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Industrial Mix as a Factor in the Growth and Variability of States' Economies

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Abstract

We use annual employment data for the states and the U.S. from 1969-85 to estimate trend rates of growth and deviations from trend for the state economies. We calculate measures of growth and variability for each state that are net of the effect of the state industrial mix interacting with the national industrial growth rates and variabilities. We find great variety in the macroeconomic behavior of the regional state economies, and we present evidence that the industrial mix of an economy is one factor that helps explain differences in net growth rates and variabilities across the states.

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1 Introduction

It is easily documented that in any given period, different economies display quite different growth rates and variabilities. Explanations can be found in the literature for the differences observed in the macroeconomic behavior of regional or national economies. For example, business climate studies (such as Wasylenko and McGuire, 1985 and Helms, 1985), which are based on a theory of profit maximizing business location decisions, point to differences in the costs of doing business or differences in market potential as explanations for why one region experiences higher growth than another. Garcia-Milà and McGuire (forthcoming) represent aggregate economies with a production function and find that regions that invest in publicly provided infrastructure are more productive.

Several authors have studied the possibility that the source of business cycle fluctuations could be industry- or regional- specific rather than national in nature. Altonji and Ham (1987) investigate the contribution of aggregate, sectoral and regional shocks to the fluctuations of employment at national, industry and regional levels. Long and Plosser (1987) isolate the importance of independent, industry-specific shocks in accounting for the output fluctuations and co-movements of different sectors. Long and Plosser (1983) present a multisectoral model with industry specific shocks that reproduces many of the aggregate fluctuations characteristic of an economy. These studies provide evidence that regional- and industry-level shocks are relevant for explaining aggregate or regional fluctuations.

In this paper, we introduce industrial mix as an additional factor that might help explain differences in national or regional growth rates and variabilities. We argue that, once the growth rates and variabilities of industries at the national level have been controlled for, the industrial composition or mix of an economy may exert an additional effect on an economy's growth and variability. Our explanation relies on the fact that industries are interrelated, that the relationships among industries differ, and that industries display different growth and variability characteristics. Our industrial mix explanation complements rather than substitutes for other explanations of differential growth and variability across economies.

Our approach is similar to, but differs from, typical shift-share studies and business location studies of regional or local economic growth. Shift-share studies isolate three components of a region's growth by algebraic calculation, with the competitive effect component describing the portion of growth due to some undetermined regional effect rather than national growth or industrial mix. We estimate a state growth residual effect that is comparable to shift-share's calculated competitive effect, but we go further than shift-share by offering industrial mix as one factor helping to explain the differences across regions in their competitive effects. Our approach differs from most business climate studies in that we focus on differences in state growth rates net of the growth rates of industries at the national level. Doeringer, et al. (1987) are careful to focus on the local employment growth net of the effects of the interaction of local industrial mix and national industrial growth (in other words, they focus on the competitive effect in shift-share terms); however, they do not consider industrial mix as a possible explanation for the competitive effect. Esteban-Marquillas' (1972) decomposition of the traditional competitive effect in order to separate growth differentials from industry specialization effects is yet another advance in the descriptive properties of shift-share analysis, but he does not explore the possibility of industrial mix as a factor in the explanation of regional industry growth differentials.

The policy implications of a link between industrial mix and growth and variability are potentially important. Many national and state governments engage in industrial development policies that focus on specific industries. Analyses along the lines of the present paper may reveal that current policies are targeted to the wrong industries or are ineffectively designed. Clearly, policy makers care about the growth rate and variability of their economies, so improving the understanding of the factors affecting growth and variability is useful.

Using industry-specific employment data for the states and the U.S., we calculate growth and variability measures for the states that are net of the effects of the growth and variability of industries at the national level and net of the relative composition at the state level of fast- and slow-growth industries and stable and variable industries. We argue that an economy's *net* growth and variability may depend on its industrial composition - on the relative employment shares of certain industries - and we test whether industrial mix significantly affects this net measure of growth and variability. Our results for growth are the most compelling. After controlling for a state's concentration of industries that grew relatively fast or slowly at the national level, one finding is that states with greater shares of employment in manufacturing had a slower net growth than states with greater shares of employment in the FIRE industry. One implication of this result is that many state industrial development policies, which tend to be aimed at manufacturing, may be misdirected and ineffective. This is a tentative conclusion and before strong policy conclusions can be drawn, additional empirical and theoretical studies must be undertaken.

2 Towards a Theory of the Macroeconomics of Industrial Mix

There are several reasons why industrial mix may matter in the way an economy grows or cycles. In this section we suggest several possibilities that appear plausible in light of the way industries interrelate.

