Three Essays on the Impact of Automobile Production on Alabama's Economy

by

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Abstract

The Alabama state government has expanded economic incentives to attract auto industry in order to create additional employment and generate personal income for its citizens. As a result, large automobile firms and its input suppliers have located in several Alabama counties. This paper studies the effect of automobile production on per capita income, employment, population, nonfarm proprietor density and poverty in Alabama's counties, especially in the distressed black belt counties and also examines whether "people follow jobs" or "jobs follow people".

In Chapter one, regional growth models were developed as a spatial panel simultaneous equations model of population, per capita income and employment using county data for the period 1970-2007 and for 1997-2005 to determine the impact of auto production on income, population, and employment growth in the state. A partial lag adjustment was introduced into this regional growth equilibrium model and a one-way error component model for the disturbances was utilized. A Generalized Spatial Three-Stage Least Squares (GS3SLS) procedure as outlined in Kelejian and Prucha (2004) was used to estimate these regional growth models. The empirical findings suggest that the population, per capita income and employment of the county where a plant locates increases with automobile production. The population of neighboring counties decline but per capita income and employment increase. The percentage increase in per capita income of distressed Black Belt Counties might be higher than the percentage increase in per capita income of other neighboring counties. The results of this

analysis show that jobs follow people and also people follow jobs. Results also indicate that the effect of population growth on employment growth is at least 2 times as large as the effect of employment growth on the population growth. A conclusion is that appropriate policies to lure industrial development and improve the educational level of resident population are very important for economic development. The existence of spatial lags indicate that population, employment and per capita income growth are not only dependent on the characteristics of that county, but also on those of its neighbors. These interdependences provide a need for economic development policy coordination among the counties.

In Chapter two, regression models were estimated using county data for the period 1970-2000 to determine the impact of auto production and local government expenditure on poverty in Alabama, especially in the distressed Black Belt counties. The results show that automobile production in Alabama significantly reduces the poverty rate in all counties. The impact of automobile production on poverty reduction in distressed black belt counties is greater than in other counties. However local government expenditures are not very effective in reducing the poverty. The study suggests that industrial development may be more effective in reducing poverty than government programs.

In Chapter three, a spatial panel simultaneous equations model of non-farm proprietor densities and per capita income was developed, using county data for the period 1970-2007, to determine the impact of auto production on the growth of non-farm proprietor densities in Alabama's counties. The results show that automobile production in Alabama significantly increases the number of non-farm proprietorship in all counties. The impact of automobile production on the growth of non-farm proprietor densities in distressed black belt counties is greater than other counties. Appropriate policies to lure industrial development become very important to increase the self employment opportunity.

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Finally, I owe my wife and my parents a big debt of gratitude and appreciation for their patience and support during these four years. This piece of work is especially dedicated to my late father Kumaru Krishnapillai and my wife, Nanthinithevy Sooriyakumar.

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List of Abbreviations

AAMA	Alabama Automotive Manufacturers Association
CPI	Consumer Price Index
EDPA	Economic Development Partnership of Alabama
ERS	USDA Economic Research Service
FG2SLS	Flexible Generalized Two Stage Least Square
FG3SLS	Flexible Generalized Three Stage Least Square
GS3SLS	Generalized Spatial Three Stage Least Square
GM	Generalized Moments Estimation
L.R.E	Long Run Equilibrium Elasticity

CHAPTER 1

The Effects of Automobile Production on Alabama's Economic Growth and Rural Development

1. Introduction

Strategies to improve living conditions in the rural South are receiving increased attention (Wimberley et al, 2002). Local economic development has become a major concern of state policy makers and local government (Isserman 1994). Since the Alabama state government has expanded economic incentives to attract auto industry in order to create additional employment and generate personal income, large automobile firms and input suppliers have located in several Alabama counties. Prior to 1997, Alabama produced not a single automobile. Due to the aggressive recruiting efforts by the state, auto production and its ancillary industries accounted for 3.4 % of Alabama gross domestic product and for 17.5% of the state's manufacturing gross domestic product in 2006. The auto industry in Alabama accounted for 47,457 direct jobs and 85,700 indirect jobs through their purchases and expenditures with annual payroll of $5.2 billion by 2007 (AAMA 2008). In addition to providing jobs to offset losses in mining, agriculture, and textiles, these jobs are better paying. In 2004, the average weekly wage for auto manufacturing workers in the state was $ 1,318 compared to $761 for all manufacturing and $643 for all industries (EDPA 2006). Jobs in 40 of the state's 67 counties now are tied directly or indirectly to auto manufacturing (AAMA 2008).

Despite its growing importance, little scholarly work has been done to assess the impact of the auto industry on the state's economy or living standards. Gadzey et al. (2003) estimated an econometric model, using 30 years of county level data to determine whether state assistance to private firms increased the real value of manufacturing output. Results based on data through 1999 showed the subsidy effect to be positive, as expected, and statistically significant. However, the measured effect was too small for the subsidies to be profitable. This finding is important because it affirms charges of critics (Buchholz 2008) that the incentive packages given to auto companies were excessive. Mercedes-Benz, Honda, and Hyundai each received incentive packages worth between $100 and $300 million (Ahn 2005). More generally, it raises questions about whether industrial policies to lure industry are a cost effective way to improve the living standards of rural residents. A major focus on this research is to address that question.

Gadzey et al.'s findings are consistent with the substitution view of industrial subsidies, which means replacing import with domestic production (Wren 1996). Their analysis terminates in 1999, and thus covers only two full years of auto production. The multiplier effects of the industrial production were not considered in this analysis. Effects of particular interest to students of rural development include those on employment, population, and income growth (Duffy-Deno 1998; Deller et al., 2001: Kim et al., 2005; Saint Onge et al., 2007; Hammond and Thompson, 2008; and Wu and Gopinath, 2008). Enlarging the analysis to include income, population, and employment effects, as proposed in this research, provides a more complete picture of the industry's impact on the state. Subsidies are measured as transfers of sum of local, state and federal government funds to counties as recorded by the US Census Bureau and thus are non-specific to the auto industry. To circumvent the problem of non-specificity, and to provide a direct measure of impact, we propose using a simple count of auto production as the causal variable. Between 1998 and 2007 car and light truck production in the state increased from 68,800 to 739,019 units (EDPA, 2008), which provides sufficient variation to measure the impacts reliably.

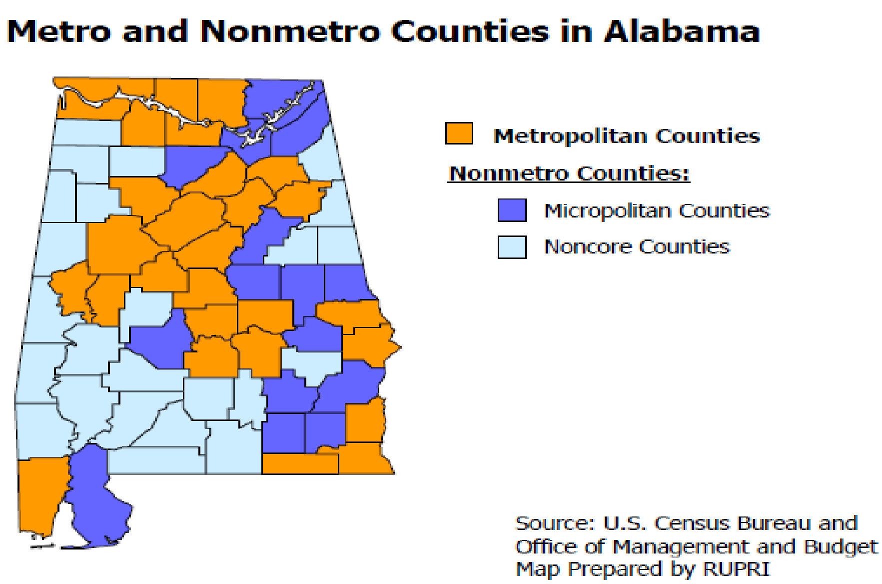
The purpose for this research is to determine the economic impact of auto production on income, population, and employment growth in the Alabama's counties. A major goal of this research is to determine whether distressed counties in the state's Black Belt benefited from the auto boom. Of the 17 counties in the Black Belt, Governor Riley's Black Belt Action Committee identified 12 as "distressed" as follows: Bullock, Choctaw, Dallas, Greene, Hale, Lowndes, Macon, Marengo, Perry, Pickens, Sumter, and Wilcox (Morton, 2007). This research improves on previous studies involving Alabama counties. First, a simultaneous model permits an analysis of the feedback effects among population, employment and per capita income which has not been seen in previous studies. A second improvements is that the initial level of employment, per capita income and population are included in the model, which allows to test whether each equation in the system converge with respect to the dependent variables. Third, this study estimates the differential impact of auto production on income, population and employment growth in the distressed black belt counties by the interaction term of auto production and these counties. Finally, spatial components are incorporated to capture the role of population, employment and per capita income of neighboring counties.

The research proposed herein is motivated in part by a recent study by Kinnucan et al. (2006) on the determinants of student performance in Alabama's county schools. Results of this study indicated that poverty reduction and income growth were among the most potent factors predictive of improved student scores on standardized achievement tests. This suggests industrial policies aimed at increasing employment or family income could have important effects on rural education. In Carlino and Mills' (1987) classic study, it was speculated that since "jobs follow people," in slow growing or declining regions, "public funds may be better spent on educating the resident population than used to lure employment". A purpose of this research is to shed light on the validity of this hypothesis by examining the extent to which growth in the auto industry benefited the state's Black Belt region.

1.1 Demographic and Economic Profile of Alabama

Based on county Core Based Statistical Area classifications, in Alabama, there are 28 metropolitan counties, 15 micropolitan counties, and 24 noncore counties. Approximately seventy one percent of Alabama's population resides in metropolitan counties, 18.4 percent resides in micropolitan counties, and the remaining 10.8 percent live in noncore counties (RUPRI, 2007)

Figure 1.1:



From 1990 to 2000, in Alabama, 12 counties lost population, six counties experienced population growth of over 30 percent. These six counties include five metro and one non-metro county. Between the 2000 Census and the July 2005 estimate, Alabama's total population grew by 2.5 percent. But 41 counties lost population. Twenty nine of these 41 counties were non-metro counties (RUPRI,2007)

Figure 1.2:

