REGIONAL CYCLICAL VOLATILITY: TESTS OF A GROWTH-BUFFER HYPOTHESIS

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Introduction

Wide disparities in regional economic performance have received increased attention by researchers and policy-makers in recent years. Concern has focused on industrial shifts among regions and how such changes are likely to influence long run growth prospects and the cyclical stability of regional economies. Significant variations in the latter are well documented. Studies of recent vintage include: Booth and Koveos [4]; Browne [6]; Cho and McDougall [10]; Clark [11]; Connaughton and Madsen [12]; Kozlowski [14, 15]; Mead and Ramsay [17]; and Strong [20]. These studies reflect a perspective that regards regional cyclical sensitivity as a function of short-run fluctuations in external demands and the manner in which they filter through regional industrial structures. Because industrial structure shifts relatively slowly over time, it is typically regarded as fixed during a specific national business cycle so that observed variations in regional cyclical behavior can be attributed to differentials in industry mix to some extent.

Industry mix does have undeniable influence on short-run cyclical behavior; but regional cyclical performance appears to be a complex phenomenon that may be influenced by other factors which have defied exact specification. In short, while cyclical swings do occur in varying magnitudes across regions, industry mix, by itself, is at best a rough and inconsistent predictor of regional cyclical sensitivity. This ambiguity has led to policy recommendations for mitigating adverse impacts associated with cyclical swings that are not only vague but are also surrounded by uncertainty about implementation. Based on aversion to cyclical risk, policy recommendations include adjustments of regional portfolios toward less volatile industries, greater overall industrial diversification, and the application of regionally oriented macroeconomic policies which may act as spatial stabilization devices (Allen [2]; Strong [20]; Vaughn [22]; and Vernez [23]). The policy goal is to minimize short-run cyclical volatility, which is quite distinct from longer run objectives regarding regional economic growth. The result has been two sets of regional policy recommendations: one focusing on regional cyclical stability; the other focusing on regional growth and development.

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However, long-run growth processes may influence short-run cyclical performance. The early work by Borts [5] suggested a link between growth and cyclical behavior of manufacturing employment across 33 states during the 1914-1953 period. For his sample Borts reported that, while growth and cyclical instability were not closely related, combinations of high growth rates and mild cycles occurred more often than their opposites. In contrast, Cho and McDougall [10] found that more rapid growth was significantly associated with greater cyclical volatility in a sample of 27 metropolitan areas during the 1953-1975 period. While there appears to be a conceptual link between long-run growth and short-run cyclical performance across regions, previous empirical results are, at best, inconclusive and, at worst, conflicting.

This paper focuses on long-run growth and short-run cyclical volatility across regions in the United States over a 30-year period from 1954 to 1983. The main argument is that long-run growth acts as a buffer that tempers the magnitude of cyclical movements. Support for a growth-buffer proposition exists in the major theoretical explanations of regional business cycles. This paper provides results of empirical tests linking regional growth to cyclical volatility. Two major questions are addressed:

1. Is there a significant association between regional growth and overall cyclical volatility in regions?

2. Is growth related to the behavior of regions during specific cyclical phases in a consistent manner?

Section 1 reviews the theoretical foundations of a growth-buffer hypothesis. Section 2 analyzes regional differentials in growth and cyclical volatility over a 30-year period. Section 3 examines regional variations in cyclical volatility in terms of key structural factors and long-run economic growth. Section 4 presents the conclusions and suggests some policy implications of the results.

Conceptual Framework

Regional macro- and microeconomic theories suggest linkages between underlying growth processes and cyclical behavior. The essence of a growth-buffer hypothesis can be gleaned from both industry-mix and interregional business cycle theories. The discussion below summarizes the major points of regional business cycle theories.

Industrial-Mix Theory. Microeconomic industrial-mix theory is based on a nonuniform distribution of industries over space. Regional economies are regarded as sets of independent and regionally homogeneous industries which behave exactly like their national counterparts. Regions, therefore, represent bundles of industries located in space; output, income, and employment vary across regions to the extent that sets of industries do.

Emphasis on industrial diversification follows from this theoretical framework. Planned or even random diversification of a regions's industrial structure may lead to less cyclical volatility because a more diversified industrial structure has greater balance between cyclically sensitive and relatively stable industry groups. A regional "portfolio" of industries which is less balanced, therefore, increases the likelihood of more severe cyclical swings, other things equal.