Growth

If an economy has a large share of an industry that relates closely with other industries, either through requiring many inputs from other industries or producing important inputs for other industries, the growth pattern of the industry may be transmitted to other industries and thus affect the growth of the overall economy. That is, if the particular industry is fast growing, its demand/supply pull will make the supplier/demander industries grow faster. The reverse argument would apply for a slow growing industry, as its demand/supply drag, given its importance in the state, would make the interrelated industries grow more slowly.

A second mechanism through which a specific industry could influence the growth of the economy is agglomeration economies. Agglomeration economies is defined as general cost savings or productivity increases resulting from a geographic concentration of firms. If agglomeration economies characterize a specific industry rather than all industries, then a state with a high share of employment in an industry exhibiting agglomeration economies will experience a higher growth rate relative to states with high concentrations of industries that do not exhibit agglomeration economies.[1]

Finally, if a specific industry devotes substantial investment in the types of R&D that have positive spillover effects on the productivity of other industries, a state with a high share of the R&D industry may have a higher overall level of productivity, and therefore a higher growth rate than other states. The spillover effects of R&D can be negative if a state has a large share of an industry that devotes very little investment in R&D or devotes investment in R&D that is not transferrable to other industries. In that case the relative lack of R&D will make the state grow slower than average.

Variation (Cycle Intensity)

The interrelatedness of industries is also important in explaining the variability of a state's economy. If a state has a large share of an industry that is highly interrelated with other industries through supply or demand of inputs, and the industry is highly variable, its variability could possibly be transmitted to related industries, making the cycle more intense. On the other hand, if the industry happens to be relatively stable, that stability is likely to be transmitted to industries that either provide or demand inputs from the stable industry, thus resulting in an economy that is less variable.

The intensity of the cycle in a state's economy may also be related to the breadth of the markets of the component industries of the state's economy. An industry that primarily produces goods and services to sell in the local market will not be able to look for alternative buyers outside the state when the local economy goes through a recession. On the other hand, if the goods and services of a majority of the state's industries are sold in the national market, these industries can sell their goods on alternative markets during a local recession, effectively diversifying the risks of local shocks.

Although it is the case that the states roughly cycle together, there are significant differences. During the period we analyze, we find that some states exhibit a high covariance between their cyclical components and the national one, while for other states the correspondence with the national cycle is not very high. The contemporaneous 1 correlation of state and national percentage deviations from trend ranges from 0.98 for Pennsylvania to 0.32 for Oklahoma. Thus, the potential for diversifying the risks of local shocks by selling on the national market exists in many states, and the industrial mix of a state, which reflects the concentration of local-market versus national-market industries, may have an effect on the intensity of the state's cycles.

There are at least two difficulties with the theories sketched here. First, as already noted, our proposed theory of the growth and variability of economies is not complete.

Industrial mix is only one factor among many that may affect the macroeconomic behavior of economies. Second, alternative explanations for a link between industrial mix and growth or variability may be as compelling as our explanation of interrelated industries. For example, if economies are open and workers migrate from one region to another, and if the more desirable region has an industrial mix that differs from the industrial mix of the less desirable region, then differential growth rates will be correlated with industrial mix but not caused by industrial mix. While devising a complete model of the macroeconomics of regional economies is beyond the scope of the present paper, we hope to address these and other difficulties in future work.

3 The Data and Summary Industry Charasteristics

Our data set contains annual employment levels for 45 states (five states are eliminated because of missing data) and the U.S. for each of ten industries and the total of the ten industries from 1969 to 1985. The source for the data is the Bureau of Labor Statistics (BLS). We thus observe employment data for 46 economies (counting the U.S. as one), and for eleven industries (including total employment) within each economy. We divide total private employment into the following ten industries; farming, construction, nondurable manufacturing, durable manufacturing, transportation and public utilities, wholesale trade, retail trade, FIRE (finance, insurance and real estate), services, and all other (primarily mining and agricultural services, forestry, and fisheries). Using these employment data, we describe the industrial composition of each economy by calculating the employment shares (averages over the time period) for each industry.

Our choice to use employment data rather than some measure of output, such as Gross State Product (GSP), was based on the availability of a well-documented data set. The Bureau of Economic Analysis has recently begun to generate GSP data for the fifty states for several years. While these output data are the best available, they do not have the documentation and credibility of the employment data from the BLS. Our purpose is to explore relative growth rates and variabilities of different states and industries, which can be accomplished with employment or output data. The use of employment data is likely to exaggerate the changes in some industries, such as manufacturing, relative to what we would find using output data. But, output data are likely to be less convincing as a measure of activity for other industries such as services and FIRE.

