Examining Income Convergence in Southern United States

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Abstract

County-level data for 11 southern states were used to examine income convergence between 1980 and 2000. Ordinary least squares regression of logarithmic difference on average per capita income in 1980 and 2000 indicated conditional income convergence over the 20-year period. The estimated rate of income convergence was 3.82% per year. This convergence varied across the region based on the initial and changed conditions of population density, African-American population, employment, education, age structure, and travel time to work.

Introduction

This study explicitly examines income convergence at the county level in the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. Two fundamental objectives are to: (1) examine income convergence in these 11 states between 1980 and 2000, and (2) identify predictors of income growth over the period 1980-2000.

The historical events in the southern United States have produced differing impacts and regional variations in demographic, industrial, and overall economic growth across the region. There are significant contrasts between rural and metro counties in demographics such as race, population density, education, industrial firms, jobs, and growing urban structures. Majority of the studies on U.S. income convergence are based on states or multi-state aggregate data, with few examinations in metropolitan areas and counties (Hammond 2006).This study is aimed at eliciting the role of these variations in income growth using the data available at the county level, which is the first known effort in the southern United States.

Figure 1: 11-State Region of Southeastern United States

Methodology

This study employs county-level data available for all 1,010 counties of the southern United States (Table 2). Following Mankiw et al. (1992), Sala-i-Martin (1996), and Rey and Montouri (1999), income convergence in the entire region was estimated by ordinary least squares. Two income convergence models were estimated (1) Absolute Income or β-convergence (Equation 1) and (2) Conditional Income Convergence (Equation 2).

Initially, a univariate *β*-convergence model was estimated to determine if there was absolute income convergence over the 20-year period (Sala-i-Martin 1996):

(1) $$\ln\left(\frac{y_t}{y_{t-1}}\right) = \alpha + \beta_0(\ln y_{t-1}) + \varepsilon ,$$

where y_t is the average per capita income in year *t (2000)*, *ln* is natural logarithm, *t-1 is* initial year *(*1980), α is a constant, β_0 is a coefficient vector, and *ε* is an error term.

However, the absolute income convergence may not occur due to differences in the steady-state conditions. Differences in demographics, employment, industry structures, and other factors may affect a region and lead to unbalanced growth in the region. That is, the income growth process may be conditioned by these factors and a conditional income convergence model has to be estimated (Barro and Sala-i-Martin 1991; Sala-i-Martin 1996). Such a model is:

$$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha + \beta_0(\ln y_{i,t-1}) + \beta_i(X_{i,t} - X_{i,t-1}) + \beta_j X_j + \varepsilon_{i,t}, \quad (2)$$

where y_i is the average per capita income of county i in year *t (2000)*, *ln* is natural logarithm, *t-1 is* initial year *(*1980), X_j indicates initial conditions of the explanatory variables in year 1980, $X_{i,t-1}$ is a vector of growth in explanatory variables, β_i is a vector of X_i parameters, and $\varepsilon_{i,t}$ is an error term. The conditioning factors are initial and changed conditions of population, race, education, age structure, employment, and travel time to work that control per capita income growth (see Table 1 for a description of the variables used).

Previous income convergence studies have reported six socioeconomic factors play important role in income convergence. These factors are population, race, labor structure, age structure, education, and employment. In this study, initial levels and changes in population density, population between 16 and 64 years old, African American population, college education, unemployed population, and travel time to the work place were used in the model. Heterogeneity and exogenous biases in the models were controlled by inclusion of the initial conditions of the variables. Inclusion of both initial and changed conditions of the control variables help show whether the income change was a result of initial conditions, some changes of their conditions, or both.