Modified industrial-mix theory recognizes that industries are not regionally homogeneous. Instead, differences in size, age, and growth of firms do exist over space. Some firms may be relatively efficient and have low cost characteristics; others may be marginal, high-cost facilities linked to declining segments of certain industries. When national economic conditions deteriorate, the former are more likely to maintain output then the latter. Moreover, efficient, low-cost firms are likely to return to 'normal' operating rates more rapidly than their high-cost counterparts which may be forced to await an increase in demand sufficient to cover their relatively higher costs. Rapidly growing regions may have industrial structures composed of more efficient firms in an industry. A rapidly growing region may, therefore, exhibit a cyclical pattern that differs from that of a slower growing region.

Interregional Business Cycle Theory. Interregional macroeconomic theory focuses attention on trade among regions. Emphasis is placed on changes in regional export, import, consumption and investment spending, as well as the mechanism through which fluctuations are transmitted across regions. In short, interregional macro theory emphasizes consumption, investment and trade flows as determinants of cyclical performance.

Models of interregional business cycles have been constructed in various ways; the illustration below follows the work of Airov [1].

Let Y, C, I, and A represent (nx1) vectors of income, induced consumption, induced investment, and autonomous expenditures. Induced consumption can be treated as a function of lagged income and divided between local spending and exports as follows:

$$C_{ii,t} = m_{ii}Y_{i,t-1} \quad \text{for } i = 1, 2, \ldots, n \tag{1}$$

$$C_{ij,t} = m_{ij}Y_{j,t-1} \quad \text{for } i \neq j \tag{2}$$

Equation (2) specifies that exports of consumption goods from region i to j are a function of lagged income in region j. Combining (1) and (2) yields a system of regional consumption equations given by (3), where M is an (nxn) matrix of consumption coefficients.

$$C_t = MY_{t-1} \tag{3}$$

Because of trade, induced investment is divided into two components and is treated as a function of lagged changes in income as follows:

$$I_{ii,t} = b_{ii}(Y_{i,t-1} - Y_{i,t-2}) \tag{4}$$

$$I_{ij,t} = b_{ij}(Y_{j,t-1} - Y_{j,t-2}). \tag{5}$$

Combining (4) and (5) yields a system of regional investment equations, where B represents an (nxn) matrix of incremental capital-output ratios.

$$I_t = B(Y_{t-1} - Y_{t-2}) \tag{6}$$

The autonomous component, A, includes, among other things, consumption and investment expenditures which are not linked to the level or changes in the level of regional income.

Using the income-expenditure equilibrium condition yields a simultaneous second-order difference equation system given by (7).

$$Y_t - (M+B)Y_{t-1} + BY_{t-2} = A \quad (7)$$

The solution reveals the nature of regional cyclical patterns. Equilibrium levels of income depend on a vector of autonomous expenditure values and numerous regional multipliers, as show in (8). If the regional

$$Y^* = (J-M)^{-1}A \quad (8)$$

structural parameters are of appropriate values to generate cycles around Y^*, then the roots of the simultaneous system are complex with the solution given by (8). The values of kR(G) and kE(G) determine the amplitudes of cycles; the multiplicative constant r determines whether the cycles are damped ($r<1$), explosive ($r>1$), or regular ($r=1$).

$$Y_t = r^t\,[\{k_1R(G) + k_2E(G)\}\cos\theta t + \{-k_1E(G) + k_2R(G)\}\mathrm{Sin}\theta t] \quad (9)$$

For this system, regional cyclical patterns vary to the extent that combinations of stable consumption (m_{ij}) and unstable capital goods (b_{ij}) do. The model suggests that regions with higher capital coefficients experience greater cyclical amplitudes, thus providing a direct link between regional industrial structure and cyclical performance.

However, for "realistic" values of the consumption and capital coefficients the simultaneous difference equation model yields explosive cycles. Such behavior may be constrained by exogenous buffers which act to limit the explosive nature of the cycles. Long-run economic growth is one such buffer which may place a floor under the explosive downward movement of regional income (or output) inherent in the model. More rapid regional growth has been linked to higher rates of return and technological advances which tend to boost localized sources of demand and, thereby, act to dampen cyclical downswings (Richardson [18, 19]).

