed to relate diversity in regional cycles to appropriate causal factors. Previous students

of the question have looked at diversity in the industrial composition of regions (Borts, 1960; Browne, 1978; and Connaugton and Madsen, 1984) and at the vintage of industrial investment across regions (Howland, 1984). Amos (1989) suggests four theoretical models that could explain the historic process of convergence in regional economic performance; careful empirical work might separate these different sources of regional behavior. But these are only beginnings; the sources of diversity in regional cycles need to be pursued more vigorously and more carefully in both theory and empirical work. Further, there is the question of implied interregional linkages that we noted above in our discussion of the correlational measure of growth cycle co-movements. There is a large field of further work to be done in the study of regional business cycle movements.

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Table 1—Growth Cycle Correlations of Census Pairs

Region Pairs	1947–1967	1967–1987
NE...MA	0.9468 ***	0.8662 ***
NE...SA	0.8449 ***	0.6655 ***
NE...ENC	0.8785 ***	0.7092 ***
NE...WNC	0.6842 ***	0.4811 ***
NE...ESC	0.7773 ***	0.4422 ***
NE...WSC	0.3892 ***	0.0845
NE...MTN	0.1887 ***	–0.1003
NE...PAC	0.8217 ***	0.7174 ***
MA...SA	0.8741 ***	0.7452 ***
MA...ENC	0.9053 ***	0.7047 ***
MA...WNC	0.6695 ***	0.2642 ***
MA...ESC	0.7884 ***	0.3617 ***
MA...WSC	0.3892 ***	–0.5029 ***
MA...MTN	0.1320 ***	–0.4541 ***
MA...PAC	0.8212 ***	0.3982 ***
SA...ENC	0.9516 ***	0.8023 ***
SA...WNC	0.9208 ***	0.5680 ***
SA...ESC	0.9680 ***	0.7572 ***
SA...WSC	0.7314 ***	–0.3557 ***
SA...MTN	0.5082 ***	0.0516
SA...PAC	0.8094 ***	0.4277 ***
ENC...WNC	0.8769 ***	0.8259 ***
ENC...ESC	0.9484 ***	0.8855 ***
ENC...WSC	0.6762 ***	–0.2883 ***
ENC...MTN	0.4022 ***	0.0275
ENC...PAC	0.7964 ***	0.7066 ***
WNC...ESC	0.9703 ***	0.9206 ***
WNC...WSC	0.8919 ***	0.2196 ***
WNC...MTN	0.7140 ***	0.5269 ***
WNC...PAC	0.6677 ***	0.8497 ***
ESC...WSC	0.8445 ***	–0.0644
ESC...MTN	0.6287 ***	0.4078
ESC...PAC	0.7744 ***	0.6625 ***
WSC...MTN	0.9134 ***	0.7722 ***
WSC...PAC	0.5883 ***	0.4030 ***
MTN...PAC	0.4796 ***	0.4360 ***
Mean	0.7270	0.4099
Decrease in mean coefficient value		43.6% ****

* Significant at .10
** Significant at .05
*** Significant at .01
**** Significant at .005

Table 2—Changes in Correlations of Highly Paired Regions

Region Pairs Showing Little To Moderate Change Region Pair	1947–1967	1967–1989	% Change
WNC...ESC	0.9703	0.9206	–5.12
ENC...WNC	0.8769	0.8259	–5.82
NE...MA	0.9468	0.8862	–6.40
ENC...ESC	0.9484	0.8855	–6.63
MA...SA	0.8741	0.7452	–14.75
WSC...MTN	0.9134	0.7722	–15.46
SA...ENC	0.9516	0.8023	–15.69

Region Pairs Showing Considerable Change Region Pair	1947–1967	1967–1989	% Change
NE...ENC	0.8785	0.7092	–19.27
NE...SA	0.8449	0.6655	–21.23
SA...ESC	0.9680	0.7572	–21.78
MA...ENC	0.9053	0.7047	–22.16
SA...WNC	0.9208	0.5680	–38.31
WNC...WSC	0.8919	0.2196	–75.38
WNC...PAC	0.6677	0.8497	+27.26

Table 3—Regression on Time of Adjusted Cycle Standard Deviations

March 1947 to March 1967	Coefficient	T Value	Prob Value
Time	–.0146	–3.29	.001
Constant	5.6858	4.70	.000

April 1967 to May 1989	Coefficient	T Value	Prob Value
Time	.0027	.96	.339
Constant	1.7802	1.52	.131

Table 4—Elasticities for Census Regions at NBER Cycle Peaks

Region	NBER National Peaks							
	Nov 1948	Jul 1953	Aug 1957	Apr 1960	Nov 1969	Nov 1973	Jan 1980	Jan 1981
US	-0.60162	5.37798	3.81142	-0.57431	2.95991	2.52318	4.31004	1.53866
NE	1.41403	3.54038	1.56072	-1.11854	4.89886	2.22411	2.44600	0.82872
Elas	-2.35037	0.65831	0.40949	1.94762	1.65507	0.88147	0.56751	0.53860
MA	1.61200	3.25556	2.13332	-1.85912	5.86194	3.25700	0.83598	-0.75044
Elas	-2.67943	0.60535	0.55972	3.23714	1.98045	1.29083	0.19396	-0.48772
SA	-0.55981	5.40337	2.90541	-0.92809	1.94413	6.20920	2.63863	0.58904
Elas	0.93050	1.00472	0.76229	1.61601	0.65682	2.46086	0.61221	0.38282
ENC	-0.34415	7.11680	4.83792	-2.05008	4.85976	3.63726	5.61051	-0.35591
Elas	0.57204	1.32332	1.26932	3.56964	1.64186	1.44154	1.30173	-0.23131
WNC	-2.89576	6.49913	3.78667	0.24448	1.48098	1.93349	6.49883	1.87396
Elas	4.81327	1.20847	0.99351	-0.42569	0.50035	0.76629	1.50784	1.21792
ESC	-1.31268	7.33209	4.75129	-1.20460	0.48089	4.07661	6.60719	***
Elas	2.18191	1.36335	1.24659	2.09747	0.16247	11.61566	1.53298	
WSC	-6.25826	9.44630	9.89832	4.37852	-1.55568	-1.85502	***	8.33337
Elast	10.40235	1.75648	2.59702	-7.62397	-0.52558	-0.73519		5.41599
MTN	-5.57306	7.35446	7.24801	4.95790	-5.11502	0.87064	7.71199	4.93925
Elas	9.26342	1.36751	1.90166	-8.63279	-1.72810	0.34506	1.78931	3.21010
PAC	1.10722	4.02492	3.49166	1.04403	3.66770	-0.22877	6.28246	3.56502
Elas	-1.84040	0.74841	0.91610	-1.81789	1.23913	-0.09067	1.45763	2.31696