In order to isolate the growth and cyclical components of employment for each state, for each industry and for the aggregate, we estimate log linear time trends. Because we are interested in constructing a measure of variability as well as one for growth, we do not obtain the growth rates by calculating the percentage change of employment over the period as is done in traditional shift-share analyses. Instead, we estimate time trends, obtaining as by-products measures of variability through the residuals of the estimated equations. The estimating equations take the following form:

$$(1)\quad \ln\ E_i^s(t) = \alpha_i^s + \beta_i^s \cdot t + \epsilon_i^s(t) \quad \textit{for each } i \textit{ and } s,\ t=1,\ldots,17$$

$$(2)\quad \ln\ E^s(t) = \alpha^s + \beta^s \cdot t + \epsilon^s(t) \quad \textit{for each } s,\ t=1,\ldots,17$$

$$(3)\quad \ln\ E_i(t) = \alpha_i + \beta_i \cdot t + \epsilon_i(t) \quad \textit{for each } i,\ t=1,\ldots,17$$

where

$E_i^s(t)$ *is employment of industry i in state s at time t,*

$E_i(t)$ *is employment of industry i in the U.S. at time t,*

$E^s(t)$ *is total employment in state s at time t,*

with i=1,...,10 (ten industries); s=1,...,45 (45 states); t=1,...,17 (17 years).

From these estimated equations, we extract a trend rate of growth for the 17-year period, and the standard deviation of the residuals, which gives us a summary measure of the percentage deviations from trend. Thus, each equation yields two pieces of information - growth and variability.

Tables 1 and 2 display descriptive statistics, which are somewhat comparable to the national growth and industrial mix components of shift-share analysis. In Table 1, the growth rates and variabilities of the ten industries and total employment for the U.S. are displayed. Also displayed is the industrial composition of the U.S. as measured by the average employment shares for each industry during the period. Total employment grew 43.4 percent between 1969 and 1985. Farming employment actually declined 10.9 percent, while employment in the two manufacturing industries remained almost constant, decreasing 2.9 percent for nondurables and increasing 3.3 percent for durables. The FIRE and services industries experienced very rapid growth during this period, nearly doubling in size with growth rates of 92.6 percent and 87.1 percent, respectively.

Total employment in the U.S. varied 2.03 percent around trend during the period. Services was the most stable industry during the period with a variability around trend of 1.33 percent. Not surprisingly, construction and durable manufacturing were the most variable industries during the period.

Table 1

Growth Rates, Variability, and Average Employment Shares of U.S. Industries - 1969 to 1985

	Growth	Variability	Share
Farming	-10.9%	1.99%	4.48%
Construction	38.3%	5.03%	6.04%
Nondurable Manufacturing	-2.9%	2.35%	9.54%
Durable Manufacturing	3.3%	5.36%	13.77%
Transportation & Public Works	23.9%	2.21%	6.14%
Wholesale Trade	56.3%	2.57%	5.94%
Retail Trade	49.8%	1.71%	19.02%
FIRE	92.6%	1.87%	7.64%
Services	87.1%	1.33%	25.40%
All Other	131.3%	4.38%	2.02%
Total Employment	43.4%	2.03%	100%

Growth is the estimated trend rate of growth for the 17-year period, variability is the standard deviation of the residuals from the estimated log linear trend, and share is the average share of total employment over the 17-year period.

Of the ten industries, services and retail trade were the most important in terms of having the greatest shares of total employment in these industries (employment shares of 25.40 and 19.02 respectively). The "all other" industry is quantitatively unimportant at 2.02 percent, and thus is given little attention in our analysis. The two manufacturing industries taken together account for 23.31 percent of total employment. The shares for the remaining industries range from 4.48 for farming to 7.64 for the FIRE industry.

Industries do behave differently by these measures in the different states. To get a picture of the cross-state variability, in Table 2 we display, by industry, the coefficients of variation (defined across the 45 states in the sample), the minimum value and the maximum value for each of three variables - the employment growth rate, the employment variability, and the average employment share (each defined over the 17-year period). As shown in Table 2, the coefficient of variation of the states' total employment growth rates is 0.66 with the growth in total employment over the period ranging from 10.69 percent in Pennsylvania to 163.19 percent in Nevada. As evidence that these differences are not only due to the differences in industrial mix across the states, we note that there are wide ranges of variation across states industry by industry. Despite the apparently wide range in growth rates for the services industry (from 22.17 percent for Mississippi to 185.48 percent for Arizona), the services growth rate displays the least variability across the states with a coefficient of variation of 0.39. Non-durable manufacturing growth rates vary widely across the states as evidenced by a coefficient of variation of 2.35.