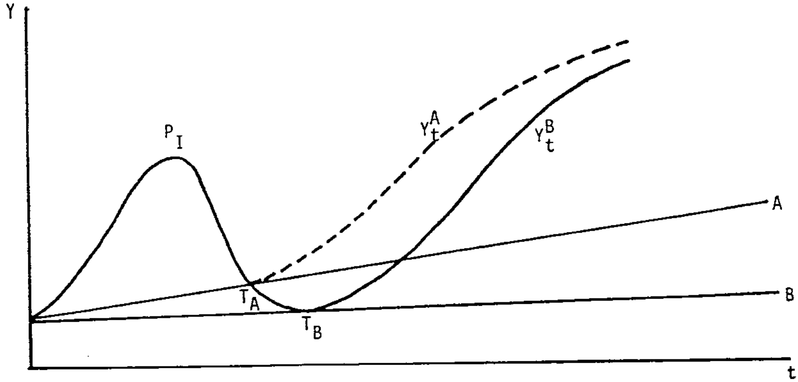
The micro and macroeconomic theories reinforce each other, suggesting that regional cyclical volatility is likely to be influenced by long-run growth processes.

The essence of a growth-buffer hypothesis is illustrated in Figure 1. Regions A and B exhibit distinct cyclical patterns for income, Y^A and Y^B. Region A, which experiences greater long-run growth, displays less cyclical volatility from inital peak (P_1) to terminal trough (T_A) than Region B, ($T_B - P_1$), because the growth process provides a floor for the contraction phase. If Regions A and B have similar industrial structures, then the smaller amplitude of the downswing in Region A may be attributable to more rapid growth in that region.

Measures of Growth and Cyclical Volatility

The relationship between growth and cyclical performance was analyzed by measuring the behavior of total nonagricultural employment across a

FIGURE 1



sample of forty-two metropolitan areas distributed throughout nine census divisions in the United States. These metropolitan areas are economic regions, and monthly employment provides a comparable measure of subnational economic activity covering a thirty-year period from 1954 to 1983 during which six full national business cycles occurred.

The regional time series were seasonally adjusted and average growth rates estimated over the entire 30 years. These are given in column 1 of Table 1.

The most rapid employment growth occurred in the areas in the Mountain division, with all areas ranking above average for the group. Phoenix and Reno rank first and second, respectively. The selected areas in the East North Central and New England divisions all experienced slower than average growth. Except for Rochester, this is also the case for the Middle Atlantic division, in which New York City was the only area to exhibit negative employment growth over the thirty-year period. For the sample as a whole, considerable variation existed in terms of long-run growth during the period examined, with relatively slow employment growth evident in the heavily industrialized sections of the country.

It is quite possible that employment does not reflect long-run economic growth very well because income (or output) may be rising while employment is falling. Annual average growth rates for personal income are shown in column 2 of Table 1. The relative growth rankings for income of the metropolitan areas are similar to those for employment. In fact, the correlation between employment and income growth across the sample of metropolitan areas is +.941, indicating a strong association between regional employment and income growth over a long period of time. In sum, the growth estimates reveal that the heavily industrialized sections of the country experienced

TABLE 1
Regional Economic Growth, 1954-1983

	Employment (Average Monthly)	Personal Income (Average Annual)
New England		
Boston	.216	8.14
Providence	.144	7.95
Hartford	.184	8.40
Bridgeport	.096	8.46
Lewiston	.079	8.05
Waterbury	.092	7.87
Middle Atlantic		
Buffalo	.047	6.60
Pittsburgh	.059	6.87
New York City	.026	6.74
Rochester	.236	7.83
South Atlantic		
Washington, D.C.	.305	9.69
Atlantic	.374	10.56
Miami	.361	9.99
Richmond	.257	9.17
Baltimore	.167	8.45
East South Central		
Birmingham	.210	8.31
Louisville	.174	8.11
Jackson	.332	9.63
Memphis	.244	8.89
Nashville	.281	9.56
West South Central		
Little Rock	.322	9.58
New Orleans	.206	8.87
Tulsa	.308	9.32
East North Central		
Detroit	.116	7.41
Indianapolis	.217	7.81
Chicago	.088	7.13
Milwaukee	.146	7.32
West North Central		
Minneapolis	.265	8.90
Wichita	.167	7.91
Omaha	.198	8.22
Des Moines	.214	7.95
Kansas City	.185	8.23
St. Louis	.115	7.72
Mountain		
Phoenix	.546	11.96
Albuquerque	.370	9.42
Denver	.375	10.28
Salt Lake City	.276	9.39
Reno	.495	11.10
Pacific		
Portland	.272	8.76
San Francisco	.175	8.03
Los Angeles	.180	8.06
San Diego	.387	10.34

Sources: U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings*; U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, April 1986.

relatively slower growth of both income and employment during the 1954-83 period.