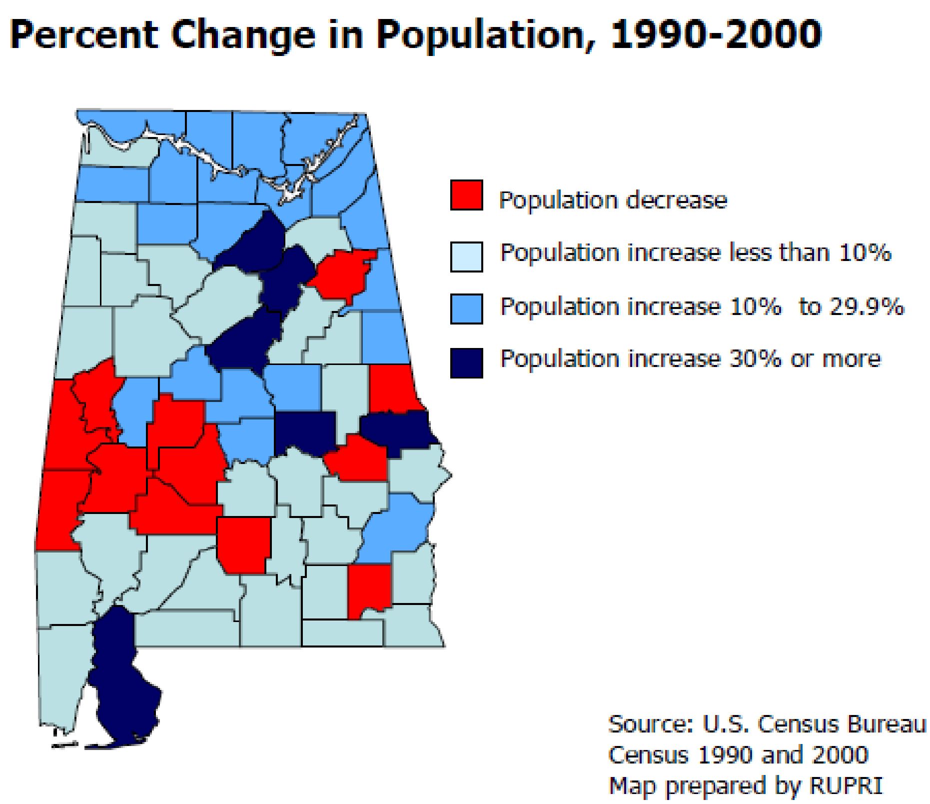
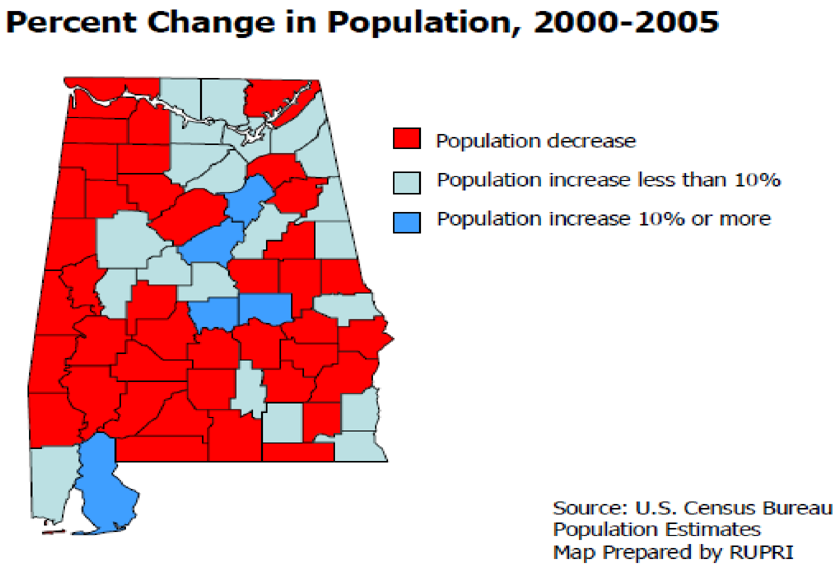
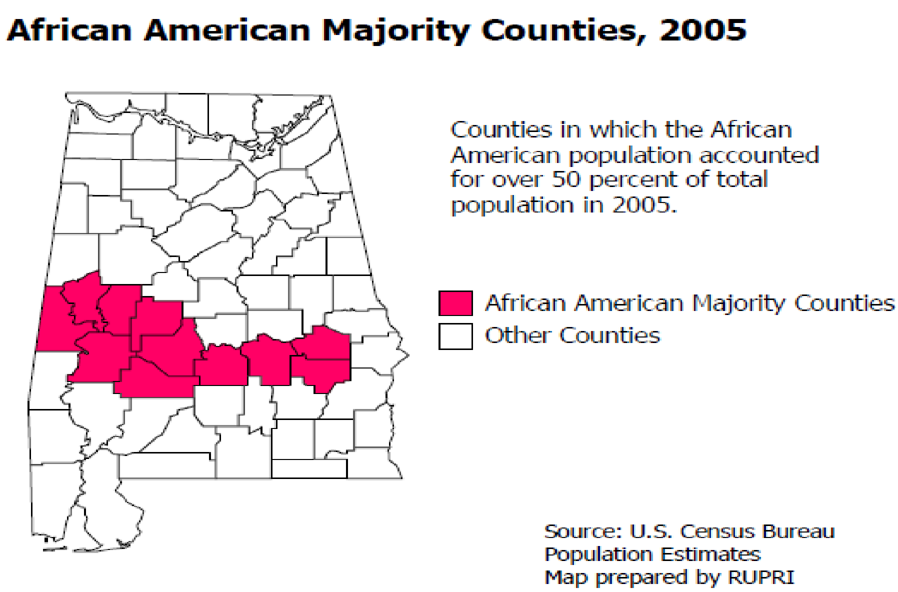


Figure 1.3:



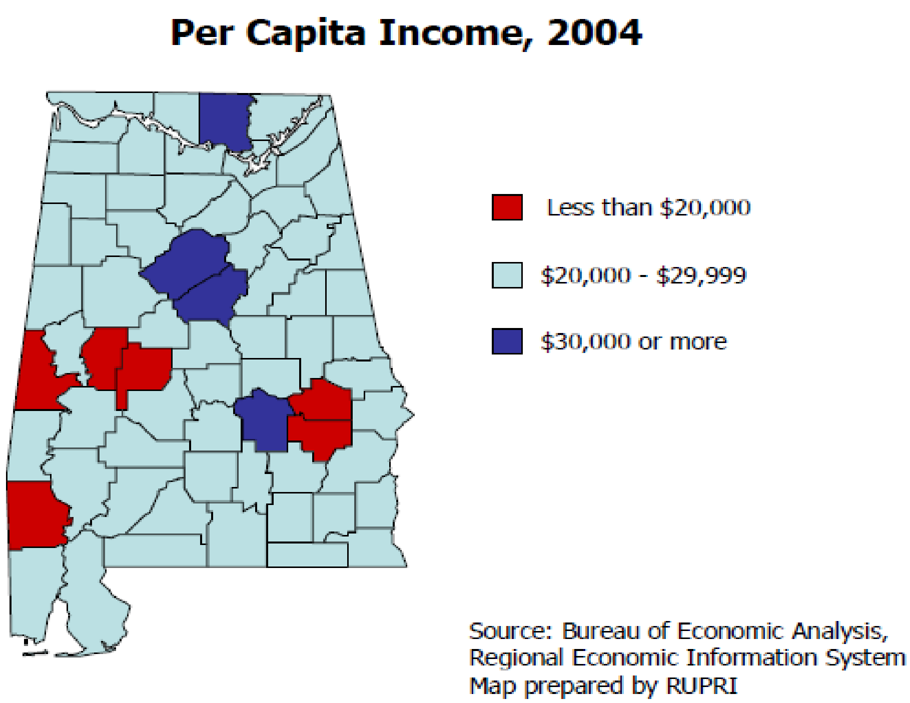
In many Alabama counties, the African American population accounts for a significant portion of total population. African Americans are majority population in eleven counties in Alabama.

Figure 1.4:



In 2004, the per capita income in Alabama's counties ranged from $17,976 in Bullock County to $36,041 in Jefferson County. Seven counties had per capita income less than $20,000 in 2004, six of them non-metro. Only four metro counties had per capita income over $30,000 in 2004 (RUPRI,2007).

Figure 1.5:



The Economic Research Service of USDA classifies counties as low employment counties if "less than 65 percent of residents 21-64 years old were employed in 2000." ERS classified 21 counties in Alabama as low employment counties. 16 of these low employment counties are non-metro counties. The unemployment rate for Alabama in 2005 was 4.0 percent, compared to 5.1 percent for the U.S. Within Alabama, the unemployment rate ranged from 2.6 percent to 8.7 percent (RUPRI, 2007).

Figure 1.6:

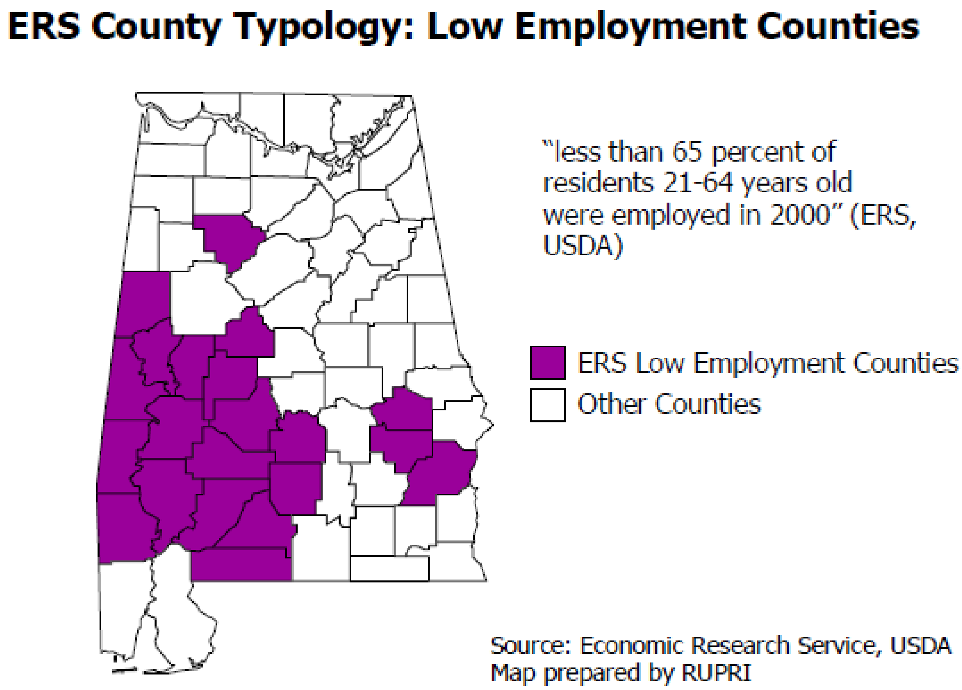
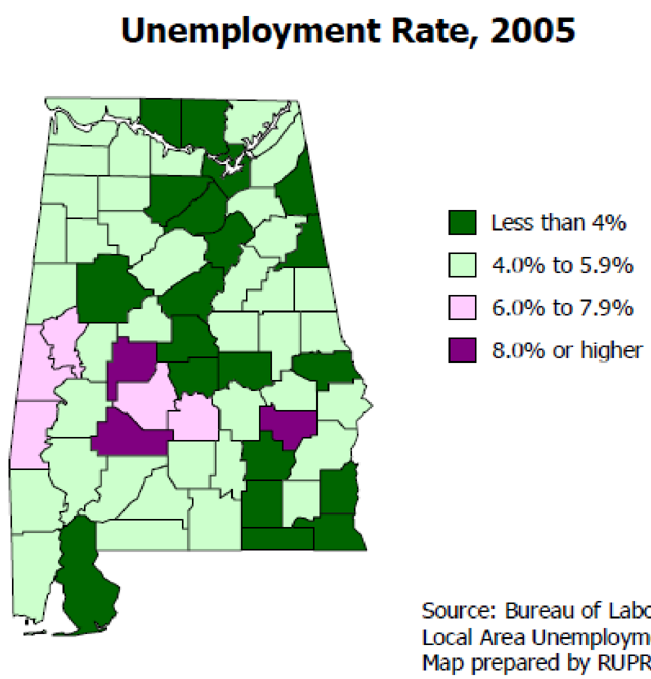


Figure 1.7:



2. Literature Review

Regional Scientists adopted simple modeling techniques in very early regional economics literature. Most of this early literature analyzed employment, population and per capita income growth separately. Steinnes and Fisher (1974) in their study found that there is simultaneity between employment and population growth. The classic two-equation country growth model of Carlino and Mills (1987) is a key contribution to the literature of regional growth. Their study has also demonstrated how combinations of exogenous variables affected regional growth. Many studies have suggested that dual causality and stable growth characterized the interaction of population and employment changes (Carlion and Mills, 1987, Clark and Murphy, 1996, Mulligan et al. (1999).

Deller et al. (2001) expanded the original Carilno and Mills Model by adding income as an endogenous variable to determine the role of income in regional growth process. They used county data, but restricted to non-metropolitan counties. Their empirical results indicate that counties with higher initial population will have higher employment growth. However, they found that counties that had higher levels of population, employment, and per capita income tended to have lower rates of overall growth. There have also been studies to model the interdependence between employment growth and migration (Clark and Murphy 1996; MacDonald 1992) and the interdependence among net migration, employment growth and average per capita income (Greenwood and Hunt 1984; Greenwood et al. 1986; Lewis et al. 2002) in simultaneous-equations models. Clark and Murphy's (1996) findings about simultaneity between employment density and population density have been influential in regional science. Gebremariam et al. (2010) have found a strong interdependence between employment and median household income growth rates. Their study confirms the importance of spatial effects in regional development.

Several studies have examined the effects of business location on local economy (Gottlieb, 1994; Glasmeier and Howland, 1994), and urban and rural status on population migration (Graves, 1980, 1983; Nord and Cromartie, 1997; McGranahan, 1999) and amenities on local economy (Duffy-Deno, 1997; Deller and Tsai, 1999; English et al. 2000). Deller at al. (2000) found that climate had a strong effect on population change, but it had a less effect on employment and per capita income growth. Gottlieb (1994) found that amenity factors did not have a strong influence on firm location decision. Nzaku and Bukenya (2005) have examined the effects of aging population, road density, population with high school diploma, per capita tax and the proportion of jobs in the agriculture, manufacturing and service sectors on the local economy.