Similar comparisons can be made for the industry variability measure, although the differences across the states are not so great as for the growth rates (compare coefficients of variation for total employment of 0.32 to 0.66). The variability measure for the wholesale trade industry is quite different across the states (coefficient of variation of 0.55), while the variability measure for the transportation industry is relatively stable across the states (coefficient of variation of 0.28).

The coefficients of variation for the various industry employment shares indicate that industrial composition varies across the states. While there are small differences in the shares of employment in retail trade (coefficient of variation of 0.08), the employment shares for farming and the two types of manufacturing vary greatly across the states (with coefficients of variation of 0.72, 0.53, and 0.45, respectively).

The statistics displayed in Tables 1 and 2 indicate that industries nationally behave quite differently, and that across the states, the growth, variability and industrial compositions differ. The remainder of the paper explores whether a link exists between growth and variability, and the industrial composition of state economies.

Table 2

Growth, Variability and Employment Shares
Coefficients of Variation, Maxima and Minima for 45 States

	Growth	Variability	Share
Farming	1.64 OR 27.20% MS -35.16%	0.45 NH 8.65% TX 1.12%	0.72 ND 21.01% MA 0.56%
Construction	0.94 WY 178.12% MI -14.52%	0.34 WY 18.97% PA 4.52%	0.20 WY 10.47% NY 4.27%
Nondurable Manufacturing	2.35 NV 126.52% WV -30.27%	0.44 WY 9.59% VA 1.93%	0.53 SC 24.09% NV 1.80%
Durable Manufacturing	1.60 NV 243.99% WV -36.24%	0.39 ND 23.48% NJ 4.40%	0.45 MI 25.79% WY 2.42%
Transportation & Public Works	0.77 WV 120.17% NY -12.30%	0.28 WY 6.63% MD 2.20%	0.16 WY 8.75% NH 4.30%
Wholesale Trade	0.52 WY 219.82% MI 9.59%	0.55 ID 14.40% PA 1.47%	0.17 GA 7.47% NV 3.48%
Retail Trade	0.54 NV 151.95% NY 7.53%	0.34 NV 6.14% TX 1.47%	0.08 NM 22.79% NC 16.58%
FIRE	0.46 NV 262.68% NY 26.98%	0.36 ND 7.24% PA 1.82%	0.20 NY 10.73% WV 4.83%
Services	0.39 AZ 185.48% MS 22.17%	0.37 NV 4.58% WV 0.73%	0.18 NV 48.41% NC 19.49%
All Other	0.62 ND 299.17% SD 3.27%	0.55 WY 18.60% OH 2.16%	1.0 WY 14.39% NY 0.69%
Total Employment	0.66 NV 163.19% PA 10.69%	0.32 WY 7.70% PA 1.87%	---

See notes to Table 1 for definitions of growth, variability and share.

4 Regional Economic Growth and Industrial Mix

We have documented above that the growth behaviors of states' economies differ from one another and from the U.S. A first question that arises is whether these differences arise simply because one state has a greater share of its employment or output in a relatively fast-growth industry than does another state. The empirical evidence presented below indicates that, once state industrial mix and national industrial growth behavior have been controlled for, great differences exist across the states in their growth patterns, and that these differences may be related to industrial mix.

To construct a measure of growth that is net of national industrial growth and the state's industrial mix we rely on the estimated trends of equations (1), (2) and (3). We define one plus the growth rate over the period 1969-85 for industries and states as follows:

$$G_i^s = \exp\ (\beta_i^s \cdot 16),\ \textit{for industry i in state s}$$

$$G^s = \exp\ (\beta^s \cdot 16),\ \textit{for total employment in state s}$$

$$G_i = \exp\ (\beta_i \cdot 16),\ \textit{for industry i in the U.S.}$$

For the last year of the sample, 1985, we define:

$$\textbf{\textit{estimated state aggregate employment}}\ \textit{in state s} = \sum_{i=1}^{10} G_i^s \cdot E_i^s(1)$$

for s=1,...,45

$$\textbf{\textit{estimated national aggregate employment}}\ \textit{in state s} = \sum_{i=1}^{10} G_i \cdot E_i^s(1)$$

for s=1,...,45

where $E_i^s(1)$ is the level of employment in state s in industry i in period 1 (1969).