Total Cyclical Volatility. How wide was the dispersion in cyclical performance across the forty-two metropolitan areas during the thirty-year period? Measures of total cyclical performance are given in columns 1 and 2 of Table 2.

CYCLES represents the number of actual cycles identified in the employment series by delineating upper and lower turning points in the series themselves. Time-domain standard business cycle procedures yield detailed information about cyclical movements that is comparable across regions (see, Bry and Boschan [7]).[1]

Six national business cycles, defined on a trough-peak-trough basis, occurred during the 1954-1983 period. Table 2 shows that the number of cycles varied from 2 in four areas to 6 in eleven others. In terms of geographic distribution, the New England, Middle Atlantic, East North Central, and Pacific divisions include metropolitan areas which experienced five or six complete specific cycles. In many cases 5 specific cycles would easily have been 6 — the national total — except that the unusually short and weak national expansion from August 1980 to July 1981 was skipped by many areas. This resulted in one long and deep specific cycle contraction during the 1980-82 period instead of two contractions exhibited by the nation as a whole. The metropolitan areas in the Mountain division experienced the fewest cyclical episodes. Those areas skipped several national recessions as employment continued to expand while the national economy was contracting. That was certainly not the case in the heavily industrialized Northeast and North Central divisions.

It should also be noted that none of the metropolitan areas experienced more cycles than the nation did, and that those regional cyclical movements that did occur conformed to national cyclical episodes. There are, of course, differences in timing, duration and amplitude between national and regional cyclical swings, but unique, independently occurring regional cycles were not evident during the thirty-year period from 1954 to 1983.

The SPEC measures represent spectral density estimates utilizing a Fast Fourier Transform as follows:

$$f_k(q) = (.25) \qquad W_j I_{k+j}$$

where q is the angular frequency and W represents weights used to smooth the periodogram. The magnitude of the spectral estimate at any frequency indicates the relative contribution of that frequency to the total variance of a covariance stationary series. Second differences of moving averages for each series were used. For these adjusted series, the strength of total cyclical movements was measured by the ratio of the mean of the frequencies in the business cycle frequency band (24 to 100 months) to the spectral mean itself. The higher the ratio is, the greater is the contribution of cycles in this range to the total variance of the series, and these may be statistically significant (Chatfield [9]). Table 2 shows that these estimates of total cyclical amplitude are greater than one for forty-one of the forty-two areas, and in a high