A controversial issue in the estimation of Carlino and Mills-type regional development models is the treatment of dynamics. The controversy is aptly summarized by Carruthers and Mulligan (2007): " One side of the argument is that the space economy exists in a state of disequilibrium, so that people move in response to visible disparities in the cost of living, wages, and employment opportunities. This traditional view is epitomized by the notion that employment growth fuels population growth, but not the other way around. The other side of the argument is that a state of equilibrium exists, so that people move in an effort to maximize their utility which often means trading off economic comfort for natural, cultural, and/or other environmental amenities. In this view, it is reasonable for people to relocate to areas with low wages and even with dismal employment prospects, if they are somehow compensated by desirable attributes of their destination. Further, in addition to the traditional growth process, it is reasonable to expect that jobs also follow people, as a result of firms pursuing their labor pools, increased demand in the service sector, and other economic forces. Although it is impossible to know for certain which perspective is correct, the question remains a source of extensive debate (Greenwood 1984; Evans 1990; Graves and Mueser 1993; Hunt 2006).

Duffy-Deno (1998) and MacKinnon, White, and Davidson (1983) show that a log- linear specification is more suitable for models involving population and employment densities than a linear specification. Following Edmiston (2004), Deller et al (2001), Henry et al (1999), Duffy – Deno (1998), Barkley et al (1998), Boarnet, (1994), Carlino and Mills (1987), Mills and Price (1984) who suggest that equilibrium employment , population and median household income are likely to adjust to their equilibrium values with a substantial lag.

2.1 Spillover effect of Automobile Plants

The greatest spillover benefit of automobile plants in Alabama is the movement of input suppliers to Alabama counties. These input suppliers cluster around automobile plants and create additional employment and generate personal income. The multiplier effects of this income through consumer spending generate additional employment and income. One of the major advantages of industry clustering is the potential for labor pooling (Krugman, 1991). Workers usually locate near the place where there are several firms and high demand for their skills because if they lost a job in one firm there may be another firm to hire them. Firms also want a pool of skilled workers in order to hire easily more labor during higher demand periods for their products. Another reason for the intra and inter industry clustering is the technological spillovers benefits (Romer, 1986: Krugman, 1991). Financial institutions and supporting service firms moves near these industries and this creates additional employment and personal income.

There can also be negative spillovers of automobile firms on other industries. Large automobile firms increase the market demand for inputs and then increase the wages, rents and price of other inputs. These increased input costs deter new firms moving into the counties where large firms locate and also deter the expansion of existing firms in these counties. The congestion of public services and infrastructure due to the large firms and population increase is another reason for negative impact on new and existing firms. Congestion may force the local government to raise the tax rates and this also deters the entering of new potential firms.

3. Model

The point of departure in this analysis is the regional growth model estimated by Deller et al. (2001). This model extends the classic two-equation country growth model of Carlino and Mills (1987) to include per capita income as an endogenous variable. It is based upon the assumption that utility-maximizing households migrate in search of utility derived from the consumption of market and non-market goods, and profit maximizing firms become mobile when looking for regions that have lower production costs or higher market demand. Importantly, the extended model retains the essential character of Carlino and Mills's model by permitting household and firm location choices to be interdependent. This is important because, as a by-product of the analysis, we can address a key issue in regional growth; namely, whether "people follow jobs" or "jobs follow people" (Muth 1971; Steinnes 1978; Treyz et al., 1993; and Wu and Gopinath 2008).

The basic specification of the model used is a simultaneous-equation system of the form:

$$POP_t^* = f_1 \; [(PCI_t^*, (I \otimes W)\, PCI_t^*), (EMP_t^*,\; (I \otimes W)\, EMP_t^*),\; (I \otimes W) POP_t^*,\; A_{t-i},\; BA_{t-i}, | X_{t-i}^{pop}] \quad (1)$$

$$PCI_t^* = f_2 \; [(POP_t^*, (I \otimes W)\, POP_t^*), (EMP_t^*,\; (I \otimes W)\, EMP_t^*),\; (I \otimes W) PCI_t^*,\; A_{t-i},\; BA_{t-i}, | X_{t-i}^{pci}] \quad (2)$$

$$EMP_t^* = f_3 \; [(POP_t^*, (I \otimes W)\, POP_t^*), (PCI_t^*,\; (I \otimes W)\, PCI_t^*),\; (I \otimes W) EMP_t^*,\; A_{t-i},\; BA_{t-i}, | X_{t-i}^{emp}] \quad (3)$$

The equilibrium levels of population, per capita income and employment are assumed to be functions of the equilibrium values of the other endogenous variables included in right hand side of equation and their spatial lags, automobile production, and the vectors of the additional exogenous variables. POP_t^*, PCI_t^*, and EMP_t^* are vectors of dimension NT x 1 of the equilibrium levels of population, per capita income and employment respectively; t denotes time. **I** is an identity matrix of dimension T and, W is a row standardized N x N spatial weights matrix with zero diagonal values. Each element of this spatial weights matrix, w_{ij} , represents a measure of proximity between observation i and observation j. Based on the queen based adjacency criteria, w_{ij} is equal to $1/k_i$, where k_i is the number of nonzero elements in row i, if i and j are adjacent, and zero otherwise. Therefore, $(I \otimes W)\, POP_t^*)$, $(I \otimes W)\, EMP_t^*)$, and $(I \otimes W) PCI_t^*$ stand for the equilibrium values of neighboring counties'effect. A_{t-i} is vector of dimension NT x 1 of automobile production. BA_{t-i} is the interaction term of the distressed black belt county and automobile production. The matrices of additional exogenous variables that are included in the population, per capita income and employment equations are given by X_{t-i}^{pop} , X_{t-i}^{pci} , and X_{t-i}^{emp} respectively. These additional exogenous variables are included in the equations to control their effects on the dependent variables. This system of equation captures the simultaneous nature of interaction among population, employment and per capita income.

The nature of interaction among the endogenous variables depends on the spillover effect of neighboring counties and the initial conditions of exogenous variables in a county.

A multiplicative functional form was used for the equations in this system. A lagged adjustment is introduced into our model. This partial-adjustment process replaced unobservable equilibrium allowing the model to take the general form.

$$POPG_t = \propto_1 + \beta_{11}EMPG_t + \beta_{12}PCIG_t + \lambda_{11}\big((I\otimes W)POPG_t\big) + \lambda_{12}(I\otimes W)PCIG_t$$
$$+\lambda_{13}(I\otimes W)EMPG_t + \delta_1 lnA_{t-i}^{pop} + \theta_1 BA_{t-i}^{pop} + \sum_{k=1}^{K_1}\gamma_{1k}\ln(X_{t-i,k}^{pop})$$
$$-\eta_{11}\ln(POP_{t-i}) - \eta_{12}\ln(PCI_{t-i}) - \eta_{13}\ln(EMP_{t-i}) + u_{t,1} \quad (4)$$

$$PCIG_t = \propto_2 + \beta_{21}POPG_t + \beta_{22}EMPG_t + \lambda_{21}\big((I\otimes W)POPG_t\big) + \lambda_{22}(I\otimes W)PCIG_t$$
$$+\lambda_{23}(I\otimes W)EMPG_t + \delta_2 lnA_{t-i}^{pci} + \theta_2 BA_{t-i}^{pci} + \sum_{k=1}^{K_1}\gamma_{2k}\ln(X_{t-i,k}^{pci})$$
$$-\eta_{21}\ln(POP_{t-i}) - \eta_{22}\ln(PCI_{t-i}) - \eta_{23}\ln(EMP_{t-i}) + u_{t,2} \quad (5)$$

(1) $$EMPG_t = \propto_3 + \beta_{31}POPG_t + \beta_{32}PCIG_t + \lambda_{31}\big((I\otimes W)POPG_t\big) + \lambda_{32}(I\otimes W)PCIG_t$$
$$+\lambda_{33}(I\otimes W)EMPG_t + \delta_3 lnA_{t-i}^{emp} + \theta_3 BA_{t-i}^{emp} + \sum_{k=1}^{K_1}\gamma_{3k}\ln(X_{t-i,k}^{emp})$$
$$-\eta_{31}\ln(POP_{t-i}) - \eta_{32}\ln(PCI_{t-i}) - \eta_{33}\ln(EMP_{t-i}) + u_{t,3} \quad (6)$$

Where $\propto_r$, β_{rq} , λ_{rl}, δ_r , θ_r , γ_{rk} , η_{rl} for k=1,….,K_r ; r, l = 1,2, 3; and q= 1,2 are the parameter estimates of the model and K_r is the number of exogenous variables in the respective equations. $POPG_t$, $PCIG_t$ and $EMPG_t$ represent the log differences between the end and beginning period values of population, per capita income and employment respectively representing the growth of respective variables. The variable, automobile production (***lnA_{t-i}***), was constructed as ***ln*** (automobile production/ distance). The subscript t-i denotes to the variable lagged seven years for the study period 1970-2007 or two years for the study period 1997-2005. The coefficient η_r for r =1,2,3 represents the speed of adjustment coefficients, the rate at which population, per capita income and employment adjust to their respective steady state equilibrium levels. $\mathbf{u}_{t,r}$ for r=1,2,3 are NT x 1 vectors of disturbances. A Moran's I test statistic suggested that there is the existence of spatial autocorrelation in the errors. The test results are given in Table 1.3. Therefore, the disturbance vector in the r^{th} equation is generated as:

$$\boldsymbol{u}_{t,r} = \rho_r \, (\boldsymbol{I}_T \otimes \boldsymbol{W}) \, \boldsymbol{u}_{t,r} + \boldsymbol{\varepsilon}_{t,r} , \quad r = 1,2.3 \qquad (7)$$

This specification relates the disturbance vector in the r^{th} equation to its own spatial lag. A one-way error component structure was utilized to allow the innovations ($\boldsymbol{\varepsilon}_{t,r}$) to be correlated over time, following Baltagi (1995). Therefore, the innovation in the r^{th} equation is given by

$$\boldsymbol{\varepsilon}_{t,r} = \boldsymbol{Z}_\mu \, \boldsymbol{\mu}_r + \boldsymbol{\omega}_{t,r} , \quad r = 1,2,3. \qquad (8)$$

Where $\boldsymbol{Z}_\mu = (I_N \otimes \iota_T)$, $\mu_r' = (\mu_{1r}, \mu_{2r}, , \mu_{Nr})$, $\omega_{t,r}' = (\omega_{11r}, \omega_{12r}, \ldots, \omega_{1Tr}, \ldots, \omega_{N1r}, \ldots, \omega_{NTr})$

I_T and I_N are identity matrices of dimension T and N, respectively, ι_T is a vector of ones of dimension T, and $\otimes$ denotes the Kronecker product. $\boldsymbol{\mu}_r$ and $\boldsymbol{\omega}_{t,r}$ are random vectors with zero means and covariance matrix (suppressing the time index):

$$E\begin{pmatrix}\mu_r\\ \omega_r\end{pmatrix}(\mu_r'\ \omega_r') = \begin{bmatrix}\sigma^2_{\mu rr}\ I_N & 0\\ 0 & \sigma^2_{\omega rr}\ I_{NT}\end{bmatrix} \quad (9)$$

Where, $\boldsymbol{\mu}_r$ denotes vector of unit specific error components and $\boldsymbol{\omega}_r$ contains the error components that vary over both the cross- sectional units and time periods. Innovations $\boldsymbol{\varepsilon}_{t,r}$ are not spatially correlated across units but they are auto-correlated over time. However, this specification allows innovations from the same cross sectional unit to be correlated across equations. Therefore, the vectors of disturbances are spatially correlated across units and across equations as given in (10) the same specification was used by Kapoor, Kelejian, and Prucha (2007); Baltagi, Song, and Koh (2003)).

$$\boldsymbol{u}_{t,r} = \rho_r\,(\boldsymbol{I}_T \otimes \boldsymbol{W})\,\boldsymbol{u}_{t,r} + (\boldsymbol{I}_N \otimes \boldsymbol{\iota}_T)\boldsymbol{\mu}_r + \boldsymbol{\omega}_{t,r}\ , \quad r = 1,2,3 \quad (10)$$

The intercepts ($\propto_r$ $for\ r = 1,2,3$) in equations (4) – (6) represent the combined influences of changes in the suppressed exogenous variables; the β_r for r = 1,2,3 coefficients are structural elasticities corresponding to the endogenous variables. A basic hypothesis to be tested is that the δ_r coefficients are positive, which would mean an increase in automobile production causes population, employment, and income to increase jointly, ceteris paribus. We add the interaction terms to test whether the automobile production boom differentially affected economic growth in the distressed Black Belt counties. Spatial components were incorporated to capture the role of population, employment and per capita income of neighboring counties. A Generalized Spatial Three-Stage Least squares (GS3SLS) approach as outlined by Kelejian and Prucha (2004) into a panel data setting was used to estimate the model.