The first measure, estimated state aggregate employment, is an estimate of total actual employment at the end of the period - the sum over the ten industries of the estimated employment in each industry at the end of the period in the state. The second measure, estimated national aggregate employment, differs from the first only in that the growth rates used to calculate the final period industry employment levels are those of the national industries rather than of the state industries. Thus, this second measure is an estimate of the employment in the state in the final period one would expect if the state's industries behaved like the nation's. It is a hypothetical level of employment for the state based on the behavior of industries at the national level and the industrial composition of the state at the beginning of the period. This is similar to the sum of the national growth and industrial mix components of traditional shift share analysis.[2]

Our measure of net state growth, what we call the state growth residual, is the difference between the estimated state aggregate employment and the estimated national aggregate employment as a percentage of the estimated state aggregate employment, that is:

$$\textit{state growth residual for state } s = \frac{\sum_{i=1}^{10} G_i^s \cdot E_i^s(1) - \sum_{i=1}^{10} G_i \cdot E_i^s(1)}{\sum_{i=1}^{10} G_i^s \cdot E_i^s(1)} \quad \textit{for } s=1,\ldots,45$$

This variable is similar to the competitive effect defined in the shift-share literature.[3]

We calculate the growth rates in a slightly different form in order to obtain the cyclical components at the same time. Also, we aggregate over all industries and present the results in percentage terms, which is not commonly done in shift-share analysis.

The value of this variable, the state growth residual, is displayed in Table 3. Also displayed in Table 3 is the estimated percentage growth of total employment for each state over the entire period. So, for example, the figures in the first column indicate that employment in Arizona increased 136 percent over the period, more than doubling, while employment in New York increased only 12 percent over the period, far below the average for the 45 states of 54 percent.

The figures in the second column of Table 3 indicate whether residual employment growth in a state (once the state's relative concentration of fast- and slow-growth industries has been controlled for) was positive or negative. The value of -32.3 for New York for the state growth residual indicates that New York's level of employment in 1985 was 32.3 percent less than we would have expected if New York's industries had grown at their corresponding estimated national growth rates. The coefficient of variation of 5.6 indicates that, once state industrial mix and national industry growth rates are controlled for, there is much variability across the states in residual growth.

It is interesting to note that there is a high correlation (0.941) between the growth rates and the state growth residuals displayed in Table 3. This indicates that fast-growing states grow even faster than expected once we account for the national growth of their industrial mix, and, similarly, slow-growing states grow slower than expected under the same measure. This raises the question of whether the growth rates of all industries in a state are highly correlated with the state growth residual.

Table 3

State Growth Description, 1969 to 1985

	Percentage Growth	State Growth Residual
Alabama	31	-6.1
Arizona	136	34.3
Arkansas	38	1.1
California	82	18.3
Colorado	121	31.9
Connecticut	39	-1.4
Florida	112	27.7
Georgia	55	8.7
Idaho	65	14.8
Illinois	15	-23.1
Indiana	17	-15.3
Iowa	22	-13.7
Kansas	48	3.8
Kentucky	34	-4.2
Louisiana	56	3.5
Maryland	46	-1.4
Massachusetts	37	-6.7
Michigan	14	-21.4
Minnesota	51	5.6
Mississippi	24	-9.7
Missouri	28	-9.7
Montana	49	2.5
Nebraska	33	-6.3
Nevada	163	37.0
New Hampshire	89	25.2
New Jersey	32	-6.6
New Mexico	93	18.6
New York	12	-32.3
North Carolina	37	3.3
North Dakota	48	5.8
Ohio	12	-23.5
Oklahoma	71	13.7
Oregon	61	10.7
Pennsylvania	11	-26.8
South Carolina	42	6.1
South Dakota	31	-6.5
Tennessee	35	-0.97
Texas	93	23.3
Utah	102	26.0
Vermont	58	9.1
Virginia	59	9.5
Washington	81	19.5
West Virginia	15	-30.4
Wisconsin	34	-2.1
Wyoming	116	28.6
mean	54	3.1
standard deviation	36.2	17.4
coefficient of variation	0.67	5.6

To investigate this question, we present in Table 4 the correlations between the growth rates for each industry and the state growth residual. The figures displayed indicate that, except for farming and all other, the correlations between the industry growth rates and the state growth residual are positive and quite high, indicating that, in general, those states that grew faster than expected had relatively fast-growing industries. The reverse is true for states with a negative state growth residual.