TABLE 2
Measures of Metropolitan Cyclical Volatility

	(1) CY-CLES	(2) SPEC	(3) EXP	(4) CON	(5) CYC	(6) DEXP6	(7) DCON6	(8) DCYC6
New England								
Boston	5	2.605	.186	.033	.220	.039	.053	.092
Providence	6	3.561	.122	.060	.182	.067	.084	.151
Hartford	5	3.089	.162	.024	.186	.034	.041	.075
Bridgeport	5	4.067	.135	.060	.195	.068	.072	.140
Lewiston	5	2.398	.142	.088	.230	.084	.096	.180
Waterbury	5	2.007	.135	.076	.211	.066	.083	.149
Middle Atlantic								
Buffalo	6	2.394	.091	.072	.163	.067	.083	.150
Pittsburg	5	0.870	.101	.073	.174	.058	.074	.132
New York City	5	2.807	.047	.053	.100	.048	.041	.089
Rochester	6	3.181	.171	.035	.206	.042	.067	.109
South Atlantic								
Washington, D.C.	3	2.007	.450	.012	.462	.009	.020	.029
Atlanta	4	3.517	.312	.033	.345	.041	.046	.087
Miami	4	2.506	.463	.040	.503	.061	.057	.118
Richmond	4	4.091	.280	.026	.306	.025	.039	.064
Baltimore	6	1.637	.126	.027	.153	.045	.053	.098
East South Central								
Birmingham	5	1.530	.181	.046	.228	.045	.068	.113
Louisville	6	2.504	.154	.060	.214	.077	.099	.176
Jackson	3	3.682	.552	.027	.579	.024	.031	.055
Memphis	6	3.361	.177	.035	.212	.047	.066	.113
Nashville	4	2.837	.331	.040	.371	.027	.038	.065
West South Central								
Little Rock	4	2.307	.352	.029	.380	.025	.042	.067
New Orleans	5	2.496	.173	.026	.199	.039	.048	.087
Tulsa	4	3.958	.383	.053	.435	.055	.071	.126
East North Central								
Detroit	6	3.175	.156	.097	.254	.096	.123	.219
Indianapolis	6	3.602	.174	.044	.219	.061	.076	.137
Chicago	5	1.592	.103	.050	.153	.044	.058	.102
Milwaukee	5	4.160	.164	.068	.232	.066	.081	.147
West North Central								
Minneapolis	3	2.228	.373	.037	.410	.024	.048	.072
Wichita	5	4.617	.206	.084	.290	.085	.101	.186
Omaha	4	2.501	.208	.030	.238	.021	.039	.060
Des Moines	5	1.413	.177	.036	.281	.038	.063	.101
Kansas City	5	1.257	.156	.032	.188	.038	.046	.084
St. Louis	6	2.958	.105	.038	.143	.057	.065	.122
Mountain								
Phoenix	2	4.654	2.090	.035	2.125	.036	.027	.063
Albuquerque	3	3.404	.557	.021	.578	.034	.022	.056
Denver	2	2.143	1.060	.025	1.085	.022	.020	.042
Salt Lake City	2	2.537	.910	.012	.920	.013	.010	.023
Reno	2	3.199	2.110	.030	2.140	.017	.030	.047
Pacific								
Portland	6	4.357	.195	.038	.246	.048	.078	.124
San Francisco	5	2.503	.148	.020	.168	.033	.040	.073
Los Angeles	5	4.377	.180	.028	.208	.048	.041	.089
San Diego	6	3.804	.286	.017	.303	.050	.054	.104

proportion of the cases SPEC are significant.[2]

The spectral measures reveal a high degree of regional variation over the 1954-83 period. No geographic division stands out as the most cyclically volatile, however, All divisions include some metropolitan areas that rank relatively low and others that rank high in this regard. For example, the East North Central division includes Milwaukee and Indianapolis, which rank high in terms of spectral measures of cyclical amplitude; but it also includes Chicago which ranks fairly low. For the thirty-year period, Phoenix ranks highest, followed by Wichita, Los Angeles, Portland and Bridgeport. In contrast, Pittsburgh has the lowest cyclical ranking based on these spectral estimates. Although this may seem surprising and somewhat unusual, it does conform to previous research results which showed Pittsburgh having less severe cycles than Atlanta, Miami, Tampa, Los Angeles, and Seattle, (Cho and McDougall [10]).[3] These spectral estimates should be interpreted cautiously, however, because they may reflect inherent methodological weaknesses in frequency-domain techniques.

Cyclical Phases. Spectral analysis yields measures of overall cyclical amplitude in each of the regional employment series, but does not provide estimates of the magnitude of individual phases which may vary in duration and magnitude. Standard business cycle analysis, used to identify the number of cycles for each metropolitan area, permits measurement of amplitudes of expansion and contraction phases based on the upper and lower turning points determined for each series. These phase amplitude estimates are shown in columns 3, 4, 6 and 7 in Table 2.

The magnitudes of cyclical expansion and contraction phases were measured with and without trend adjustment. Measurement without trend adjustment reflects an argument that cyclical phenomena and trend are difficult to separate conceptually and empirically, and that information about cyclical swings may be lost by removing trend (Burns and Mitchell [8]). Without trend adjustment, amplitudes were measured by absolute values of relative changes from the initial to terminal turning point for each cycle phase. Means for the entire period are shown as EXP and CON in Table 2. Detrended measures were computed as differences between the ratios of the initial and terminal turning points to an estimated long-run trend. These amplitude measures were standardized to six cyclical episodes and appear in Table 2 as DEXP6 and DCON6. Total cycle amplitude is the sum of the expansion and contraction phase magnitudes and are shown in Table 2 as CYC and DCYC6.

