REGIONAL GROWTH AND INCOME CONVERGENCE IN THE WESTERN BLACK BELT COUNTIES OF ALABAMA: EVIDENCE FROM CENSUS BLOCK GROUP DATA

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Abstract

This paper examines the effects of growth in African American population, employment, and human capital on growth in per capita income at the census block group (CBG) level using ordinary least square and spatial regression models. The results indicate the presence of conditional income convergence between 1980 and 2000 with poorer CBGs growing faster than the wealthier CBGs. The results also suggest a significant negative relationship between per capita income growth and growth in African-American population. In addition, this study finds that sub-county level data is useful for a realistic understanding of economic growth processes and patterns in rural communities.

Introduction

Income convergence is one of the major indicators of regional economic development (Cass, 1965; Solow, 1956). Large differences in income are considered undesirable for balanced or equitable economic development (Sen, 1992). Substantial research has been conducted to determine whether there is convergence or divergence in regional economies over time. These studies were designed to track the growth of local economies and assess their pace and progress in achieving national economic growth levels. Previous research suggests the existence of income convergence and in some cases, income divergence across the United States (Mankiw et al., 1992). Some of the empirical evidence (Barro and Sali-i- Martin, 1995; Cole and Neumayer, 2003) contradicts neoclassical growth theorists' prediction (Baumol, 1986) that poorer economies grow at a faster rate compared to the richer economies to reach equilibrium levels. Variations in the results of these studies may be due to the differences in economic characteristics of "studied regions" since it has been difficult for the "studied regions" to maintain the same steady state, a fundamental condition for determining the existence of income convergence. Other sources of variation may have been differences in the spatial characteristics across regions and difficulties in capturing these interregional variations of the "studied regions." That is, most of the "income convergence studies" thus far have been conducted at larger geographic scales such as county, region, state, or national levels. These studies did not address clustering of the communities based on similarities in physical geography and socio-economic characteristics. The concentration of primary resources, such as farmland and forests or agglomeration in the manufacturing sector, was inadequately addressed.

Consideration of such spatial dynamics has become essential when examining income convergence as recent studies (Coughlin et al., 2006; Janikas and Rey, 2005; Lall and Yilmaz, 2001; Lim, 2003) have shown. The later studies have addressed the issue of clustering effects by including "spatial dependence" factors in income convergence models. However, these studies were conducted at larger geographic scales and have not explicitly addressed intra-regional variations within counties. In this study, the role of intra-county level variations was factored into the income convergence analysis. This study explicitly examines income convergence at the Census Block Group (CBG) level in the Black Belt Region of Alabama.

The Black Belt Region of Alabama has many economically segregated communities differentiated by disparities in income, population distribution, resource allocation, and human capital development (Schelhas et al., 2003). The region is made up of 50 or higher percentage of African-American population and there is a clustering of communities based on race, income distribution, education level, and land covers (Fraser et al., 2005). The Region's primary source of income has shifted from an agrarian and forest-based economy to a more industrial-based economy. The availability of cheap labor, raw materials, and access to water ways, ports, and major national highways has enticed forest-based and automobile plants into the Region (Bliss et al., 1998). As a result, the region was expected to grow faster due to higher paying industrial jobs, capital accumulations, and human capital development (Joshi et al., 2000). However, except communities along the corridors of major highways and near urban areas, the majority of communities in the Black Belt Region have experienced sluggish economic growth. At the current rate of economic growth, the Black Belt Region is not likely to attain national economic growth level in the foreseeable future.

This study hypothesizes that variations in human capital, spatial heterogeneity, and clustering have influenced economic growth processes across the Black Belt Region of Alabama. These hypotheses were tested by examining income convergence across 161 CBG in eight contiguous counties of the Alabama Black Belt Region over the period 1980-2000. Three fundamental questions are addressed in this paper. First, is per capita income converging in the Black Belt in accordance with neoclassical economic theory? Second, are changes in ethnicity, employment, and human capital affecting income convergence? Third, are spatial or clustering effects influencing income convergence?

The rest of the paper is organized into five sections. Section two provides an explanation of empirical aspatial and spatial models of income convergence. Section three provides important details of the study area and the data used in the study. Section four presents the empirical results of an ordinary least square (OLS) and spatial regression-models. Lastly, section five provides the conclusion.