Table 4. Correlations of Industry Growth Rates with State Growth Residuals

Farming	0.227	Retail trade	0.892
Construction	0.901	FIRE	0.884
Nondur manuf	0.737	Services	0.828
Durable manuf	0.751	All other	0.493
Transportation	0.890	Total employment	0.941
Wholesale trade	0.767		

The fact that some of the correlations are not equal to one seems to indicate that not all the differences observed in the state growth residual can be attributed to fast-growing states having all their industries growing faster than the average. Thus, not all industries appear to be equally affected by whatever causes differential state growth rates.

A Statistical Test

Although the state growth residual presented in Table 3 seems to indicate that, once industrial mix and the national growth rates of industries are accounted for, important differences still exist across states, we want to test for the statistical significance of these differences. If the differences in total employment growth rates across the states could be accounted for completely by industry growth differences at the national level and the industrial mix of each state, we would expect the following relationship to hold:

$$G^s = \sum_{i=1}^{10} G_i \cdot S_i^s + \eta^s \qquad s=1,\ldots,45$$

where S_i^s is the average share of employment in industry i in state s over the period, and where η^s is a random variable with mean zero and constant variance for all s, reflecting the approximation errors of estimated values of the growth rates at state and national levels. Thus, if a state is merely a microcosm of the nation, we could obtain the growth rate of total employment in the state by calculating a weighted average of the national industry growth rates where the weights are the industry shares in the state (the state industrial mix).

Under the assumption that observed growth differences are all due to the industry growth differences at the national level and differences in the industrial mixes of states, the estimated coefficients of a regression with state total employment growth rates as the dependent variable and the product of the industry growth rates at the national level times the industry shares for the state as explanatory variables, should yield estimated coefficients which are not statistically different from one.

The equation we estimate is:

$$(4) \quad G^s = \sum_{i=1}^{10} \beta_i \, (G_i \cdot S_i^s) + \eta^s \qquad s=1,\ldots,45$$

Under the null hypothesis that state growth residuals are not important, $\beta_1 = \beta_2 = \ldots = \beta_{10} = 1$. The alternative hypothesis is that at least one of the β_i's is different from one.

In Table 5 we display the results of estimating equation (4). The null hypothesis is clearly rejected, with an F-statistic of 9.585, which is significant at a five percent significance level. Thus, we reject the notion that differences in state growth rates are merely a reflection of the differences in state industrial mix combined with national industry growth rates.

Given that the null hypothesis is rejected, it is interesting to analyze the estimated β_i's in order to test which of the β's are significantly greater than one and which are less than one. A β_i greater than one would suggest that states with large shares of industry i tend to grow faster than the average. The opposite could be said for those industries with β_i's less than one.

Column 3 of Table 5 displays the t-statistics for the null hypothesis that $\beta_i = 1$ for each industry. For the alternative hypothesis that β_i is greater than one, the null hypothesis is rejected at a 5% significance level for the construction industry, and at a 10% significance level for the FIRE industry. FIRE was a fast-growth industry during this period. If FIRE provides service inputs to many other industries, then this result of a positive relationship between growth and FIRE's share is consistent with one of our explanations of regional growth. In particular, firms located in a state with a strong financial services sector may have access to more investment opportunities and better credit conditions than firms located in states where the financial network is not well developed; these differences may be explained in part by the ease of credit risk evaluation of potential customers by the financial institutions, which may result in faster and less expensive credit decisions.

None of the industrial mix explanations of growth that we suggest seems to apply to construction. It is likely that the share of employment in construction is picking up a regional effect - the fast-growth regions during this period probably had large shares of their employment in construction. This demand-side explanation is also potentially applicable to certain subsectors of the FIRE industry.

For the alternative hypothesis that β_i is smaller than one, the null hypothesis is rejected at a 5% significance level for the two manufacturing industries and for transportation and public utilities. For the latter industry the result is consistent with an R&D explanation - that the level of R&D in the transportation and public utilities industry is low and nontransferable and, thus, having a large concentration of the industry pulls down the relative growth rate of the entire economy.

Table 5

Estimation Results

	(1) estimated coefficient	(2) t-statistic	(3) t-statistic for $\beta_i = 1$
Farming	-0.130	-0.126	-1.097
Construction	10.031	3.483	3.136
Nondurable Manufacturing	-0.448	-0.529	-1.711
Durable Manufacturing	-0.725	-0.979	-2.329
Transportation & Public Works	-9.558	-2.415	-2.667
Wholesale Trade	-0.097	-0.031	-0.351
Retail Trade	0.466	0.266	-0.304
FIRE	4.085	2.169	1.638
Services	1.559	3.529	1.266
All Other	1.364	1.524	0.407
R^2	0.785		
Number of Observations	45		

Note: Dependent variable is growth rate of total employment. Independent variables are shares of employment times national growth rates in each of ten industries. See equation (4).