An important issue in regional development policy is whether “people follow jobs” or “jobs follow people.” For example, if people follow jobs, then policies to lure industry would be appropriate. Conversely, if jobs follow people, public funds might be better spent educating the resident population. The chicken or egg question can be tested by simple inspection of the t-ratios associated the β_{11} and β_{31} coefficients in equations (4) and (6). For example, if β_{11} = 0 and $\beta_{31} > 0$, then people follow jobs and the state should emphasize industrial development. Conversely, if $\beta_{31} = 0$ and $\beta_{11} > 0$, then jobs follow people and the state should emphasize educating the resident population. If $\beta_{11} > 0$ and $\beta_{31} > 0$ migration and employment are interrelated. In this instance, both development approaches are relevant and their relative effectiveness would depend on the relative size of the coefficients.

3.1 Reduced Form Estimates and Long Run Elasticity

The reduced form equations are obtained by solving structural equations derived from GS3SLS model. A spatial autoregressive model, in the context of single equation and in panel data setting, is expressed as:

$$\boldsymbol{y} = \lambda \boldsymbol{W}\boldsymbol{y} + \boldsymbol{X}\boldsymbol{\gamma} + \boldsymbol{u} \qquad (11)$$

$$\boldsymbol{u} = \rho \boldsymbol{W}\boldsymbol{u} + \boldsymbol{\varepsilon} \qquad (12)$$

Where **y** is an NT x 1 vector of observations on the dependent variable. **Wy** is the corresponding spatial lagged dependent variable for weights matrix **W**, X is NT X K matrix of observations on the explanatory variables, u is an NT X 1 vector of error terms. $\boldsymbol{\lambda}$ is the spatial autoregressive parameter and γ is a K X 1 vector of regression coefficients. $\boldsymbol{\rho}$ is the spatial autoregressive coefficient for the error lag $\boldsymbol{W}\boldsymbol{u}$ and $\boldsymbol{\varepsilon}$ is NT x 1 vector of innovations or white noise error. This single spatial autoregressive model can be extended to a system of spatially interrelated equations. A standard G system of equations can be written as:

$$\boldsymbol{Y = YB + X\Gamma + WY\Lambda + U} \qquad (13)$$

$$\boldsymbol{U = WUC + E} \qquad (14)$$

$\mathbf{Y} = \mathbf{y}_1, \ldots\ldots, \mathbf{y}_G$ $\quad$ $\mathbf{X} = \mathbf{x}_1, \ldots\ldots, \mathbf{x}_G$ $\quad$ $\mathbf{U} = \mathbf{u}_1, \ldots\ldots, \mathbf{u}_G$

$\mathbf{WU} = \mathbf{Wu}_1, \ldots\ldots, \mathbf{Wu}_G$ $\quad$ $\boldsymbol{C = diag_{r=1}^{G} \rho_j}$ $\quad$ $\boldsymbol{E = \varepsilon_1, \ldots \ldots, \varepsilon_G}$

Where $\mathbf{y_r}$ is the NT x 1 vector of observations on the dependent variable in r^{th} equation **,** $\mathbf{x_k}$ is the NT x 1 vector of observations on the k^{th} exogenous variable, u_r is the NTx1 vector of error terms in the r^{th} equation, and **B** and $\mathbf{\Gamma}$ are parameter matrices of dimension G x G and K x G respectively. **B** is a diagonal matrix. **W** is N x N weights matrix of known constants and $\mathbf{\Lambda}$ is G x G matrix of parameters. $\mathbf{Wy}_r$ and $\mathbf{Wu}_r$ are spatial lag and spatial autoregressive error term in the rth equation respectively.

The solution for the endogenous variable can be revealed through the vector transformation:

$$vec\ Y = vec\ YB + vec\ X\Gamma + vec\ WYA + vec\ U$$

$$vec\ Y = vec\ YB + vec\ X\Gamma + vec\ WYA + vec\ UWC + E$$

$$vec\ Y = B' \otimes I\ vec\ Y + \Gamma' \otimes I\ vec\ X + \Lambda' \otimes Wy + C' \otimes WvecU + vecE$$

Letting $\mathbf{y}$ = vec Y , $\mathbf{x}$ = vec X, $\mathbf{u}$= vec U and $\boldsymbol{\varepsilon} = vec\ E$

$$\boldsymbol{y = B' \otimes Iy + \Gamma' \otimes Ix + \Lambda' \otimes Wy + C' \otimes Wu + \varepsilon}$$

or

$$\boldsymbol{y = B' \otimes Iy + \Gamma' \otimes Ix + \Lambda' \otimes Wy + u}$$

$$u = C' \otimes Wu + \varepsilon$$

or

$$y = [B' \otimes I + \Lambda' \otimes W]y + \Gamma' \otimes Ix + u$$

$$u = C' \otimes Wu + \varepsilon$$

After all the spatial effects and the other endogenous variables effects are controlled, the relations between the dependent variables and the exogenous variables x can be expressed as:

$$y - [B' \otimes I + \Lambda' \otimes W]y = \Gamma' \otimes Ix + u$$

$$I - [B' \otimes I + \Lambda' \otimes W]y = \Gamma' \otimes Ix + u$$

$$u = C' \otimes Wu + \varepsilon$$

The reduced form can be written as:

$$y = I_{nG} - [B' \otimes I + \Lambda' \otimes W]^{-1}(\Gamma' \otimes Ix + \mathbf{u}) \quad (15)$$

$$u = (I_{nG} - C' \otimes W)^{-1}\varepsilon \quad (16)$$

The system of spatial structural equations was solved to obtain a system of reduced form equations. Since the spatial weight matrix was constructed on the queen based adjacency criteria, this system of spatial equations control the spatial spillover effect of neighboring counties (Nzaku and Bukenya, 2005; Trendle, 2009; Gebremariam,2010). Reduced coefficients of significant variables in the structural equations were estimated for the counties where automobile plant locate and its neighboring counties.

In this system of equations, the dependent variables are the change in population, employment and per capita income during a specific period and exogenous variables are the initial value of those variables at the beginning of the specific period. The dependent variables are constructed as the difference between the $\mathbf{lny}_t - \mathbf{lny}_{t-i}$. One of the exogenous variables in the right hand side of each equation is the predetermined lagged dependent variable ($\mathbf{lny}_{t-i}$). The long run elasticity of exogenous variable is calculated by dividing the coefficient of an exogenous variable by the negative value of a coefficient of a predetermined lagged dependent variable ($\mathbf{lny}_{t-i}$).

4. Data and Sources

Data for sixty seven counties in Alabama are drawn from several sources (Table 1.1). These data were collected for two study periods which are from 1970 to 2007 and from 1997 to 2005. The growth of population, employment and per capital income for the study period from 1970 to 2007 were constructed using 7 years intervals between the beginning and end period, like 1970-1977, 1980-1987, 1990-1997 and 2000-2007. These variables were constructed for the study period from 1997 to 2005, using two years interval between the beginning and end period, like 1997-1999, 1999-2001, 2001-2003 and 2003-2005. Independent variables include demographic, human capital, labor market, housing, amenities, automobile production, interaction term of automobile production and distressed black belt county and policy variables. McGranahan (1999) developed the Economic Research Service (ERS) natural amenities index, which combines the attractiveness of mild climate, varied topography, and proximity to surface water into one measure. This index was used for the amenity variable in this study. The initial values of the independent variables are used as 7 year lagged values and 2 year lagged values for 1970-

2007 and 1997-2005 study period respectively. This formulation reduces the problem of endogeneity. All independent variables are in log form except those that can take negative or zero values. Automobile plants are located in only four counties of Alabama, namely Tuscaloosa, Talladega, Madison and Montgomery. The distance between the major city of these four counties and major city of all other counties were obtained from MapQuest. Ratios of automobile production and distance for each county were constructed by dividing automobile production of each plant by distance between major city of county where plant locates and the major city of each county. Then, sum of ratios of automobile production and distance were obtained by adding the ratios of every company. It is assumed that the effect of automobile production decreases with the distance from automobile plant. Per capita income, property tax and local tax were deflated by Consumer Price Index (CPI). The descriptive statistics of the variables are given in Table 1.2.

5. Estimation Issues

Panel models for two study periods are estimated. Each panel model contains four time periods and 67 counties. Then, 268 observations are used in the panel model for each study period. Panel model can be used to control unobserved heterogenity and to investigate inter-temporal changes. Since the panel data provide more information and variables, the degree of freedom and efficiency increases and multicollinearity is less likely to occur. Following Baltagi (1995), one way error component structure model was utilized for the panel data in this empirical study.

This system of equations has econometric issues regarding feedback simultaneity, spatial autoregressive lag, and spatial cross-regressive lag simultaneity with spatially autoregressive disturbances. These simultaneities create problems in estimation and identification of each equation. The order condition for identification in a linear simultaneous equations model is that the number of dependent variables on the right hand side of an equation must be less than or equal to the number of predetermined variables in the model but not in the particular equation. Lagged dependent variables also can be considered as predetermined variables. Kelejian and Prucha considered that the spatially lagged dependent variables can be treated as predetermined (Kelejian and Prucha, 2004). The order condition for each equation of the system in (4) – (6) is fulfilled.

The Hausman test (1983) for over identification was done to investigate whether the additional instruments are valid in the sense that they are uncorrelated with the error term. That is $E(\mathbf{Q}'\mathbf{u}_r) = 0$, Where E is the expectation operator and **Q** is an instrument matrix that consist of a subset of linearly independent columns $\mathbf{X}, \mathbf{WX}, \mathbf{W}^2\mathbf{X}$, where **X** is the matrix that includes the control variables in the model. All equations are appropriately identified because the hypothesis of orthogonality for each equation cannot be rejected even at P= 0.05 as indicated by the NR_u^2 test statistic in Table 1.3.

When the spatial autoregressive lag and spatial cross-regressive lag simultaneities are present, the conventional three-stage least squares estimation to handle the feedback simultaneity would be inappropriate. Therefore, the Method of Moments approach was used rather than maximum likelihood because maximum likelihood would involve significant computational complexity. Generalized Spatial Three-Stage Least squares (GS3SLS) approach outlined by Kelejian and Prucha (2004) into a panel data setting was used to estimate the model. This new procedure is performed in a five-step routine as given in Appendix .

The system of spatial structural equations was solved to obtain a system of reduced form equations. Since spatial weight matrix was constructed on the queen based adjacency criteria, this system of spatial equations control only spatial spillover effect of neighboring counties. Reduced coefficient and long run elasticity of significant variables in the structural equations were estimated to the counties where automobile plant locates and its neighboring counties.

6. Results and Discussion

The parameter estimates of the system for the two study periods were given in Table 1.3 and 1.4. In general, the results are consistent with theoretical expectations and previous studies on regional growth. The results show the existence of simultaneity among endogenous variables. This indicates that there are strong interdependences among population growth, per capita income growth and employment growth. The signs of the coefficients are consistent with theoretical expectations.

In the model for the study period (1970-2007), the negative and significant coefficient of lagged dependent variable in each equation indicates the conditional convergence with respect to the respective endogenous variable of each equation. This also implies that growth of population, per capita income and employment were higher in counties that had low initial level of population, per capita income and employment, respectively, compared to counties with high initial levels. These coefficients were not significant in the model for the shorter study period (1997-2005). Reduced coefficients and long run elasticities of automobile production for study period (1970 -2007) were given in Table 1.5. These estimates can be used to study the impact of automobile production on Alabama's economy. Reduced coefficients and long run elasticities of other exogenous variables and reduced coefficient of initial level of population, per capita income and employment were given in Table 1.6 and Table 1.7 respectively.

6.1 Population Growth Equation

In the equation of population growth, the coefficient of employment growth is positive as expected and significant at the 1% level. The coefficient of employment growth (0.59) indicates that a 1% increase in employment may result in-migrants and hence an increase in the population by 0.59%, other things being equal. The previous studies (Carlino and Mills, 1987 and Clark and Murphy, 1996) reported the same relationship that changes in employment are driving population. This is interpreted as jobs follow people.