Empirical Model

Empirical estimates of income convergence models are based on readily available data such as per capita income, employment, savings as a share of

GDP, share of labor in agriculture and industry (Coelen, 1978), specialization of urban areas in production of traded goods and services (Drennan and Tobier, 1996), industrial diversification (Coelen, 1978), population growth and human capital represented as completion of high school or college (Kim, 2005). Coelen (1978) contends that the more homogenous fanning, labor participation, and salaries are similar, the more regional incomes will be similar. Further, Garnick (1990) suggests that income growth models should include measures of income earnings, employment, and industry mix. Drennan and Tobier (1996) contends that population dynamics, such as changes in the rural composition of racial population, change in intra market labor mobility, residential shifts to urban areas by rural households could be the determinants of income growth. However, in this study, unavailability of all data and the risk of multicolliniarity limit the choice of variables to growth in African American population, employment, and percentage of bachelor degree holders (a proxy of human capital growth) from 1980-2000 included as independent variables in the models. The study was performed using three methods of analysis: (1) Ordinary Regression Analysis (2) Analysis of Moran's Autocorrelation and (3) Spatial Regression models. The dependent variable was the log of the average real per capita income growth in each CBG between 1980 and 2000. The empirical models for each analysis are specified in the following way.

Ordinary Least Square (OLS) Model Specification

The following equation was used to test for the conditional income convergence:

$$\ln y_{i,t} - \ln y_{i,t-1} = a + \beta_0 (\ln y_{i,t-1}) + \beta_i X_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

Where $\ln y_{i,t} - \ln y_{i,t-1}$ is a natural logarithm of a CBG i's per capita income growth for a time period between t and $t-1$. $\ln y_{i,t-1}$ is the natural logarithm of region i's average per capita income in the initial year. $X_{i,t}$ is a vector of growth in explanatory variables (African American Population, Bachelor Degree holders, and employment) that control per capita income growth and β_i is a vector of X_i parameters. $\varepsilon_{i,t}$ is an error term with mean zero and homoskedastic variances.

The existence of conditional convergence or divergence for per capita income growth is determined by the sign and magnitude of β_0. A negative estimate for β_0 supports conditional income convergence suggesting that the growth rates in per capita income over the period are negatively related with initial per capita income levels.

Spatial Model Specification

We argue that states, counties, or towns may formulate their socioeconomic policies not only independently, but also considering the behavior of their neighbors and on the basis of policies of political units sharing similar economic or demographic characteristics. Such interactive effects influence the socioeconomic characteristics of the CBGs with a higher chance of having similar per capita income of CBGs who share a common border. As discussed in the earlier section, the presence of such spatial dependence may create bias and specification problems for the estimates of conditional convergence (value of β_0) in the estimation model based on OLS model (equation 1). According to Anselin (1988), a spatial regression model controls the potential spatial dependence present in the variables and in error terms. Analysis of Moran's Autocorrelation and spatial regression models help to detect the magnitude of spatial interactions and estimate the effects of spatial dependence in the income convergence (Anselin, 1988; Coughlin et al., 2006; Janikas and Rey, 2005; Lall and Yilmaz, 2001; Lim, 2003).

Moran's Autocorrelation

To detect the possible spatial dependence in the relationship between dependent and independent variables, Moran's autocorrelation values were estimated. Spatial dependence is defined as the similarity between observation and location (Anselin, 1988). Positive autocorrelation occurs when similar values for a variable are clustered together. Negative autocorrelation happens when dissimilar values are clustered together in a space. This paper utilizes Moran's I statistic, which is the most widely known measure of spatial autocorrelation (Anselin, 1988; Lim, 2003). The Moran's I value is estimated as:

$$I = \left(\frac{n}{s_0}\right) \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} x_i x_j}{\sum_{i=1}^{n} x_i^2} \quad (2)$$

Where n is the number of observations, w_{ij} is the element in a spatial weights matrix W corresponding to the CBGs (i, j), the observations x_i and x_j are in deviations from the mean of a variable for CBGs i and j, respectively and S_0 is a normalizing factor, equal to the sum of the all spatial weights. The weight matrix W was constructed using first order "rook contiguity" by assigning a weight of i to all j that are contiguous to i or share a common border, and a weight of 0 is assigned to all other CBGs which are not contiguous to i.

The Moran's I value ranges from -1 for negative spatial autocorrelation to 1 for positive spatial autocorrelation. If similar values are more likely than dissimilar values between neighbors, the Moran's I statistics tend to be positive, and vice versa. The Moran's scatter-plot is employed to display the local structure of spatial association of the per capita income growth. Since the elements in the vector x in Equation 2 are in deviations from the mean, the Moran's I statistic is formally equivalent to the slope coefficient in the linear regression of the spatial lag W_x on x (Lim, 2003). This interpretation of the Moran's I statistic provides a way to visualize the linear association between x and the spatially weighted average of the neighboring values, or spatial lag W_x, in the form of a bivariate scatter-plot of W_x against x.