Table 1. Variables Used in the Analysis

Variables	Description	Variable Type	Expected Relationship
Per Capita Income (PCI) Growth	Natural logs of the ratios of PCI of each county in 2000 to real (in 2000 $$ value) PCI in 1980 for each county	Dependent	
PCI in 1980 (INC_{1980})	Log value of the PCI in a county in 1980 in 2000 real value	Independent	-
Population Density (POPDEN)	Number of persons in a county per mile	Control	+
African-Americans (AA)	% of AA population in a county in 1980	Control	+
Labor Population (ECOP)	% of 16-64 age population in a county in 1980	Control	-
College education (EDUC)	% of 25 years or older population with the bachelor degree in a county in 1980	Control	+
Unemployed population (UNEP)	% of unemployed population >16 age) in a county, 1980	Control	-
Travel time to work (TTIME)	Average travel time in minutes of the working population in a county, 1980	Control	-
Change in population density (ΔPOPDEN)	Difference in population density, 1980-2000	Control	+
Change in AA population (ΔAA)	Difference in % of AA population, 1980-2000	Control	+
Change in labor population (ΔECOP)	Difference in % of economic age (16-64) population, 1980-2000	Control	-
Change in college education (ΔEDUC)	Difference in the % of bachelor degree holding population, 1980-2000	Control	+
Change in unemployed population (ΔUNEP)	Difference in the % of unemployed population, 1980-2000	Control	-
Change in travel time (TTIME)	Difference in the average travel time in minutes to work, 1980-2000	Control	-

Results and Discussion

Income convergence models were estimated using Ordinary Least Squares (OLS). The dependent variable was the natural logs of the ratios of per capita income in 2000 to real (in year 2000 dollars) per capita income in 1980 for each county. All explanatory variables were standardized using log-transformations.

Table 2. Descriptive Statistics of the Variables (N = 1,010)

Variables	Minimum	Maximum	Mean	Std. Deviation
Initial Conditions (1980)				
Per Capita Income	6,756.881	29,552.752	12,490.70 1	2510.454
Total Population	2,032.000	1,625,781	50,196.41 0	101,773.155
Population Density	3.448	27,639.754	209.544	1,015.124
Blacks (%)	.000	84.159	21.240	18.453
Whites (%)	15.036	99.986	77.983	18.509
Labor Population (%)	46.042	80.567	57.691	3.856
College Graduates (%)	2.800	44.940	9.784	5.172
Unemployed Population (%)	5.250	21.960	11.713	2.154
Travel Time to work (minutes)	6.152	26.177	13.896	2.934
Year 2000				
Per Capita Income	9,629.000	41,051.000	16,741.58 1	3,803.339
Total Population	2,077.000	2,253,362	66,805.79 9	144,021.586
Population Density	5.182	7,430.579	224.500	614.158
Blacks (%)	.000	86.129	21.009	19.050
White (%)	13.306	99.565	75.684	19.015
Labor population (16-64)	50.247	80.368	65.503	3.431
College Graduates	9.11	97.32	35.45	19.47
Unemployed Population	1.080	27.950	3.542	1.417
Travel Time (minutes)	4.117	32.451	17.467	3.613
Change (1980-2000)				
Per Capita Income	-25.135	150.390	34.453	16.803
Population	-98.019	9,948.755	49.029	379.398
Population Density	.02	100.49	1.4903	3.794
Blacks (%)	-53.225	44.106	-.230	5.813
Whites (%)	-53.775	50.896	-2.299	6.270
Labor Population (16-64)	-12.523	19.029	7.813	3.011
College Graduates	-9.580	90.500	25.671	17.010
Unemployed Population	-19.80	17.35	-8.1713	2.349
Travel Time (minutes)	-10.563	13.563	3.571	2.135

The convergence model was estimated in a two-step process: (1) Absolute Income Convergence (2) Conditional Income Convergence. First, the absolute convergence model, i.e. a univariate β-convergence model was estimated to determine if there was absolute income convergence over the 20-year period (Sala-i-Martin, 1996). The model was significant ($F = 24$, $df = 1{,}1008$, $P <= .001$), but explained only 23% (adjusted $R^2 = 0.023$) of the total variation. The convergence coefficient (β value) was negative (-0.154) and significant ($t = -4.954$) indicating convergence of per capita incomes across the counties in the study region. The convergence rate is estimated to be 0.84 percent per year, *ceteris paribus* (Lim 2003). The low R^2 value indicates that a large amount of the variation in average per capita income convergence is unexplained by the model. The low value also indicates that income growth may be conditional and the convergence can be explained by other factors that control for the differences in steady-state points for different regions (Rey and Montouri 1999).