Without trend adjustment the amplitudes of expansions were greater than those of contractions in all areas except New York City. The New England, Middle Atlantic and East North Central divisions exhibit high ratios of CON to CYC, indicating that, on average, cyclical contractions were much stronger relative to total cycle amplitude than elsewhere. Areas in the Mountain division have the lowest ratios of CON to CYC. It should be noted that the Mountain division ranks as the most cyclically volatile due to large expansions (EXP) which dominate total amplitude. However, total amplitude is misleading as a measure of cyclical volatility because a cyclical pattern characterized by long and strong expansions and short and weak contractions can hardly be regarded as a sign of a high degree of cyclical instability.

Without detrending, the measures of overall cyclical amplitude are biased by strong expansions which appear to be dominated by long-run trends. The correlation between total average cyclical amplitude and employment growth is +.743, with the correlation between average cyclical expansion and growth equal to +.760 and average cyclical contraction and growth equal to −.585. The degree of association between these cyclical performance measures and growth of personal income is similar. Without trend adjustment, therefore, the growth process appears to dominate cyclical performance across metropolitan areas through its strong influence on expansion phases and, to a lesser degree, its constraining effects on contractions.

The detrended, stardardized amplitude measures (DEXP6, DCON6, DCYC6) reveal that, as a group, metropolitan areas in the East North Central division experienced the largest cyclical swings. Detroit ranks highest in overall cyclical volatility, followed by Wichita and Lewiston. The Mountain division ranks lowest overall, with Salt Lake City having the smallest measured cyclical volatility among the forty-two areas. Also, metropolitan areas in the East North Central division have the highest ranking for expansion and contraction magnitudes. This greater overall cyclical volatility is attributable, therfore, to both phases. Note also that DCON6 is greater than CON, and that DEXP6 is less than EXP in nearly all areas. This is further evidence of the influence of long-run trend on observed cyclical movements for individual phases of regional business cycles.

Explaining Regional Variations

The micro- and macroeconomic theories suggest that regional variations in cyclical volatility are linked to differences in industrial composition as well as long-run growth in a region. This relationship can be specified as follows:

$CV_i = f(DR_i, DV_i, G_i)$

where: CV_i = cyclical volatility in region i;
DR_i = degree of industrial diversification in region i;
DV_i = degree of industrial diversification in region i;
G_i = long-run growth in region i.

Measures of CV appear in Table 2. They show the number of cycles experienced by each metropolitan area as well as estimates of the magnitudes of cyclical movements over the 30 years. DR is measured as the proportion of total employment accounted for by durable goods industries averaged over three census years: 1960, 1970 and 1980. The degree of industrial diversification is an indicator of industrial balance and can be measured in several ways, none of which is completely satisfactory (Jackson [13]). Here diversification is measured by averages of standardized variances in the distribution of employment across major industry groups in 1960, 1970 and 1980. DV equal to zero implies perfect industrial balance. A larger DV indicates a less diversified industrial structure. As noted earlier, growth can be measured by either employment or income trends. The results below are based on estimates of the growth of personal income shown in Table 1.

Cross-section OLS estimates are based on the following regression equation:

$$CV = b_0 + b_1DR + b_2DV + b_3PIGR$$

A priori reasoning suggests that b_1 is positive — concentration in durable goods is associated with greater volatility; b_2 can be expected to be positive — less industrial diversification is linked to greater volatility; and b_3 is expected to be negative — more rapid growth is associated with less volatility. Cross-section regression estimates appear in Table 3.

The number of cycles appears to be influenced by durable goods mix and growth. Those areas that are more heavily concentrated in durable goods manufacturing experienced more cyclical episodes. On the other hand, more rapid growth is significantly associated with fewer cyclical swings. Regions that actually skipped national cyclical episodes tended also to have higher long-run growth rates during the period.