Spatial Lag Model

In this model, spatial dependence in the relationship between dependent and independent variables is estimated through a spatially lagged dependent variable:

$$\ln y_{i,t} - \ln y_{i,t-1} = \alpha + \beta_0(\ln y_{i,t-1}) + \rho W(\ln y_{i,t} - \ln y_{i,t-1}) + \beta_i X_{i,t-1} + \varepsilon_{i,t} \qquad (3)$$

Where scalar ρ is the spatial lag or spatial autoregressive coefficient to be estimated, W is the spatially lagged dependent variable for a spatial weights matrix, and ε is a vector of error terms (Anselin 1988). For a particular CBG, the resulting spatial W can be considered as a spatially weighted average of all other adjacent CBGs' per capita income growth. W reflects the measure of contiguity between units of observation (Anselin 1988). The individual elements of W, denoted w_{ij} are set equal to unity of observations i and j (i≠j) share a common border, and are set to zero otherwise. This matrix assumes that all adjacent observations have equal influence and any spatial correlations beyond common-border neighbors are ignored (Anselin, 2003). Positive spatial dependence in per capita income growth is denoted if $p > 0$, negative is denoted if $p < 0$, and no spatial dependence is denoted if $p = 0$. Since many economic, social, and political characteristics of the CBGs are related to each other, estimating the income convergence only by OLS model will result in biased and inefficient parameter estimates (Anselin, 1988; Haining, 1990).

Study Area and Data Description

The study area is composed of eight counties (Dallas, Greene, Hale, Lowndes, Marengo, Perry, Sumter, and Wilcox) in the Southwest Region of Alabama, which have over 50 percent of African American population (Figure 1). The region covers a total area of 6,479 square miles (U.S. Department of Commerce, 2000).

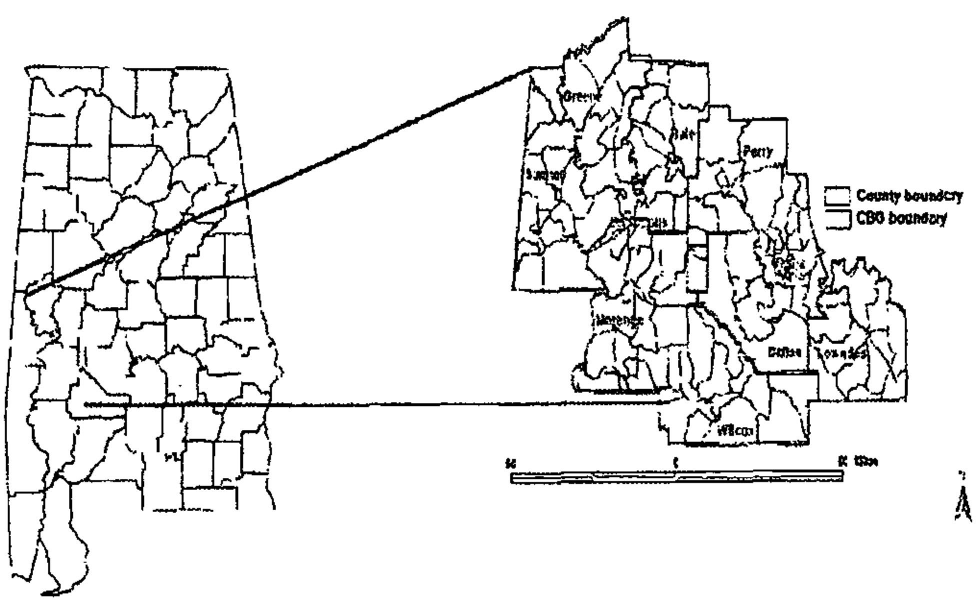

Figure 1. Study Area

US census data from 1980 and 2000 for each CBG of eight Black Belt counties were used (Geolytics, 2005a; 2005b). There are 161 CBGs in the eight counties. Table 1 displays the descriptive statistics of major socioeconomic variables. There was a 10% decline in population in the Region over the 20 years. These changes occurred across most of the CBGs. All the measures (minimum, maximum, and mean) reflect an average decrease of 100 people in 2000 as compared to 1980. Much of the change seems to be due to the decline in the non-African American (AAs) population. This demographic group made up only 33% of the Region's population in 2000 as compared to the 38% they constituted in 1980. While this is interesting, an intriguing feature of this change is the increasing racial segregation of the CBGs in the region. Over the past 20 years, there was greater concentration by race in the CBGs. As the data show there are CBGs with no non-African Americans in 2000 whereas there was at least 8% of this population in a CBG in 1980. Similarly, where there was at least 5% African Americans in a CBG in 1980 but that proportion was reduced to 1 % by 2000. At the same time, some CBGs had become either near exclusively (99%) African Americans, or exclusively (100%) non-African Americans in 2000. These results indicate development of strong racial patterns across the landscape during the twenty-year period.

