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Categorizing State Economies and Forecasting Differential Economic Growth Rates

1993

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There is wide variation among states in economic recovery since the recession of the early 1980s. Between 1980 and 1988 the compound annual rate of growth in disposable personal income per capita ranged from a low of 2.71 percent for Wyoming to a high of 9.05 percent for New Hampshire. It is widely believed that states with lagging rates of growth in personal income have been those with economies that are heavily dependent on either agriculture or energy [Knutson and Fisher, 1989, pp. 12-15; Debertin, 1989, p. 44]. Past efforts to explain interregional differences in economic growth have been based on dividing the U.S. into regions consisting of states geographically near each other [Farrell and Hall, 1989]. Often states that border each other possess quite different economies. In this paper, we determine the extent to which information about the comparative importance of major sectors of a state's economy can improve the ability to forecast compound annual growth rates in personal income.

We first calculate compound growth rates in disposable personal income per capita for the time period 1980 to 1988. We then investigate the extent to which heterogeneity exists in the economies of states that have traditionally been grouped into the same geographic region. The hypothesis is that many states' economies are unlike the economies of other states within a geographic region. We develop two categorizations for states, one solely based on the comparative economic importance of major sectors, the other a modification of Census regions incorporating certain information about the type of economy. We use information about each state's economy as well as information about each state's geographic location to develop a series of regression equations for forecasting compound growth rates in disposable personal income per capita and provide forecasts from these equations.

CALCULATING GROWTH RATES IN PERSONAL INCOME

The measure of income used was the Department of Commerce estimate of disposable personal income per capita. Estimates of the compound annual change for the 1980-1988 time period were made using the equation.

$$CINC_{1988} = (1+r)^8 * CINC_{1980}$$

Since r is unknown,

$$(1+r)^8 = \frac{CINC_{1988}}{CINC_{1980}} \text{ and } r = [\frac{CINC_{1988}}{CINC_{1980}}] - 1$$

where r is the compound annual growth rate in disposable personal income per capita, $CINC_{1988}$ is the 1988 and $CINC_{1980}$ is the 1980 per capita disposable personal income for the state. Estimates of per capita disposable personal income were obtained from the U.S. Bureau of Economic Analysis Survey of

Current Business, various August issues, [Summarized in Table 704, Statistical Abstract of the United States, 1990]. The year 1980 was chosen as the starting point because it marked the beginning of the recession. Rankings for the 50 states can be found in Debertin and Pagoulatos, 1990. Several New England states top the ranking, while states at the bottom of the ranking are those dependent on oil and coal.

CATEGORIZING STATES BY TYPE OF ECONOMY

The next step was to categorize each state's economy based on the importance of primary sectors as a percentage of Gross State Product (GSP). This portion of the analysis used Gross State Product estimates for 1986 contained in the Survey of Current Business data [Renshaw, Trott, and Friedenberg, 1988]. They estimated Gross State Product for each state for 14 separate sectors. We eliminated some sectors consisting of secondary rather than primary sources of income (such as trade and transportation sectors). We classified each state into one of five groups:

1. Agricultural-based;
2. Energy/Mining (primarily coal and oil)-based;
3. Manufacturing-based;
4. Finance- and Services-based; and
5. Diversified (none of the individual sectors dominates).

For groups (1)-(4), each state is ranked with respect to the importance of that sector with respect to proportion of Gross State Product accounted for by the sector.

South Dakota ranked first in percent GSP from Agriculture; North Dakota second. New York and New Jersey received the smallest percentage of GSP from agriculture. Alaska and Wyoming were most dependent on energy and mining activities; Delaware and Hawaii least dependent based on the 1986 GSP data. Nevada and New York are most dependent on the finance and services sector; Wyoming and Alaska the least dependent. North Carolina and Michigan are the most manufacturing-dependent states; Nevada and Wyoming least manufacturing dependent. Hawaii and Virginia most dependent on governmental activities; Massachusetts and New Hampshire least dependent. Most states were readily classified. A few states posed major difficulties in classification. South Carolina was perhaps the most difficult to classify, in that it ranked 4th among the 50 states in percent GSP from the government sectors (16.9 percent of GSP) and 8th among the 50 states in manufacturing GSP (26.7 percent of GSP). We classified it as a government-based economy. New Mexico was also difficult to classify (4th in energy/mining at 13.4 percent; 5th in government at 16.7 percent of GSP). We also classified it as government-based. Missouri ranked high in none of the 5 categories (18th in agriculture; 32nd in energy/mining; 20th in finance/services; 17th in manufacturing; 37th in government) and was classified as diversified. As a group, states with agricultural-based economies experienced a 5.8 percent compound annual growth rate; energy/mining based 4.7 percent; finance/services based 7.2 percent; government-based 6.8 percent; manufacturing based 6.9 percent; and diversified 6.7 percent for the 1980-88 time period.

Standard deviations on the compound annual growth rate were calculated for each group of states. The smaller the standard deviation, the less the variation in compound growth rate within each group. The least variation was among states classified as agricultural- dependent (S.D. = 0.56) The most variation was among states classified as manufacturing dependent (S.D. 1.07) In no case did the standard deviation in compound annual growth rate for each of the groups exceed the standard deviation in the compound

growth rate for all 50 states together (S.D. = 1.20) suggesting compound personal income growth rates were more similar "within groups" than across groups of states.