The results for SPEC are not good. While coefficients for DR and DV have the expected signs, the growth coefficient not only has the wrong sign but is highly significant. This contradicts the growth-buffer hypothesis, i.e., more rapid growth is associated with greater cyclical volatility on average. This result is not conclusive, however, because it may simply reflect the limitations of spectral analysis cited earlier.[4]

Without trend adjustment growth dominates regional cyclical volatility. The amplitude of the total cycle (CYC in Table 2) is dominated by the expansion phase, which is considerably longer and of greater magnitude than the contraction phase. The former is strongly influenced by long-run growth. More rapid growth, therefore, contributed to more vigorous expansions and milder contractions on average. Durable goods manufacturing and a less diversified industrial structure were associated with more severe downswings, on average, for the forty-two areas over the 30 years, but these structural factors had little effect on the expansion phase. Thus, without trend adjustment regional structural factors influenced only the contraction phase as expected, but long-run growth influenced both expansion and contraction phases.

The detrended and standardized measures of cyclical volatility (DEXP6, DCON6, DCYC6) reveal the influence of growth on total cyclical amplitude as well as on individual phases. Greater concentration in durable goods manufacturing and a less diversified industrial structure contributed to greater total cyclical volatility; but more rapid growth significantly lowered total amplitude across the forty-two areas. Estimates for the individual cyclical phases show a similar pattern. Basically, concentration in durable goods production and less industrial balance contributed to greater magnitudes for expansion and contraction phases, with long-run growth acting as a mitigating influence on both.

TABLE 3
Cross-Section Regression Estimates of Regional Cyclical Volatility*

CV Measures	Constant	DR	DV	PIGR	R^2
CYCLES	9.750	3.912	−0.459	−0.610	.520
	(.0001)	(.080)	(.662)	(.0001)	
SPEC	−1.852	4.330	.0469	0.419	.210
	(.290)	(.052)	(.652)	(.005)	
CYC	−2.624	0.048	0.427	0.299	.568
	(.0001)	(.948)	(.228)	(.0001)	
EXP	−2.689	−0.003	0.369	0.306	.590
	(.0001)	(.997)	(.258)	(.0001)	
CON	0.039	0.072	0.038	−0.005	.489
	(.199)	(.064)	(.044)	(.035)	
DCYC6	0.108	0.201	0.059	−0.011	.515
	(.090)	(.014)	(.123)	(.035)	
DEXP6	0.038	0.085	0.032	−0.004	.472
	(.214)	(.027)	(.081)	(.085)	
DCON6	0.071	0.117	0.026	−0.007	.517
	(.050)	(.011)	(.218)	(.023)	

*Figures in parentheses represent Prob >[t]. N=42.

Conclusions

Regional business cycles persisted throughout the 1954-83 period, and they conformed to national business cycles. The results show that long-run growth in regional economies and cyclical volatility are interrelated, as regional business cycle theory suggests. More rapid long-run growth was associated with fewer cyclical episodes as well as less severe cyclical swings, over the 30-year period examined in this study.

The results show, however, that cyclical volatility itself is a multi-dimensional phenomenon which may not be represented well by measures of total cyclical amplitude. The nonsymmetrical nature of expansion and contraction phases suggests that references to total cyclical volatility of a regional economy may be a misleading representation of short-run performance, especially when expansions are long and vigorous relative to contractions. It is this behavior that may be responsible for conflicting results about the regional growth and cycle relationship reported previously. Decomposing cyclical movements into individual phases reveals that economic growth acts as a constraining factor on cyclical contractions as the growth-buffer hypothesis suggests.

The decomposed measures of cyclical swings showed that the procyclical influence of regional industrial structure, represented by concentration in durable goods manufacturing and less industrial diversification, may be offset to some extent by more rapid growth in a region. On the other hand, a procyclical industrial structure combined with slow growth leads to greater cyclical volatility, especially during contraction phases. This confluence of factors has contributed significantly to the relatively poor economic performance in older industrialized areas located in the Middle Atlantic and East North Central divisions.

Finally, the results are suggestive of public policy options for mitigating the adverse effects of short-run cyclical swings on regions. While previous research has focused almost exclusively on changes in industrial structure as an appropriate regional policy to reduce cyclical risk, emphasizing long-run growth may help alleviate some of the adverse impacts associated with short-run cyclical swings. The effectiveness of countercyclical policies, initiated either at the national level or subnational level, is more likely to be improved in an atmosphere or more rapid long-run growth. Indeed, the results suggest that long-run growth and short-run cyclical performance are related, and while the latter may be beyond the immediate control of regional policy makers, the former may be enhanced by appropriately directed subnational policies.