Two conditional income convergence models were estimated: (1) the change model using only change condition variables, (2) the full conditional income convergence model using both initial and changed conditions of the variables.

Table 3 provides the results of the income convergence model using the change variables only. The model was significant (F = 50, df =7,1002, P = .001)) and had 25.7% of the total variance explained by independent variables (adjusted R^2 = .257). The coefficient for the initial per capita income level was negative (β = -0.226) and significant (t = 6.846), confirming conditional income convergence over the 20-year period. The estimated rate of income convergence was 1.112% per year. All of the change variables were significant at the 1% level.

Table 3. Results of the Regression Analysis between Changes in Income and Changes in Explanatory Variables

Variables	β-coefficient	Std. Error	t-value
Constant	1.582	.207	7.639
Initial Per Capita Income	-.226***	.021	-6.846
Change in Population Density	.164***	.001	5.959
Change in African American Population	-.315***	.001	-11.285
Change in College graduates	.176***	.000	6.023
Change in Unemployed population	-.103***	.001	-3.689
Change in Travel Time	.151***	.002	5.291
Change in Labor population	-.104***	.001	-3.280

*** denotes variables significant at the 1% level.

The results show that there is a significant improvement in the conditional income convergence from the change model (Table 3) to the full model (Table 4). The results indicate that the full model was significant (F = 51.543, df = 13,996, P <= .001). The initial and conditional variables explain 39.4% of the total variation (adjusted R^2= 0.394) in per capita incomes between 1980 and 2000. The coefficient for initial per capita income level is negative and significant (β = -0.534, t = 12.801) suggesting that there was conditional income convergence over the 20-year period. The estimated rate of income convergence was 3.82% per year. This convergence varied across the region based on the initial and changed conditions of the control variables.

Table 4. Conditional Income Convergence Model using both Initial and Changed Conditions of Explanatory Variables

Variables	β-coefficients	Std. Error	t-value
(Constant)	3.117	.256	12.176
Initial Conditions (1980)			
Initial Per Capita Income in 1980	-.534***	.027	-12.801
Population Density	-.076***	.000	-2.892
Black Population	.105***	.000	3.148
College Graduates	.189***	.001	4.507
Labor age Population	.125***	.001	3.147
Unemployed Population	-.341***	.003	-6.658
Travel time to work	.277***	.001	9.575
Changed Conditions (1980-2000)			
Change in Population Density	.150***	.001	6.020
Change in Black Population	-.202***	.001	-7.501
Change in College graduates	.229***	.000	7.743
Change in Labor Population	-.124***	.001	-3.796
Change in Unemployed Population	-.360***	.003	-7.133
Change in a travel time	.169***	.002	6.257

All of the changed and initial conditions variables were significant (P<0.1). The initial conditions of population density and unemployed population had significant negative coefficients. Likewise, changes in the black, unemployed, and labor population (16-64 age group) were negative and significant. The negative relationships suggest that high level of income growth occurred in areas with low African-American and unemployed populations, which are mostly in the 16-64 age group. In other words, higher level of income growth occurred in predominantly non-African-American areas of the region, and in areas where the black population was in decline over the 20-year period. Counties with increased college graduates, population density, and increased travel time were more likely to have experienced higher income growth.

Conclusion

This study used county-level data in 11 states to explore income convergence between 1980 and 2000. The income convergence model results indicate strong evidence of income convergence in the region between 1980 and 2000. Over the 20-year period, per capita incomes of poorer counties in the region increased at higher rates than that of wealthier counties. Economies of the poorer counties were catching up with the wealthier counties at 3.82% per year between 1980 and 2000.

Education made a significant contribution to income growth in the southeastern region. Increasing levels of college education in the population have improved the local labor force and increased their earning potential.

Examining economic growth at a wider geographic scale for the southern United States in general suggested that poorer counties from these regions were catching up on economic growth faster than the other regions, and the results were consistent with neoclassical growth theory.

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