The reduced coefficients of automobile production indicate that, in the short run, growth of population decreases with automobile production in a county where plant locates and increase in the neighboring counties. However, the long run elasticity implies that population increases with automobile production in a county where a plant locates and decreases in neighboring counties. This result implies that population increases at a decreasing rate with automobile production in the county where plant locates. In the long run, population declines in neighboring counties with automobile production because people migrate to a county where a plant locates for jobs. The effect of automobile production on migration decreases with distance from an automobile plant. The long run elasticity of automobile production suggests that if automobile production of a given plant can increase by 10%, the population of the county where the given plant locates will increase by 0.5% but the population of neighboring counties will decline by about 0.2%. Since the structural coefficient of the interaction term of automobile production and distressed Black County is insignificant, there is no differential impact of automobile production on population in distressed Black Belt counties.

The reduced coefficients from the study period 1970-2007 show that population growth is positively and highly associated with the natural amenity index (Amenity) and highway density (hway). Our results based on the natural amenity index show that counties scoring high in a scale of these amenities are associated with high population change. Roback (1982, 1988) found that people are willing to move to places with lower wages and fewer jobs, but that are rich in amenities. However, long run elasticity implies that the population in a county with a low natural amenity index is higher than a county with a high natural amenity index in long run. The county with high natural amenity index has high land and housing values, restrictions for industrial development and infrastructure.

The positive sign of a reduced coefficient of road density indicates that transportation is very important for population migration and economic development. In the long run, better infrastructure may reduce the population density. The reduced form coefficients imply that population growth is negatively associated with the initial level of the unemployment rate (UNEMP), and the proportions of the population above 65 years old in the short run. High unemployment rate attracts firms into a county to take advantage of cheap labor and jobs then workers from other counties in long run.

In this study, the long run elasticity shows that the population in a county will decline with the increase of per capita tax and percentage of employed labor in farming. Population is negatively associated with the initial level of average nonfarm proprietors' income. Housing and land value may increase with the nonfarm proprietors' income and then decrease the population.

The structural coefficient of initial level of employment indicates that the growth of population in a given county is positively associated with initial level of employment.

The structural coefficient of spatial autoregressive lag is positive and significant. This indicates that population growth in neighboring counties positively influence the population growth of a given county through immigration due to the low housing and land value. The structural coefficient of cross-regressive lag with respect to employment growth is negative. This may be explained as the reason that people are moving to neighboring countries for jobs. These results show that the growth of population and employment in neighboring counties has spillover effect on the growth of population in a given county. Global Moran's I statistic and ρ_1 indicate there is a spatial spillover effect with respect to the error terms. This indicates that random shocks to the system affect not only the county where the shock originates and its neighbors, but also create shockwaves across the study area, because of the structure of the autoregressive errors.

6.2 Employment Growth Equation

In both study periods, the employment growth in a given county is positively and highly associated with population growth and per capita income growth. In the study period 1970 -2007, the coefficient of population growth (1.42) indicates that a 1% increase in the population is associated with around a 1.42 % increase in the employment. This supports the hypothesis that people follow jobs. The coefficient of per capita income growth (0.58) shows that there is almost 0.58% increase in employment for 1% increase in per capita income. Carlino and Mills (1987) found that population is driving employment growth and also the increase in income led to employment growth.

The reduced form coefficient and long run elasticity of the automobile production are positive. Long run elasticity of automobile production suggests that if automobile production of a given plant can increase by 10%, the employment of a county where the given plant locates will increase by 0.1 % in long run and the employment of neighboring counties will increase by 0.2%. The counties where plant locates have major cities of Alabama and the initial level of employed people is very high, compare to neighboring counties. Since the structural coefficient of the interaction term of automobile production and distressed Black Belt County is insignificant, there is no differential impact of automobile production on employment in distressed counties.

The results from the employment growth equation indicate that the growth of employment in a given county is positively associated with initial level of unemployment rate and average nonfarm proprietor income. A county with high unemployment and nonfarm proprietor income has a higher potential for economic growth and employment growth than a county which has a low unemployment rate and nonfarm proprietor income. This is consistent with previous research findings that high regional unemployment rate indicates a plentiful supply of cheap labor, which attracts firms into the region (Marston, 1985). The results show that the initial level of population, per capita income and nonfarm proprietor income positively influence employment growth. A county with high initial level of population and per capita income has a greater demand for goods and services. An increase in the demand for goods and services can create more employment. The reduced coefficient and long run elasticity implies that road density is also very important for employment and economic growth.

In the employment growth equation, structural coefficients of spatial auto regressive lag effect are positive and significant. This implies that employment growth in a given counties depends on the averages of employment growth of neighboring counties. This positive autoregressive lag effect implies that the spillover effect of employment growth in neighboring counties positively affects the employment growth in a given county. New jobs may be created due to the positive spillover effect of industrial clustering and availability of supporting services. Employment growth in neighboring counties attracts job seekers to commute from a given county.

The coefficient of cross regressive lag with respect to the population growth is negative. This means that population growth in neighboring counties may attract more firms from a given county. These results indicate that the population and employment growth in neighboring counties have spillover effect on the employment growth of a given county. The existence of spatial dependencies in the error terms imply that random shocks to the system affect not only a county where the shock originates and its neighbors, but also the entire study area.

6.3 Per capita Income Growth Equation

The per capita income growth in a given county is positively and highly associated with the growth of employment. This result is consistent with theoretical expectations. Nzaku and Bukenya (2005) found that employment has a strong positive effect on per capita income. In the study period 1970 -2007, the coefficient of employment growth (0.38) implies that a 1% increase in employment is associated with around a 0.38 % increase in per capita income.

The reduced coefficient and long run elasticity suggests that automobile production of a plant positively influences the per capita income of a county where the plant locates and of its neighboring counties. The long run elasticity of automobile production indicates that if automobile production of a given plant can increase by 10%, the per capita income of a county where the given plant locates will increase by 0.3 % and the per capita income of neighboring counties will increase by the range of 0.05% - 0.09%. Since the structural coefficient of the interaction term of automobile production and distressed Black County is significant at the 10% level, there might be differential impacts of automobile production on per capita income in distressed Black Belt counties. Long run elasticity estimates of the interaction term suggests that per capita income of distressed Black Belt County may rise by about 0.08 % for a 10% increase in automobile production.

Although the results show that the per capita income in a given county is positively associated with the initial level of the employment, the reduced coefficient and long run elasticity of percentage of employed labor in farming suggests that the dependence of a large part of employment on farming negatively influences the per capita income of a county. Per capita income in a given county is shown to be negatively associated with the initial level of unemployment rate and population. These results are consistent with previous research (Nzaku and Bukenya, 2005). The negative reduced coefficient and long run elasticity of average nonfarm proprietor income indicate the conditional convergence with respect to the per capita income. This also implies that growth of per capita income were higher in counties that had low initial level of nonfarm proprietor income, compared to counties with high initial level of nonfarm proprietor income. The positive sign of road density indicates that transportation is very important for economic development.

The structural coefficient of spatial auto regressive lag effect is positive and significant. The per capita income growths in neighboring counties have positive spillover effect on the per capita income growth of a given county. The structural coefficient of cross regressive lag effect with respect to employment growth is negative. The higher employment growth in neighboring counties makes neighboring counties more attractive to new and existing firms. These results imply that the per capita income growth of a particular county is depend on the average of employment growth and per capita income growth of neighboring counties. This is important from a policy perspective because per capita income depends not only on the characteristics of that county, but also on the characteristics of its neighbors. The disturbances indicate the existence of spatial dependencies in the error terms. This means that random shocks to the system affect not only a county where the shock originates and its neighbors, but also the entire study area.

7. Conclusions and Policy Implications

The empirical findings suggest that if automobile production in a given plant increases by 10% the population, per capita income and employment of a county where the plant locates will increase by 0.5%, 0.3% and 0.1% respectively. But the population of neighboring counties will decline by about 0.2%. However, the employment of neighboring counties will increase by 0.2%. The per capita income of neighboring counties will increase by the range of 0.05% - 0.09%. Since the structural coefficient of the interaction term of automobile production and distressed Black County is significant at 10% level, there might be differential impact of automobile production on per capita income in distressed Black Belt counties. The per capita income of distressed Black County may rise by about 0.08 %. There is no differential impact of automobile production on population, and employment in distressed Black Belt counties.

Automobile plants are located in major cities and jobs in these plants are better paying jobs. Because of large automobile plants, input suppliers have located in neighboring counties and created employment opportunities. The prevailing high unemployment rate in neighboring counties may be the reason for the increase in employment in these counties even though people move from there to major cities for better paying jobs.

There are significant feedback simultaneities among the growth of population, per capita income and employment in Alabama counties during the study period. Employment growth in the population growth equation and population growth in the employment growth equation have positive strong effect. The conclusion can only be that jobs follow people and also people follow jobs. The results show that a 1% increase in population growth is associated with a 1.42 % increase in employment growth but a 1% increase in employment growth is associated with only 0.6 % increase in population growth. This means that the effect of population growth on employment growth is at least 2 times as large as the effect of employment growth on population growth. Appropriate policies to lure industrial development and improve the educational level of resident population become very important for economic development.

The results of this study also show the existence of positive spatial autoregressive lag with respect to the growth of population, employment and per capita income. The population growth equations show the existence of negative spatial cross regressive lag effect with respect to growth of employment in neighboring counties. The growth of per capita income equation shows the existence of negative spatial cross regressive lag effect with respect to growth of employment in neighboring counties. The growth of employment equation shows the existence of negative spatial cross regressive lag effect with respect to the growth of population in neighboring counties. These findings are important from an economic perspective because the existence of these spatial lag effects indicates that growth of population, employment and per capita income are not only dependent on the characteristics of that county, but also on those of its neighbors. These interdependences provide the need for economic development policy coordination among the counties. This finding has economic policy implications. It indicates that sector specific policies should be integrated in order to achieve desired outcomes.

Table 1.1: Variable Description and Data Sources

Variable	variable Description	unit	Source
POPG	Population Growth	%	A, B
PCIG	Per capita income Growth	%	A, B
EMPG	Employment Growth	%	A, B
pop	population	number	B
pci	per capita income	$/person	B
emp	employment	number	B
auto	No. of automobile/distance	Number/mile	A, J, K
autoblack	Interaction of auto and Black Belt county		
unemp	unemployment rate	%	E
17years	% of population below 17years	%	C, D
65years	% of population above 65years	%	C, D
hsch	% of high school degree or above	%	C, D
bach	% of bachelor degree or above	%	C, D
pov	poverty rate	%	D
protax	per capita property tax	$/person	D
tax	per capita local tax	$/person	D
owner	owner occupied housing in percent	%	D
farm	% employed in farming	%	B
manu	%employed in manufacturing	%	B
serv	%employed in other sectors	%	B
amenity	Natural Amenities Index	ERS index	H
anfpin	average nonfarm proprietor's income	$	B
hway	road density	mile/square mile	I
dista	distance from metro area	mile	J
metro	dummy variable for metro area	dummy value	
$(I \otimes W)POPG$	Spatial lag of POPG	%	A, B
$(I \otimes W)PCIG$	Spatial lag of PCIG	%	A, B
$(I \otimes W)EMPG$	Spatial lag of EMPG	%	A, B

A- Computed, B- US Department of Commerce, Bureau of Economic Analysis (REIS database), C- County & City Data Book, D- U.S Census Bureau, E- Bureau of Labor Statistics, F- American Medical Association, G- Federal Bureau of Investigation, H- Economic Research Service, USDA, I – US Bureau of Transportation Statistics, J- Map Quest, K - Mercedes-Benz U.S. International, Tuscaloosa, AL, Honda Manufacturing of Alabama, Lincoln, AL, Hyundai Motor Manufacturing Alabama, Montgomery, AL, Toyota Motor Manufacturing Alabama, Huntsville, AL, Automotive News Market Data Book