NOTES

[1] Amplitudes of cyclical movements are emphasized throughout the paper, but standard business cycle analysis yields information about the timing and the duration of individual cycle phases.

[2] Spectral estimates for first differences of the seasonally adjusted employment series yielded poor results; only 26 of 42 areas had ratios greater than one. Because trend and seasonal variation were largely removed, this suggests that random variation at high frequencies (low periods) accounted for a large share of the variance in nearly two-fifths of the employment series. Second differences of the moving averages greatly improved the spectral results.

[3] Using gain statistics from cross-spectral analysis of employment for the United States and 27 metropolitan areas, Cho and McDougall [10] found Tampa and Atlanta as the most cyclically volatile, and Washington, D.C. and New York as the least volatile during the 1954-75 period. Pittsburg ranked eighteenth.

[4] These are similar to the results of Cho and McDougall [10], who estimated significant positive rank correlations between gain statistics and regional growth which they attributed to weakness of spectral analysis. The multiple regression results above confirm their reservations about frequency-domain measures of regional cyclical amplitude.

BIBLIOGRAPHY

1. Airov, J. "The Construction of Interregional Business Cycle Models," *Journal of Regional Science*, 5 (1963), 1-20.

2. Allen, L. "Regional Economic Stabilization and the Acceleration Principle," *Growth and Change,* 13 (1982), 10-17.

3. Barth, J., Kraft, J. and Wiest, P. "Portfolio Theoretic Approach to Industrial Diversification and Regional Employment," *Journal of Regional Science,* 15 (1975), 9-15.

4. Booth, G. and Koveos, P. "Employment Fluctuations: An R/S Analysis," *Journal of Regional Science,* 23 (1983), 19-31.

5. Borts, G.H. "Regional Cycles of Manufacturing Employment in the United States, 1914-1953," *Journal of the American Statistical Association,* 55 (1960), 151-211.

6. Browne, L. "Regional Industry Mix and the Business Cycle," *New England Economic Review*, (1977), 35-53.

7. Bry, G. and Boschan C. *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs*, New York: Columbia University Press, 1971.

8. Burns, A. and Mitchell, W. *Measuring Business Cycles,* New York: National Bureau of Economic Research, 1946.

9. Chatfield, C. *The Analysis of Time Series: Theory and Practice,* London: Chapman and Hall Ltd., 1975.

10. Cho, D. and McDougall, G.S. "Regional Cyclical Patterns and Structure 1954-1975," *Economic Geography*, 54 (1978), 66-74.

11. Clark, G.L. "Factors Influencing the Space-time Lags of Regional Economic Adjustment," *Annals of Regional Science,* 15 (1981), 1-14.

12. Connaughton, J.E. and Madsen, R.A. "State and Regional Impact of the 1981-82 Recession," *Growth and Change,* 16 (1985), 1-10.

13. Jackson, R.W. "An Evaluation of Alternative Measures of Regional Industrial Diversification," *Regional Studies,* 18 (1984), 103-112.

14. Kozlowski, P.J. "Employment Fluctuations in New England: An Intraregional Analysis," *The New England Journal of Business and Economics,* 2 (1975), 30-36.

15. Kozlowski, P.J. *Business Conditions in Michigan Metropolitan Areas,* Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 1979.

16. Mead, A.C. and Ramsay, G.A. "Analyzing Differential Responses of a Region to Business Cycles," *Growth and Change,* 13 (1982), 38-42.

17. Mead, A.C. and Ramsay, G.A. "Regional Responses to Business Cycles: the New England Experience," *The Northeast Journal of Business and Economics,* 11 (1985), 27-35.

18. Richardson, H.W. *Regional Economics,* New York: Praeger, 1969.

19. Richardson, H.W. *Regional Growth Theory,* New York: John Wiley & Sons, 1973.

20. Strong, J.S. "Regional Variations in Industrial Performance," *Regional Studies,* 17 (1983), 429-444.

21. U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings.*

22. Vaughan, R.J. *Public Works as a Countercyclical Devise: A Review of the Issues*, Santa Monica, CA: The Rand Corporation, 1976.

23. Vernez, G., Vaughan, R.J., Burright, B. and Coleman, S. *Regional Cycles and Employment Effects of Public Works Investment*, Santa Monica, CA: The Rand Corporation, 1977.