The result for the manufacturing industry is consistent with our explanation of the effects on growth of having a high concentration of employment in a slow-growing industry that is strongly interrelated with other industries as a demander of inputs. This result and our proposed explanation are consistent with a result of Murphy and Topel (1987) who analyze unemployment data for males over a similar time period to find that demand shocks to unemployment in manufacturing have a positive spillover effect on total and industry-specific unemployment.

5 Economic Variability and Industrial Mix

We have decomposed the evolution of employment along time for each state and industry into two components - the trend rate of growth and the variability around the trend. We are interested in analyzing if the variability (or the intensity of the cyclical component) of the states is a mirror of the national variability once industrial mix is taken into account.

For this purpose we construct a statistic for each state - the state variation residual - which relates the observed variability of a state with the variability that would be expected if the state varied according to its industrial mix and the industries' variabilities at the national level.

Our measure of variability is the standard deviation over time of the percentage deviations from trend growth.

Let V_i^s, V_i, and V^s, be the standard deviations over the years 1969-1985 of the estimates

for ϵ_i^s, ϵ_i and ϵ^s respectively, from equations (1), (2), and (3).

If we define:

$$\textit{estimated state variability for state } s = \sum_{i=1}^{10} V_i^s \cdot S_i^s$$

for each s=1,...,45

$$\textit{estimated national variability for state } s = \sum_{i=1}^{10} V_i \cdot S_i^s$$

for each s=1,...,45

then our measure of the state variation residual is the difference between the estimated state and national variabilities, that is:

for each s=1,...,45.

$$\textit{state variation residual} = \sum_{i=1}^{10} V_i^s \cdot S_i^s - \sum_{i=1}^{10} V_i \cdot S_i^s$$

The state variation residual is a statistic that is not free of aggregation effects given that its definition involves variances of variables at different levels of aggregation. In our data it is the case that the variance of the percentage deviations from trend for a specific industry at the national level (V_i) is smaller than most of the corresponding variances for the states

(V_i^s *for* $s=1,\ldots,45$). Because of this aggregation effect, the state variation residual is positive for all observations and care must be taken in interpreting the results.

In Table 6 we display the estimated variation of total employment for each state (that is, V^s for $s=1,\ldots,45$), and the state variation residual. The figures in column 1 indicate, for example, that total employment in Alabama, with a standard deviation of percentage deviations from trend of 2.73 percent, was relatively stable during this period compared to the average level of variability of 3.25 percent. Once Alabama's relative concentration of variable and stable industries is accounted for, Alabama is still relatively stable, as indicated by its state variation residual (displayed in column 2) with a value below the average. On the other hand, Wyoming's economy was much more variable - a state variation residual of 6.11 - than we would have expected if Wyoming's industries displayed the same variability as the industries did nationally over this period. The coefficient of variation for the state variation residual variable is 0.63, indicating that, once industrial mix and national industry variation are controlled for, state economies (and their component industries) display considerable differences in their cyclical behavior.

To determine whether industrial mix can account for some of the differences in the variability patterns observed across states, we estimate OLS regressions with the state variation residual as the dependent variable, and the industry share variables as explanatory variables. We concentrate on industrial shares because our goal is to isolate the effects of different industrial compositions, as opposed to other state-specific characteristics that are likely to affect state variability.

Because we do not develop a theoretical model, we do not have a well defined alternative hypothesis to test. Instead, to infer something about the robustness of our results, we specify several simple regressions that differ only in terms of which share variables are included as explanatory variables.

Table 7 summarizes the results of our estimation. In each regression, we include a variable that is a measure of the size of the state - the total employment in the first year of the sample. This size variable controls for the negative effect that aggregation has on variance. We find strong evidence of a positive effect of the share of the "all other" industry, primarily mining, agricultural services, forestry and fisheries, on the intensity of the variability of a state. This industry is highly cyclical and provides basic inputs to many other industries. Thus, this result is consistent with the theory outlined above - the interrelatedness of industries - for why industrial mix may matter.