*** No cycle peak was recorded. The region evidenced a continuing rise in adjusted regional employment with no evident peak. Omitted from calculations

Table 5—Mean Elasticities and Standard Deviations at NBER Cycle Peaks

	NBER National Peaks							
	Nov 1948	Jul 1953	Aug 1957	Apr 1960	Nov 1969	Nov 1973	Jan 1980	Jan 1981
Mean Elasticity	2.36592	1.11510	1.18397	-0.67027	0.62027	0.88621	1.12040	1.54542
Mean of First Four Means	0.99868							
Mean of Second Four Means	0.96902							
Standard Deviation of Elasticities	4.78011	0.38343	0.67519	4.60949	1.18783	0.91231	0.55369	1.95226
Mean of First Four Standard Deviations	2.61205							
Mean of Second Four Standard Deviations	1.15152							

Table 6—Elasticities for Census Regions at NBER Cycle Troughs

Region	NBER National Troughs							
	Oct 1949	May 1954	Apr 1958	Feb 1961	Nov 1970	Mar 1975	Jul 1980	Nov 1982
US	-4.79127	0.41244	-2.07327	-4.10001	-1.45087	-2.45973	1.47352	-4.65107
NE	-4.37188	-0.86967	-3.92203	-2.78507	-0.86028	-4.09421	0.72192	-4.05783
Elas	0.91247	-2.10860	1.89171	0.67928	0.59294	1.66450	0.48993	0.87245
MA	-3.84342	-1.63414	-2.88348	-4.06705	1.42543	-2.81254	-0.96922	-4.28518
Elas	0.80217	-3.96213	1.39079	0.99196	-0.98247	1.14343	-0.65776	0.92133
SA	-4.34376	-0.47285	-1.97963	-4.69958	0.44487	-1.93251	0.55255	-5.52478
Elas	0.90660	-1.14647	0.95483	1.14624	-0.30662	0.78566	0.37499	1.18785
ENC	-5.40341	0.81852	-4.81069	-6.92709	-0.71737	-2.17494	-0.35993	-7.91931
Elas	1.12776	1.98458	2.32034	1.68953	0.49444	0.88422	-0.24427	1.70269
WNC	-3.96359	2.58388	-1.05865	-4.70107	-2.93868	-1.17254	1.87273	-5.22541
Elas	0.82725	6.26486	0.51062	1.14660	2.02546	0.47669	1.27092	1.12349
ESC	-5.51262	2.02047	-1.42949	-5.09994	-2.39672	-1.61317	***	-6.94429
Elas	1.15056	4.89882	0.68949	1.24388	1.65192	0.65583		1.49305
WSC	-6.79438	5.70886	4.31937	-4.47231	-6.75510	-3.73309	***	1.53924
Elas	1.41807	13.84167	-2.08336	1.09080	4.65590	1.51768		-0.33094
MTN	-6.32204	2.49273	3.84994	-6.50167	-6.75639	-2.71470	4.87932	-2.05893
Elas	1.31949	6.04386	-1.85694	1.58577	4.65679	1.10366	3.31134	0.44268
PAC	-6.03991	-1.18063	-1.61564	-2.57244	-3.66335	-3.53233	3.49204	-4.60930
Elas	1.26061	-2.86255	0.77927	0.62742	2.52393	1.43606	2.36986	0.99102

*** No cycle trough was recorded. The region evidenced a continuing fall in adjusted regional employment with no evident trough. Omitted from calculations

Table 7—Mean Elasticities and Standard Deviations at NBER Cycle Troughs

Region	NBER National Troughs Oct 1949	May 1954	Apr 1958	Feb 1961	Nov 1970	Mar 1975	Jul 1980	Nov 1982
Mean Elasticity	1.08055	2.55045	0.51075	1.13350	1.70137	1.07419	0.98786	0.93374
Mean of First Four Means.....1.31881								
Mean of Second Four Means.....1.17429								
Standard Deviation of Elasticities	0.22831	5.65735	1.51830	0.36070	2.01647	0.39196	1.32230	0.56686
Mean of First Four Standard Deviations 1.94116								
Mean of Second Four Standard Deviations 1.07440								

Appendix—The Nine Census Regions

Title	Abbreviation	States
Northeast	NE	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Middle Atlantic	MA	New Jersey, New York, Pennsylvania
East North Central	ENC	Illinois, Indiana, Michigan, Ohio Wisconsin
West North Central	WNC	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
South Atlantic	SA	Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia
East South Central	ESC	Alabama, Kentucky, Mississippi, Tennessee
West South Central	WSC	Arkansas, Louisiana, Oklahoma, Texas
Mountain	MTN	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming
Pacific	PAC	Alaska,* California, Hawaii,* Oregon, Washington

*Not included in study