A second approach placed most of the states in the traditional Census regions with a few modifications. Most of the regions are geographic. Arkansas (formerly in West South Central) and Missouri (formerly in West North Central) were moved into the East South Central Region. The major change is the addition of several other energy-dependent states to the former West South Central region, including Alaska (formerly Pacific), Colorado (formerly Mountain), West Virginia (formerly South Atlantic) and Wyoming (formerly Mountain). The result is a grouping of states with quite homogeneous compound annual growth rates over the period. These modified geographic regions are even more homogeneous in personal income growth rates than the sector-based groups.

FORECASTING COMPOUND GROWTH RATES IN PERSONAL INCOME

We next attempted to determine if information about the kind of economy each state possesses could be used to improve forecasts of compound annual growth rates in per capita personal income. We used two different approaches in incorporating sector and geographic location information into income forecasting models. One option was to use a series of 0-1 dummy variables (1 if the state is located in modified census region i, zero otherwise). We developed a series of 0-1 dummies based on the modified geographic regions For the regression, the dummy D5 (for the South Atlantic region) was omitted. One problem with this approach is that there are eight dummy variables plus the intercept dummy.

The second approach used continuous X-Y coordinate data representing geographic location. The SAS Institute has developed a data set consisting of X and Y coordinates representing the visual center of each state, which were developed for cartography (computer mapping) applications. These X and Y coordinates provide a location for each state that requires only two, not eight variables. These data are continuous, not discrete as are the regional dummies. It might be more appropriate to use X and Y coordinate for the "center" of economic activity within each state, rather than the visual center. In a state such as Nebraska where major cities are all located in the eastern third of the state, the economic activity coordinate would be further east than the visual center. However, most states have major cities and economic activity more evenly distributed than does Nebraska, and the coordinates for the visual center are probably appropriate for most states and we have yet to determine a practical means for locating the "center' of economic activity within each state. Another problem with using the X and Y coordinates is that Alaska and Hawaii are "outliers" with coordinates located at great distances from the 48 contiguous states. We dealt with this problem by excluding Alaska and Hawaii, since their inclusion would have a significant impact on the regression results for the 48 contiguous states.

We first regressed the compound growth in personal income from 1980 to 1988 on the X and Y coordinates for the visual center for each state (Hawaii and Alaska excluded). The equation (with t ratios in parentheses) was

(1) CINC = 6.06 + 4.40 X + 1.39 Y.
(7.21) (0.99)

The R\2 was 0.54; moderate for a data set consisting of 50 cross sectional observations. The t ratio indicates that the X coordinate, which locates the state in the east-west plane, is far more important than the Y coordinate which locates the state in the north-south plane, and the coefficient is much larger for the X coordinate than the Y coordinate.

The next step was to estimate an equation which included both the coordinate and the sector data. Hawaii and Alaska were excluded. The equation was

(3) CINC = 7.01 - 0.08 PFARM - 0.06 PMIN + 0.01 PMFG - 0.01 PFINSER
(-1.57) (-1.59) (0.16) (0.33)

- 0.01 PGOV + 0.51 D1 - 0.13 D2 - 1.15 D3 - 0.58 D4 - 0.57 D6 - 1.72 D7
(0.17) (1.51) (-0.31) (-3.19) (-1.22) (-1.80) (-4.00)

- 1.57 D8 - 1.51 D9
(-4.50) (-4.30) ,

where D1=New England; D2=Middle Atlantic; D3=East North Central; D4=West North Central; D6=Modified East South Central; D7=Modified West South Central; D8=Mountain and D9=Pacific. This resulted in an equation with an R\2 of 0.86 or 0.80 adjusted for degrees of freedom.

FORECASTS

Equation 2 (cartographer coordinates and sector information) and Equation 3 (dummies for modified geographic regions and sector information) were used to predict compound annual growth rates in personal income. Results for both equations were similar, with a few exceptions. Equation 2 overpredicts compound growth rates most severely for Oklahoma Pennsylvania Ohio and Florida, and underpredicts most severely for New Hampshire Massachusetts, California and New Mexico. However, it predicts compound growth within one half of one percent for the remaining 40 of the 48 contiguous states, and even comes close for Wyoming. For twenty-one states, the forecast is within one quarter of one percent. Equation 3 incorporating dummies for modified regions overpredicts six states by greater than one half of one percent (Wyoming, Oklahoma, Pennsylvania, Vermont, South Carolina and Nevada) and underpredicts five states by greater than one half of one percent (New Hampshire, New Jersey, Alaska, Massachusetts and Arizona). For twenty two states, the forecast is within one quarter of one percent. Forecast and actual compound annual growth rates can be found in Debertin and Pagoulatos (1990).

CONCLUDING COMMENTS

This paper has shown that: (1) It is possible to categorize states into groups with economies that are comparable with respect to sector characteristics, and that these categories may be more suitable for economic analysis than the traditional geographic regions; (2) Cartographer's coordinates used as variables to locate a state have important advantages over regional dummy variables in forecasting personal income growth in that they are continuous, non-arbitrarily defined, and reduce the number of variables in the regression equation; and (3) The approach using dummy variables representing modified regions and sector information produced a regression equation with a higher R\2 than did the approach using cartographer's coordinates and sector information.

If these equations are to be used for forecasting growth in personal income, important problems need to be resolved. Information about the potential for the major sectors over the forecast period is needed. For example, if oil prices or prices for agricultural commodities suddenly rise, states which depend on these sectors could experience phenomenal increases in personal income growth. Recent price increases for oil might change these results.

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