Table 1.2: Descriptive Statistics for Alabama Counties

Variable	variable Description	1970-2007 Mean	1970-2007 Std Dev	1997-2005 Mean	1997-2005 Std Dev
POPG	Population Growth, t	1.05	0.09	1.00	0.02
PCIG	Per capita income Growth, t	1.14	0.1	1.04	0.03
EMPG	Employment Growth, t	1.1	0.14	1.01	0.06
pop	population, t-i	59149.84	93442.84	66241.42	98368.96
pci	per capita income, t-i	18225.76	4978.4	23675.26	3662.83
emp	employment, t-i	28441.48	55516.72	35295.81	66389.74
auto	No. of automobile/distance, t-i years	494.7	4892.61	3284.24	15224.87
autoblack	Interaction of auto and Black Belt county	55.24	283.85	246.25	741.71
unemp	unemployment rate, t-i years	8.8	4.93	6.62	2.15
17years	% of population below 17years, t-i	30.03	4.99	25.49	4.18
65years	% of population above 65years, t-i	12.74	2.53	13.91	2.01
hsch	% of high school degree or above, ,t-i	53.37	14.97	69.65	6.73
bach	% of bachelor degree or above, t-i	9.95	5.61	13.49	6.32
pov	poverty rate, t-i	23.09	10.33	18.05	5.35
protax	per capita property tax, t-i	81.21	80.5	201.82	100.38
tax	per capita local tax, t-i	208.02	181.56	482.31	217.88
owner	owner occupied housing in percent, t-i	72.97	7.1		
farm	% employed in farming, t-i	9.03	6.69	5.58	3.69
manu	%employed in manufacturing, t-i	25.4	10.42	20.52	9.21
serv	%employed in other sectors, t-i	16.98	5.87	54.38	9.63
amenity	Natural Amenities Index, t-i	1.87	1.79	1.87	1.79
anfpin	average nonfarm proprietor's income, t-i	11312.53	4988.92	18172.37	6034.65
hway	road density, t-i	0.13	0.03	0.13	0.03
dista	distance from metro area	34.72	25.18	34.72	25.18
metro	dummy variable for metro area	1.31	0.66	1.31	0.66
$(I \otimes W)$POPG	Spatial lag of POPG, t	1.05	1.06	1	1.01
$(I \otimes W)$PCIG	Spatial lag of PCIG, t	1.13	1.07	1.03	1.02
$(I \otimes W)$EMPG	Spatial lag of EMPG, t	1.09	1.07	1.01	1.03

i is 7 for the period 1970 -2007 and 2 for the period 1997- 2005.

Table 1.3: Structural Coefficients for the Study Period (1970-2007)

	POPG Equation		EMPG Equation		PCIG Equation	
Variable	*Coeff.*	*z-stat*	*Coeff.*	*z-test*	*Coeff.*	*z-test*
POPG			1.424	17.38	-0.148	-1.42
PCIG	-0.173	-2.02	0.587	5.13		
EMPG	0.594	16.01			0.377	6.33
pop	-0.069	-2.68	0.133	3.83	-0.077	-2.38
pci	-0.020	-0.46	0.139	2.24	-0.289	-5.68
emp	0.052	2.34	-0.102	-3.39	0.056	2
auto	-0.007	-4.18	0.006	2.39	0.007	3.1
autoblack	-0.002	-1.05	0.001	0.29	0.004	1.62
unemp	-0.049	-5.91	0.084	6.89	-0.054	-5.22
17years	0.001	0.02	-0.030	-0.54	0.063	1.23
65years	-0.060	-2.55	0.064	1.81	0.035	1.14
hsch	-0.028	-0.81	-0.001	-0.02	0.082	1.8
bach	-0.008	-0.62	0.022	1.14	-0.016	-1.01
pov	0.004	0.29	-0.009	-0.44	0.012	0.67
protax	0.005	0.55	-0.003	-0.25	-0.019	-1.77
tax	0.033	2.44	-0.060	-3	0.055	3.31
owner	0.011	0.4				
farm	0.008	1.35	-0.003	-0.35	-0.017	-2.41
manu	-0.005	-0.59	0.010	0.86	-0.009	-0.92
serv	-0.008	-0.6	0.020	1	-0.022	-1.24
amenity	0.013	3.89	-0.018	-3.7	0.001	0.34
anfpin	-0.029	-2.07	0.058	2.88	-0.052	-3.24
hway	0.025	2.25	-0.042	-2.59	0.032	2.28
dista	-0.008	-1.36	0.010	1.16	-0.002	-0.2
metro	-0.032	-1.44	0.033	1.01	0.019	0.68
$(I \otimes W)$ POPG	0.469	4.02	-0.812	-4.86	0.131	0.85
$(I \otimes W)$ PCIG	0.017	0.25	-0.147	-1.49	0.267	2.95
$(I \otimes W)$ EMPG	-0.376	-4.13	0.713	5.67	-0.283	-2.66
Constant	0.967	2.15	-2.529	-4.11	3.121	6.1
RHO(ρ)	-0.321	-8.33^b	-0.538	-3.88^b	-0.121	-1.18^b
SIG V	0.001	29.1^b	0.003	7.3^b	0.003	12.24^b
SIG 1	0.002	16.59^b	0.004	3.52^b	0.002	6.82^b
NR^2 - $\chi 2$ (39,41,40)	31.770	0.7877^c	31.283	0.8364^c	44.135	0.3405^c
Moran I	0.149	0.022	0.065	0.244	0.144	0.027
N	268		268		268	

b: t-static value, c: p-value

Table 1.4: Structural Coefficients for the Study Period (1997-2005)

	POPG Equation		EMPG Equation		PCIG Equation	
Variable	*Coeff.*	*z-stat*	*Coeff.*	*z-test*	*Coeff.*	*z-test*
POPG			1.5919	5.99	-0.7680	-3.5
PCIG	-0.1742	-3.3	1.0307	8.12		
EMPG	0.2201	6.23			0.5545	8.35
pop	0.0006	0.08	0.0312	1.48	-0.0205	-1.37
pci	0.0062	0.48	0.0456	1.37	-0.0172	-0.72
emp	-0.0004	-0.05	-0.0237	-1.32	0.0136	1.09
auto	-0.0006	-1.78	-0.0002	-0.24	-0.0004	-0.71
autoblack	-0.0005	-1.32	-0.0015	-1.34	0.0018	2.41
unemp	-0.0290	-6.62	0.0381	2.81	-0.0183	-1.86
17years	-0.0025	-0.31	0.0103	0.5	-0.0167	-1.22
65years	-0.0274	-3.59	0.0021	0.1	-0.0004	-0.03
hsch	0.0070	1.74	-0.0096	-0.91	0.0073	1
bach	-0.0018	-0.42	0.0076	0.71	-0.0015	-0.2
farm	0.0036	1.8	0.0065	1.32	-0.0050	-1.57
manu	-0.0012	-0.4	0.0116	1.55	-0.0023	-0.46
serv	-0.0018	-0.14	0.0563	1.88	-0.0141	-0.7
amenity	0.0022	1.99	-0.0023	-0.79	0.0009	0.45
anfpin	-0.0024	-0.69	0.0033	0.37	-0.0063	-1.04
hway	0.0040	1.14	-0.0085	-0.92	0.0036	0.57
dista	-0.0025	-1.26	-0.0032	-0.62	0.0033	0.99
metro	-0.0120	-1.64	-0.0133	-0.69	0.0117	0.88
$(I \otimes W)$ POPG	0.1031	0.93	-0.8776	-3.42	0.4821	2.75
$(I \otimes W)$ PCIG	-0.0486	-0.6	-0.9182	-4.88	0.9099	7.41
$(I \otimes W)$ EMPG	-0.0740	-1.38	0.7485	6.98	-0.4111	-4.6
Constant	0.1093	0.77	-0.9666	-2.96	0.4564	0.31
RHO(ρ)	0.0089	0.05^{b}	-0.6998	-6.52^{b}	-0.8148	-6.51^{b}
SIG V	0.0002	6.05^{b}	0.0009	7.08^{b}	0.0004	5.31^{b}
SIG 1	0.0002	3.52^{b}	0.0009	3.49^{b}	0.0042	1.94^{b}
NR^2- 2(37,37,37)	28.6	0.838^{c}	27.7	0.867^{c}	35.2	0.554^{c}
Moran I	0.0310	0.498	0.1490	0.025	0.0200	0.592
N	268		268		268	

b: t-static value, c: p-value

Table 1.5: Reduced Coefficients, Long Run Elasticities and 10% Impacts of Automobile Production (1970-2007)

	Reduced Coefficient			Long Run Elasticity			10% impact		
County	POPG	PCIG	EMPG	pop	pci	emp	pop	pci	emp
Toyota									
Jackson	0.005	0.003	0.015	-0.029	0.015	0.032	-0.183	0.092	0.199
Limestone	0.005	0.003	0.014	-0.028	0.013	0.030	-0.193	0.085	0.206
Madison	-0.008	0.008	0.005	0.048	0.034	0.010	0.483	0.337	0.099
Marshall	0.004	0.002	0.012	-0.024	0.009	0.025	-0.155	0.059	0.162
Morgan	0.005	0.003	0.013	-0.027	0.011	0.029	-0.173	0.072	0.184
Hyundai									
Autauga	0.004	0.002	0.013	-0.026	0.011	0.028	-0.191	0.079	0.202
Bullock	0.005	0.003	0.015	-0.031	0.012	0.032	-0.191	0.074	0.200
Crenshaw	0.005	0.002	0.013	-0.027	0.010	0.029	-0.164	0.062	0.171
Elmore	0.004	0.002	0.012	-0.025	0.010	0.027	-0.177	0.069	0.185
Lowndes	0.004	0.002	0.012	-0.026	0.010	0.028	-0.177	0.068	0.190
Macon	0.005	0.002	0.013	-0.028	0.011	0.029	-0.176	0.066	0.184
Montgomery	-0.008	0.008	0.004	0.050	0.033	0.009	0.495	0.333	0.094
Pike	0.005	0.002	0.014	-0.029	0.011	0.031	-0.178	0.065	0.185
Honda									
Calhoun	0.005	0.003	0.014	-0.029	0.011	0.030	-0.195	0.077	0.205
Clay	0.005	0.003	0.013	-0.028	0.011	0.030	-0.194	0.077	0.204
Cleburne	0.005	0.003	0.014	-0.030	0.012	0.031	-0.191	0.074	0.200
Coosa	0.004	0.002	0.012	-0.025	0.010	0.026	-0.156	0.060	0.164
St. Clair	0.004	0.002	0.012	-0.025	0.010	0.026	-0.161	0.062	0.168
Shelby	0.004	0.002	0.011	-0.024	0.009	0.025	-0.151	0.059	0.159
Talladega	-0.008	0.008	0.004	0.052	0.033	0.008	0.524	0.330	0.083
Mercedes -Benz									
Bibb	0.004	0.002	0.011	-0.024	0.009	0.025	-0.154	0.060	0.162
Fayette	0.005	0.003	0.014	-0.030	0.011	0.031	-0.185	0.071	0.194
Greene	0.004	0.002	0.013	-0.027	0.011	0.029	-0.173	0.070	0.183
Hale	0.004	0.002	0.012	-0.026	0.011	0.027	-0.162	0.067	0.172
Jefferson	0.004	0.002	0.011	-0.024	0.009	0.025	-0.142	0.055	0.149
Pickens	0.005	0.003	0.014	-0.030	0.012	0.031	-0.194	0.075	0.203
Tuscaloosa	-0.009	0.007	0.003	0.054	0.033	0.008	0.540	0.328	0.077
Walker	0.004	0.002	0.012	-0.025	0.009	0.026	-0.151	0.054	0.156

Table 1.6: Reduced Coefficients, Long Run Elasticities of Exogenous Variables (1970-2007)