Table 6
State Variability Description, 1969 to 1985
(figures are percentages)

	Variability of Total Employment	State Variation Residual
Alabama	2.73%	1.34%
Arizona	3.81	2.41
Arkansas	2.96	1.48
California	2.73	0.88
Colorado	2.77	1.55
Connecticut	2.85	0.77
Florida	3.69	2.22
Georgia	2.82	1.45
Idaho	5.25	3.92
Illinois	2.33	0.61
Indiana	3.40	1.21
Iowa	3.49	2.19
Kansas	2.71	1.75
Kentucky	3.20	1.68
Louisiana	3.43	2.05
Maryland	2.30	0.46
Massachusetts	3.25	1.30
Michigan	4.06	1.75
Minnesota	2.69	1.07
Mississippi	3.29	2.06
Missouri	2.23	0.38
Montana	3.40	2.76
Nebraska	2.50	1.32
Nevada	5.66	4.20
New Hampshire	3.51	1.63
New Jersey	2.90	0.83
New Mexico	3.04	2.15
New York	3.18	1.10
North Carolina	2.45	0.79
North Dakota	3.08	2.63
Ohio	2.88	0.66
Oklahoma	2.92	1.93
Oregon	4.81	2.73
Pennsylvania	1.87	0.19
South Carolina	2.44	1.61
South Dakota	2.70	2.18
Tennessee	2.84	1.19
Texas	2.32	0.91
Utah	3.36	2.10
Vermont	2.68	1.61
Virginia	2.09	0.57
Washington	4.46	2.42
West Virginia	4.27	2.95
Wisconsin	3.07	1.15
Wyoming	7.70%	6.11%
mean	3.25%	1.74%
standard deviation	1.04	1.10
coefficient of variation	0.32	0.63

Table 7

Variability Regression Results

	Regression 1	Regression 2	Regression 3	Regression 4
Constant	-0.009 (0.77)	0.019 (4.43)	-0.010 (1.33)	0.006 (0.66)
Farming Share	0.054 (1.88)	0.015 (0.59)	0.055 (2.14)	--
Nondurable Manuf Share	-0.004 (0.14)	-0.051 (1.93)	--	-0.027 (0.94)
Services Share	0.080 (2.53)	--	0.082 (3.30)	0.048 (1.75)
All Other Share	0.231 (5.02)	0.192 (4.16)	0.234 (5.89)	0.212 (4.58)
Total Employment	-0.000000002 (2.39)	-0.000000002 (2.65)	-0.000000002 (2.41)	-0.000000002 (3.46)
R^2	0.65	0.60	0.65	0.62
Number of observations	45	45	45	45

The numbers in parentheses are t-statistics.
Dependent variable is the state variation residual defined in the text.

We also find consistent evidence that the share of services is positively related to the amount of variation in a state. While services' share is only significant at a 10% significance level in regression 4 of Table 7, it is highly significant in the other two specifications in which it is included. Because the service industry tends to sell to a local market it is unable to diversify the risks of a downturn in the local economy. Thus, this result is also consistent with the explanation put forth above for why industrial mix might have an effect on the intensity of cycles of a state.

6 Conclusions and Future Research

In this paper we use annual employment data from 1969 to 1985 to document three characteristics of regional economies in the U.S. - the trend rate of growth, the variability around trend, and the industrial mix. We calculate measures of growth and variability for each state that are net of the effect of the state industrial mix interacting with the national industrial growth rates and variabilities. We postulate that a state's industrial mix might be one factor in explaining the differences across the states in their net growths and variabilities.

Our results for the net rates of growth are the most compelling. After controlling for the mix of fast- and slow-growing industries, we find that there are great differences in the net growth rates of the states. This indicates that state economies are not microcosms of the national economy, differing only because of differences in industrial composition. Further, we find that the differences in growth rates are statistically significant and are correlated with concentrations of certain industries. In particular, our results indicate that the net growth rate is greater in states with higher concentrations of employment in the construction and FIRE industries and lower in states with higher concentrations of employment in the manufacturing and transportation industries. These findings have policy implications since many states focus their economic development programs on manufacturing industries. Our results indicate that these programs may be misguided.

Our goal in this paper is to highlight some characteristics of the macroeconomics of regional economies, and to search for explanations of the differences observed. While we present and explore empirically some tentative explanations for the differences we find in growth and variability - explanations that revolve around the industrial compositions of the economies - we are far from a complete theory of the macroeconomic behavior of regional economies. It is toward development and testing of a theory of regional macroeconomics, consistent with the empirical facts illustrated in this paper, that we hope to devote future efforts.

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Notes

1. This industry-specific form of agglomeration economies is sometimes referred to as localization economies. See the discussion of agglomeration economies on pages 15-18 of Heilbrun (1987).

2. By traditional shift-share analysis we refer to Dunn (1960).

3. We refer to the competitive effect as defined originally by Dunn (1960) and (1980), and not the reformulation of Esteban-Marquillas (1972).

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