Table 1. Socio-economic Characteristics of the Black Belt Counties in 1980-2000.

	Minimum		Maximum		Mean		Change
Variables	1980	2000	1980	2000	1980	2000	
Total Population	433	314	2,553	2,459	1,032	929	-103
AAs (%)	5	1	91	100	61	66	5
Non-AAs (%)	8	0	95	99	38	33	-5
High School graduate (%)	4	10	17	55	9	34	25
Bachelor Degree (%)	1	0	14	27	4	7	3
Total Employed (%)	12	22	37	70	24	43	19
Median HH Income ($)	4,679	7,974	19,054	61,055	9,685	23,504	13,819
Per capita Income ($)	1,941	4,814	8,684	28,094	4,293	12,907	8,614

N=161 CBGs, AA=African Americans, HH=Household.

Overall, the region experienced major gains in education, employment, and income between 1980 and 2000. The percentages of the adult (over 25 years old) population with high school and college education increased 25%

and 3%, respectively. Moreover, the minimums and maximums in the CBGs are the same or higher in 2000 than in 1980. Employment increased 19% over the period. The minimum was up by 10% from 12% to 22% and the maximum almost doubled from 37% to 70% in the 20 years. There was a 140% increase in average median household income and a 200% increase in average per capita income in the twenty years. These rates of increase are consistent with the rest of the state. However, closer examination of these statistics suggests a rather disturbing increase in the income gap between low income CBGs and high income CBGs. In 1980, the ratio between the minimum and maximum average median household and per capita income were 1:4.1 and 1:4.5, respectively. However, by 2000 these ratios increased 1:1.7 and 1:5.8. These results indicate that while some areas have done very well there are some areas that are well below the poverty level.

Empirical Results and Discussion

OLS Estimation of Conditional Convergence

The results of the OLS estimation of the conditional convergence as specified in equation 1 are presented in Table 2. The overall fit of the model is highly significant (F= 17.34, p <=0.001), with the adjusted R^2 value of 0.30. The results show that initial per capita income, growth in African American population, and bachelor degree holders were significant. The estimated coefficient of the initial per capita income level is negative (-0.42) and highly significant, confirming the proposition of the conditional income convergence over 20 years period as theorized by neoclassical growth model. The rate of income convergence over the 20 years period is 2.74%.

Table 2. Results of the OLS-estimated Conditional Convergence Model

Variable	βCoefficient	t-Statistic	F statistic	Adjusted R^2	Convergence Rate φ	Moran's I	AIC
Constant	4.562	6.347	17.343	0.290	2.74%	0.180	74.877
Per capita Income 1980***	-0.423	-4.863					
AA pop. Growth***	-0.104	-4.863					
Employment Growth	0.022	0.607					
BD holders growth**	0.017	2.332					
Convergence rate φ	2.74%						

BD=Bachelor Degree, AIC=Akaike Information Criteria.
***=Significant at 1% level; **=Significant at 5% level

The growth in African American population is negatively significant (β = -0.10) suggesting that those CBGs with the increased African American population growth had inverse relationship with the per capita income growth over the 20 years period. In other words, those CBGs which had lower percentage of African American population (or higher percentage of white population) had higher per capita income growth compared to the CBGs with the higher initial African American population (or lower percentage of white population) in 1980. This relationship suggests that the income convergence rate in the African Americans dominated CBGs was less compared to the whites dominated CBGs over the 20 years period.

The growth in the college degree population had positive and significant relationship ($\beta = +0.017$), with the per capita income growth which is consistent with the findings of other researchers (Lall and Yilmaz 2001). The result suggests that CBGs with the higher growth rate in the college degree population had the higher income growth rates or vice versa. The diagnostic of autocorrelation in the OLS estimation showed a high degree of correlations among the error values. Moran's I statistics derived from the OLS model was 0.18 and was highly significant (Table 2). This value indicates a significant presence of spatial autocorrelation suggesting non-random distributions of income values but high concentration and clustering among CBGs. Therefore, the Moran's I statistics were further investigated by using equation 2 to detect the strength of the spatial effects on income growth.