Variable	County	Reduced Coefficient			Long Run Elasticity		
		POPG	PCIG	EMPG	pop	pci	emp
	Madison	0.018	-0.036	0.097	-0.107	-0.157	0.207
anfpin	Montgomery	0.018	-0.036	0.095	-0.104	-0.158	0.206
	Talladega	0.016	-0.036	0.091	-0.099	-0.16	0.203
	Tuscaloosa	0.015	-0.036	0.089	-0.097	-0.16	0.201
	Madison	-0.026	-0.049	0.061	0.156	-0.217	0.13
unemp	Montgomery	-0.027	-0.05	0.058	0.164	-0.219	0.126
	Talladega	-0.029	-0.05	0.053	0.179	-0.22	0.119
	Tuscaloosa	-0.03	-0.05	0.051	0.188	-0.221	0.115
	Madison	-0.101	0.022	-0.028	0.599	0.095	-0.06
65years	Montgomery	-0.101	0.021	-0.03	0.612	0.092	-0.065
	Talladega	-0.103	0.02	-0.034	0.64	0.09	-0.076
	Tuscaloosa	-0.104	0.02	-0.037	0.656	0.089	-0.082
	Madison	0.058	0.073	0.052	-0.347	0.321	0.111
tax	Montgomery	0.059	0.073	0.052	-0.355	0.323	0.114
	Talladega	0.059	0.073	0.054	-0.369	0.322	0.12
	Tuscaloosa	0.06	0.073	0.055	-0.377	0.322	0.124
	Madison	0.027	-0.011	0.027	-0.158	-0.048	0.057
farm	Montgomery	0.027	-0.011	0.027	-0.161	-0.048	0.058
	Talladega	0.027	-0.011	0.027	-0.166	-0.047	0.06
	Tuscaloosa	0.027	-0.011	0.027	-0.169	-0.047	0.061
	Madison	0.003	-0.003	-0.029	-0.019	-0.015	-0.061
amenity	Montgomery	0.003	-0.003	-0.028	-0.02	-0.014	-0.06
	Talladega	0.004	-0.003	-0.026	-0.024	-0.013	-0.059
	Tuscaloosa	0.004	-0.003	-0.026	-0.026	-0.013	-0.058
	Madison	0.051	0.048	0.049	-0.3	0.21	0.105
hway	Montgomery	0.051	0.048	0.049	-0.307	0.211	0.107
	Talladega	0.051	0.048	0.05	-0.318	0.211	0.112
	Tuscaloosa	0.051	0.048	0.051	-0.324	0.211	0.115
	Bullock	----	0.0004	----	----	0.0018	----
autoblack	Greene	----	0.0004	----	----	0.0019	----
	Hale	----	0.0004	----	----	0.0019	----
	Lowndes	----	0.0003	----	----	0.0015	----
	Macon	----	0.0003	----	----	0.0015	----
	Pickens	----	0.0004	----	----	0.0019	----

Table 1.7 Reduced Coefficients of Initial of Population, Per Capita Income and Employment (1970-2007)

Variable	county	POPG	PCIG	EMPG
	Madison	0.168	0.191	-0.165
	Montgomery	0.165	0.188	-0.163
pop	Talladega	0.161	0.186	-0.159
	Tuscaloosa	0.158	0.185	-0.157
	Madison	0.027	-0.227	-0.041
pci	Montgomery	0.027	-0.227	-0.040
	Talladega	0.025	-0.227	-0.039
	Tuscaloosa	0.024	-0.228	-0.039
	Madison	0.513	0.335	-0.467
emp	Montgomery	0.505	0.331	-0.460
	Talladega	0.492	0.325	-0.449
	Tuscaloosa	0.485	0.322	-0.443

CHAPTER 2

The Effects of Automobile Production and Local Government Expenditure on Poverty in Alabama

1. Introduction

Poverty reduction is one of the major concerns for policy makers and local governments in most of the countries. In the United States, Poverty is unevenly distributed across counties. Poverty rates remains high in the most isolated rural counties, particularly in counties far from metropolitan areas (Glasmeier and Farrigan, 2003; Swaminathan and Findeis, 2004; Partridge and Rickman, 2006, Ch. 2). Poverty rate in the United States increased from 11.3% in 2000 to 12.3% in 2006 (DeNavas-Walt, Bernadette, and Smith 2007). In the United States, the Appalachian Region has been the center of attention for poverty reform because most of the counties are isolated rural counties and far behind in the social and economic development from the rest of the nation (Pollard, 2003). National and local policy programs to alleviate poverty in this region have shown a substantial improvement in economic conditions over the past several decades.

The poverty rate in Alabama was 15.3 percent in 2003. In Alabama counties, the poverty rate ranged from 6.8 percent in Shelby County to 28.7 percent in Perry County. Among the counties, fourteen had poverty rates of 20 percent or higher. The Economic Research Service, USDA, classifies counties as persistent poverty counties if they have had poverty rates of 20 percent or higher in each decennial census from 1970 through 2000. In Alabama, 22 counties are classified as persistent poverty counties. 17 counties of these 22 counties are non-metro counties (RUPRI, 2007).

Figure 2.1:

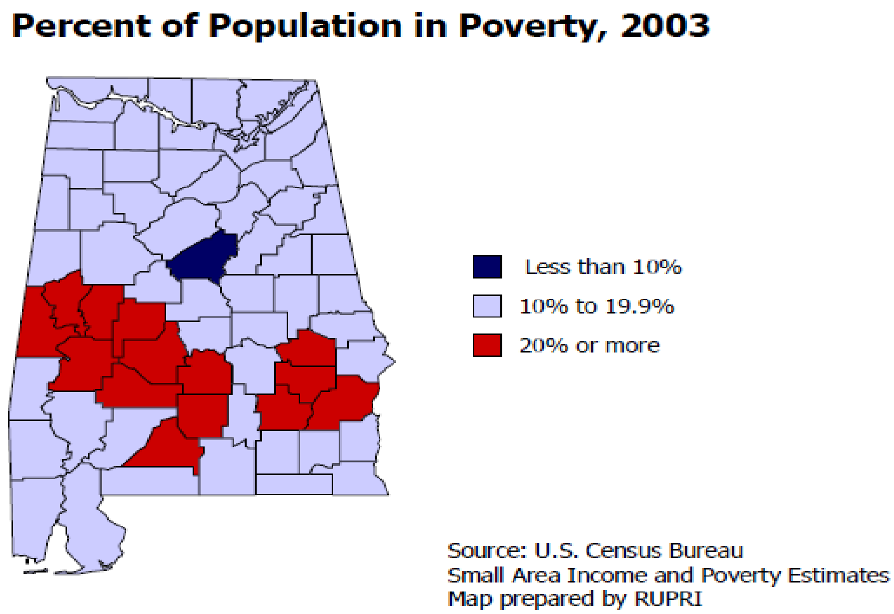
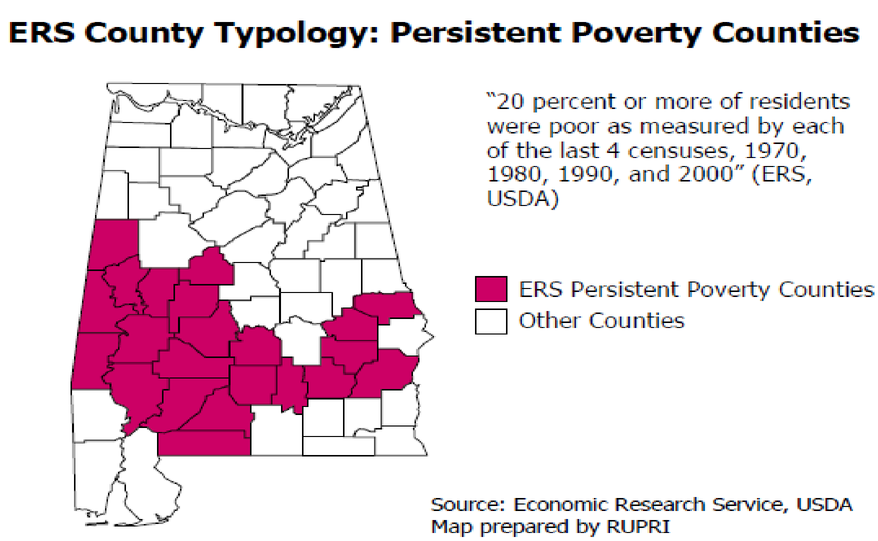


Figure 2.2:



Alabama is the tenth poorest state in the nation and one of 20 states that have established a commission on poverty. The Alabama state legislature has formed the State Commission to study state-supported programs, policies and services and make recommendations on proposed legislation concerning poverty. Since the state government has expanded economic incentives to attract auto industry to create additional employment and generate personal income, large auto mobile firms and its input suppliers have located in several Alabama counties. The auto industry in Alabama accounted for 47,457 direct jobs and 85,700 indirect jobs through their purchases and expenditures with annual payroll of $5.2 billion by 2007 (AAMA 2008). Jobs in 40 of the state's 67 counties now are tied directly or indirectly to auto manufacturing (AAMA 2008). Private investments and government expenditures are sources of both employment and income. In addition to the socio, economic, demographic and other factors, these two sources substantially contribute to the family poverty rate on county level.

2. Literature Review

There are several studies on the determinants of poverty in urban and rural areas. Most of these studies model poverty rates or changes in poverty rates as functions of demographic characteristics and local economic conditions, using county-level data. Gibbs (1994) and Davis and Weber (2002) argue that rural labor markets are thinner with poorer employer-employee matches than their urban counterparts, Fisher (2005; 2007) shows that while part of the higher rate of poverty in rural areas is attributable to poor economic opportunities in rural areas and self-selection of poor people locating into rural areas. Some studies have examined spatial externalities in poverty research. Rupasingha and Goetz (2000) have developed a spatial econometric model and found that changes in poverty are affected by the poverty of neighboring counties.

Several researchers have investigated the effects of changes in economic, social, political, and demographic conditions on the poverty rate. Levernier, Partridge, and Rickman (2000) in their study found that economic development targeting African-American communities and non-MSA counties would be most effective in reducing poverty. Triest (1997) concluded that increased employment and educational opportunity of the low-income population would narrow the interregional gap in poverty. Rupasingha and Goetz (2007) suggested that public investment in social capital can reduce poverty rates by easing transaction costs paid by local associations.

Fan, Linxiu, and Xiaobo (2002) concluded that government expenditures on rural education and infrastructure reduced the rural poverty rate. Jung and Thorbecke (2003) found that increased expenditure on education can contribute to economic growth and poverty alleviation by supplying more educated and skilled labor. Education is another key for reducing poverty rates for the counties with minorities (Swail, Redd, and Perna 2003). But, Gomanee et al. (2005) found that public spending on social services was ineffective in reducing poverty and suggested that new techniques should be developed to improve the efficiency of public spending. Industry composition also can affect the poverty rate. Levernier, Partridge, and Rickman (2000) found that counties with above-average shares of employment in agriculture, trade, and services have higher poverty rates.

The purpose of the research is to determine the effects of the auto industry and local government expenditure on the poverty of Alabama's counties. This research improves on existing research in many ways. First, we include the initial level of poverty rate, which allow us to test whether the equation converges with the respective to dependent variable. Second, we are able to estimate the differential impact of auto production on proportional change in the poverty rate in the distressed black belt counties by introducing an interaction term of auto production and these counties. Third, we incorporate spatial components to capture the role of poverty rate of neighboring counties. Finally, we include the initial level of employment, per capita income, population, and other socio, economic, demographic and policy variables to control their effect on the dependent variable. Since these variables are 10 years lagged, the endogenous problem from these variables can be avoided. The analysis will be based on county data for the study period 1970 – 2000. A major goal is to determine whether poverty rate in the distressed counties in the state's Black Belt are reduced from the auto boom.

3. Model

This model developed using the idea that private investments are important sources for generating employment and income. In addition to the socio, economic, demographic and other factors, private investments can substantially influence the poverty rate on a county level. Poverty rate, in county level are influenced by the socio, economic, demographic and policy variables and spatial components of poverty rate of neighboring counties.

4. Data and Sources

Data for sixty seven counties in Alabama are drawn from several sources (Table 2.1). These data were collected for the study period for the years 1970 to 2000. The growth of poverty rate was constructed using 10 years interval between the beginning and end period, like 1970-1980, 1980-1990 and 1990-2000. Independent variables include demographic, human capital, labor market, automobile production, interaction term of automobile production and distressed Black Belt county and policy variables. The initial values of the independent variables are lagged 10 years. But automobile production variable is lagged 2 years in this equation.   This formulation reduces the problem of endogeneity. The variable, automobile production ($\boldsymbol{lnA_{t-i}}$), was constructed as ***ln*** (automobile production/ distance). All independent variables are in log form except those that can take negative or zero values. Per capita income, per capita local government expenditure and per capita local tax were deflated using consumer price index (CPI). The descriptive statistics of the variables are given in Table 2.2.

5. Estimation Issues

A panel model is estimated using 201 observations. This panel model contains three time periods for 67 Alabama counties. This panel model was used to control unobserved heterogenity and to investigate inter-temporal changes. Since the panel data provide more information and variables, the degree of freedom and efficiency increases and multicollinearity is less likely to occur.