Spatial Model Estimation of Conditional Income Convergence

The results of the exploratory spatial data analysis with the use of autocorrelation analysis showed a significant positive spatial association for both per capita income level of 1980 and 2000 and income growth over the twenty -year period. Therefore, the third equation was used to examine the effects of spatial dependence on the growth in per capita income.

Table 3. Results of Conditional Convergence Estimated by Spatial Lag Model

Variable	βCoefficient	t-Statistic	Convergence rate φ	Adjusted R^2	Log Likelihood	AIC
Constant	3.620	4.667	1.810 %	0.357	-27.990	67.984
P (spatial lag)***	0.304	3.131				
Per capita Income 1980***	-0.347	- 3.923				
AA pop. Growth	-0.102	- 4.297				
Employment Growth	0.012	0.357				
BD holders growth**	0.016	2.263				

***Significance 1% **Significant 5% level

The results of spatial lag model are reported in Table 3. Spatial lag model fit better to that of original OLS model as supported by a decrease in Akaike Information Criterion (AIC) from 75 in OLS estimation to 68 in spatial lag model (Lim 2003). The spatial lag *(P)* estimate is positive and highly significant indicating a strong positive neighborhood effect on income growth. In the spatial lag model, the estimated βcoefficient for initial per capita income is lower (β= -0.347) than that in the OLS model (β= -0.423). This indicates a growth rate of average per capita income in a given CBG is affected by those of neighboring regions. The convergence rate estimated by spatial lag model was 1.81 %, a 0.93% decrease from the OLS estimated convergence rate. This suggests that the consideration of spatial lag dependence results in a slower annual rate of convergence compared with that in the OLS model.

Among the other explanatory variables, growth in the African American population and bachelor degree holders' population were the significant predictors of income growth as estimated in the OLS model. However, their parameter values were lower compared to that of OLS showing a slightly weaker relationship between income growth and the predictor variables after taking into account for spatial dependence.

Conclusion

There is a strong evidence of income convergence in the Black Belt Region of Alabama between 1980 and 2000. Over this twenty-year period, per capita incomes of poorer communities increased at higher rates than that of wealthier communities. Empirical model estimates suggest economies of the poorer CBGs are catching up with the wealthier CBGs at the rate of 1.81 percent per year. Good as these rates are, they are still lower than rates estimated in other studies across the United States (Barro and Sala-i-Martin 1992; Lim 2003; Young et al. 2006). This means income convergence rates have some way to go if this Region's income were to approach national levels.

There is a pattern of declining per capita income dispersion across the Region. This is an indicator of the emergence of more economically heterogeneous communities and consistency between economic progress in the Black Belt Region and neoclassical growth theories.

There is also compelling evidence of the correlation between race and education and income growth. An inverse relationship exists between growth in African American population and growth in per capita income. That is, incomes have grown at a higher rate in the CBGs where African Americans were not the majority population in 1980. In other words, predominantly white CBGs in 1980 had higher income growth rates as compared to predominantly African American CBGs. This finding is consistent with anecdotal evidence that predominantly white communities benefited more than other communities from the increased income earning opportunities in the Region over the twenty-year period.

Educational attainment made significant contribution to income growth in the region over the twenty-year period. Increasing levels of college education in the population have improved the local labor force and increased their earning potential. On contrary, employment growth did not significantly influence income growth. A finding more consistent with observation that many of the college educated population are either retired, self-employed, or commute to work.

Estimates of autocorrelation and spatial lag models indicate weakened clustering within the CBGs despite the presence of strong spatial effects on income growth during the time period. The spatial lag model estimated a decline in the income convergence rate and the impacts of significant variables. This means OLS model overestimates conditional convergence process. The results also revealed that CBGs with high income growth tend to positively influence the economic growth of adjacent CBGs.

This study has shown the importance of using disaggregated data at a finer geographic scale when examining regional economic growth. The results, in addition, provide evidence that income convergence over the past twenty-year period has provided more benefits to predominantly the white population, who are a minority in the Region. It can be argued that inferences based on the broad income growth models estimated at larger geographic scale may have provided misleading message in the past. This is very evident in Alabama's Black Belt Counties where population is geographically segregated by race and there is uneven distribution of human capital. This study's approach of examining economic growth at a finer geographic scale while considering conditional income convergence can provide more dependable results and more realistic assessment of income growth in specific parts of the region. Regional growth models can be built on aggregation at lower-levels, such as the CBG level models. Such studies can better help policy makers understand the importance of internal and geographic dynamics of rural communities. An understanding based on underlying regional economic growth patterns can translate into more effective economic development policies and plans.

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