Many studies suggest that geographical location and location parameters significantly affect productivity, inequality and growth (Quah 1996, Redding and Venables 2002, Rupasingha et al. 2002, Rupasingha and Goetz 2007). The presence of spatial dependence can result in misleading results from employing models using OLS (LeSage 1999). Poverty in a given county may have spillover effects to the neighboring county. Then, the errors are dependent. In this study, three alternative spatial specification models and a model without spatial component were estimated. The three alternative spatial specification models are Spatial Lag model, Spatial Error Model (SEM) and Spatial Autoregressive model (SAR). Spatial Lag model was estimated by Maximum Likelihood Estimation method. Spatial Error Model and Spatial Autoregressive Model were estimated by a Method of Moments Approach. The Spatial Lag model accounts for the spatial dependence in the dependent variable and SEM incorporates spatial dependence in the error term. The SAR model accounts for both spatial dependence in the dependent variable and error term.

The Spatial Lag model takes the following form:

$$y_i = \rho W y_i + X_i \beta + \varepsilon_i \qquad (1)$$

$$\varepsilon_i \sim N(0, \sigma^2)$$

Y is the dependent variable and X is a vector containing all the independent variables and ε is a normally distributed error term. ρ is autoregressive coefficient and W is the weighting matrix that was constructed on the queen based adjacency criteria. This weight matrix controls only spatial spillover effect of neighboring counties.

Spatial dependence could also arise if a shock to an omitted variable in the model affects the dependent variable. The SEM takes the following:

$$y = X\beta + u \qquad (2)$$

$$u = \delta W u + \varepsilon \qquad (3)$$

$$\varepsilon_i \sim N(0, \sigma^2)$$

Where δ is the scalar spatial error coefficient. The spatial Autoregressive Model incorporates spatial dependence in both the dependent variable and shocks to omitted variables in the model. It takes the following form:

$$y = \rho W y + X\beta + u \qquad (4)$$

$$u = \delta W u + \varepsilon \qquad (5)$$

$$\varepsilon_i \sim N(0, \sigma^2)$$

6. Results and Discussion

The parameter estimates of the four regression models and long run elasticity were given in Table 2.3 and Table 2.4 respectively. In general, the results are consistent with theoretical expectations and previous studies. The results of Moran I statistics and spatial dependence models indicate that there is no spatial dependence in dependent variable and in error terms. The significant coefficient of initial level of poverty rate (0.169) implies that there is conditional convergence with respect to the poverty rate. It also indicate that, other thing being equal, a county which had higher initial level of poverty rate will have higher poverty rate than a county which had lower initial poverty rate.

6.1 Poverty Rate Equation

In the equation of poverty rate, the coefficient of automobile production (-.0326), and the interaction term of automobile production and distressed black belt county (-0.026) are negative and significant at the 5% level. The long run elasticity of automobile production (-.039), and the interaction term of automobile production and distressed Black Belt county (0.031) suggest that if automobile production in a given plant can increase by 10%, the poverty rate of a county where the plant locates will decrease by 0.39% but if a county is a distressed Black Belt County, the poverty rate will decrease by 0.7%. The poverty rate of other counties decreases but this decrease in poverty declines with distance from a county where the plant locates. This result shows that automobile production in Alabama significantly reduced the poverty of the distressed Black Belt counties, compare to other counties.

The coefficient of female household head (0.29) suggests that the poverty rate in a given county is positively associated with the percentage of female headed households. The long run elasticity of female household head (0.35) indicates that a 10% increase in the percentage of female household heads in a given country is associated with 3.5% increase in the poverty rate in the given county. This positive sign is consistent with previous studies. Poverty rates are also higher for female-headed families, among most minority groups and among families with larger numbers of children (Farmer et al., 1989, Levernier et al., 2000). The results show that unemployment is positively related to the poverty rate. The long run elasticity of unemployment rate (0.116) suggests that a10 % increase in unemployment rate of a given county will raise the poverty rate of the county by 1.6%.

In this study period, the coefficient of per capita local government expenditure is insignificant. It indicates that the local government expenditure is ineffective in reducing the poverty rate of the given county. Gomanee et al. (2005) also found that public spending on social services was not effective in reducing poverty and highlighted the need for new techniques to improve the efficiency of public spending. The results show that the poverty rate is negatively associated with the initial level of per capita income. The long run elasticity of the initial level of per capita income (-1.28) implies that a 10 % increase in the initial level of per capita of income of a given county will reduce the poverty rate of the county by 12.8%.

7. Conclusions and Policy Implications

The empirical findings suggest that automobile production in Alabama significantly reduced the poverty rate in all counties. The impact of automobile production on poverty reduction in distressed Black Belt counties is greater than in other counties. Local government expenditures aimed at reducing poverty was found to be effective. This result suggests that industrial development may be more effective in reducing poverty than government programs.

Table 2.1: Variable Description and Data Sources

Variable	variable Description	unit	Source
POV	Poverty Rate, t	%	A, D
Auto	No. of automobile/distance, t- 2 years	Number/mile	A, G, H
Autoblack	Interaction of auto and Black Belt county		
Lpov	Poverty Rate, t- i	%	D
Lgexp	Per Capita Local Government Expenditure, t-i	$/person	D
Lpop	population, t-i	number	B
Lpcip	per capita income, t-i	$/person	B
Ltem	employment, t-i	number	B
Unemp	Unemployment Rate, t-i year	%	E
D17years	% of population below 17years, t-i	%	C, D
D65years	% of population above 65years, t-i	%	C, D
Hsch	% of high school degree or above,t-i	%	C, D
Fhh	% of Female household Head family, t-i	%	C, D
Tax	per capita local tax	$/person	D
Hway	road density, t-i	mile/square mile	F
Metro	dummy variable for metro area	Dummy value	
$(I \otimes W)POV$	Spatial Lag of Growth Rate of Poverty, t	%	A, D

A- Computed, B- US Department of Commerce, Bureau of Economic Analysis (REIS database), C- County & City Data Book, D- U.S Census Bureau, E- Bureau of Labor Statistics, F – US Bureau of Transportation Statistics, G- Map Quest, H - Mercedes-Benz U.S. International, Tuscaloosa, AL, Honda Manufacturing of Alabama, Lincoln, AL, Hyundai Motor Manufacturing Alabama, Montgomery, AL, Toyota Motor Manufacturing Alabama, Huntsville, AL, Automotive News Market Data Book

Table 2.2: Descriptive Statistics for Alabama Counties

Variable	variable Description	Mean	Std Dev
POV	Poverty Rate, t	19.93	10.697
Auto	No. of automobile/distance, t-2 years	566.4	4853
Autoblack	Interaction of auto and Black Belt county	62.25	280.5
Lpov	Poverty Rate, t- i	25.12	12.05
Lgexp	Per Capita Local Government Expenditure, t-i	1614	784.6
Lpop	population, t-i	56717	91682
Lpcip	per capita income, t-i	16476	4009
Ltem	employment, t-i	25899	50298
Unemp	Unemployment Rate, t-i year	9.6	5.22
D17years	% of population below 17years, t-i	31.52	4.78
D65years	% of population above 65years, t-i	12.36	2.59
Hsch	% of high school degree or above,t-i	47.93	12.92
Fhh	% of Female household Head family, t-i	18.18	7.23
Tax	per capita local tax	292.61	131.09
Hway	road density, t-i	0.126	.031
Metro	dummy variable for metro area	.179	.384
$(I \otimes W)POV$	Spatial Lag of Growth Rate of Poverty, t	- 13.9	11.1

i is 10 years

Table 2.3: The Estimation Results of Regression Models

Variable	OLS coeff.	OLS t	Spatial Lag coeff.	Spatial Lag t	SEM coeff.	SEM t	Spatial Autoregressive coeff.	Spatial Autoregressive t
const	10.16	4.54	10.29	4.47	9.59	4.29	9.71	4.22
auto	-0.0326	-2.79	-0.0322	-2.73	-0.0327	-2.85	-0.0324	-2.79
autoblack	-0.0259	-2.26	-0.0259	-2.25	-0.0267	-2.32	-0.0266	-2.31
unemp	0.0966	2.37	0.0975	2.38	0.1000	2.49	0.1006	2.48
d17years	0.0880	0.37	0.0827	0.35	0.1317	0.56	0.1256	0.53
d65years	0.1567	1.32	0.1545	1.29	0.1653	1.39	0.1634	1.36
hsch	0.1292	0.76	0.1253	0.73	0.1164	0.69	0.1136	0.67
fhh	0.2903	3.61	0.2907	3.6	0.2832	3.54	0.2837	3.54
tax	-0.0376	-0.52	-0.0360	-0.49	-0.0428	-0.6	-0.0414	-0.57
lpop	-0.0298	-0.3	-0.0298	-0.3	-0.0276	-0.28	-0.0277	-0.28
lpci	-1.0738	-4.77	-1.0793	-4.76	-1.0297	-4.61	-1.0354	-4.6
ltem	0.0623	0.68	0.0628	0.69	0.0624	0.69	0.0628	0.69
lgex	0.0505	0.81	0.0502	0.81	0.0561	0.92	0.0556	0.9
lpov	0.1642	2.01	0.1638	2	0.1677	2.07	0.1674	2.06
hway	-0.0231	-0.35	-0.0245	-0.37	-0.0179	-0.28	-0.0191	-0.29
metro	-0.0121	-0.23	-0.0118	-0.22	-0.0169	-0.32	-0.0165	-0.31
$(I \otimes W)$povr			-0.0191	-0.25			-0.0144	-0.19
Rho					0.1165	0.62	0.1385	0.74
sigv					0.0390	4.83	0.0391	4.8
sig1					0.0436	3.25	0.0434	3.25
Adj R-squared	0.7521		0.7508		0.7565		0.7551	
N	201		201		201		201	

Table 2.4: Long Run Elasticities of Exogenous Variables

auto	-0.039
autoblack	-0.031
unemp	0.116
fhh	0.347
lpci	-1.285

CHAPTER 3

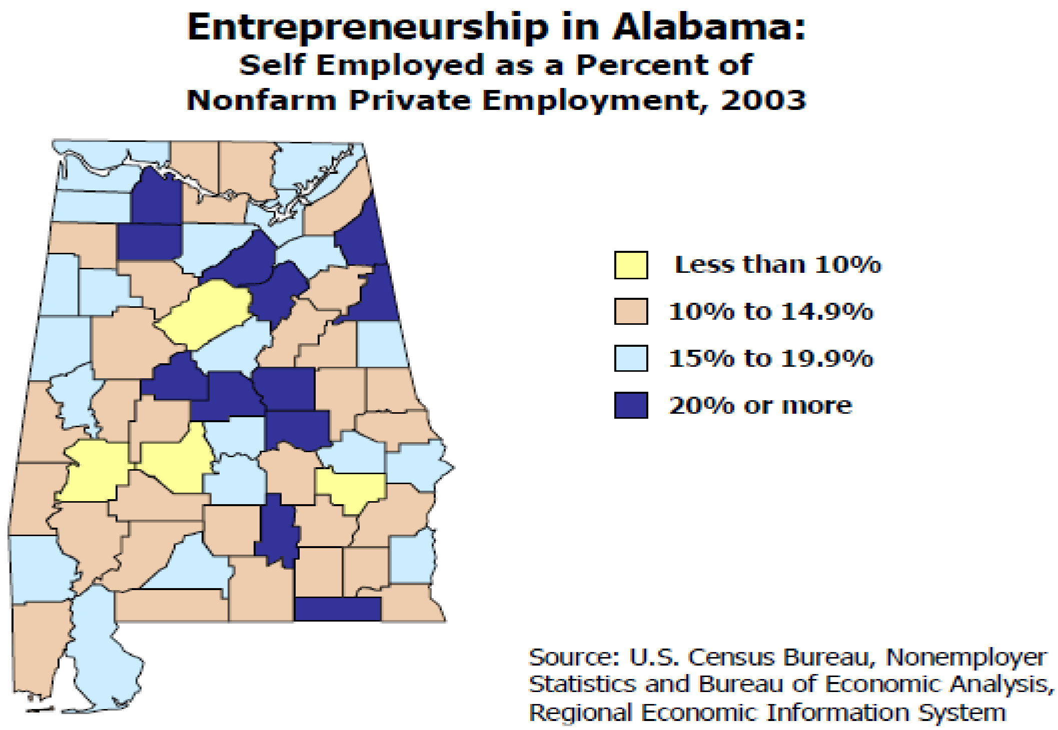
The Effect of Automobile Production on the Growth of Non-Farm Proprietor Densities in Alabama's Counties

1. Introduction

Entrepreneurship is a key catalyst for economic growth and regional development. State and local policymakers are allocating considerable resources to promote entrepreneurship. In the United States, the number of full and part time non-farm self employed, or proprietors, grew by around 300% or from 9.6 million in 1969 to 29.2 million in 2004. In comparison, the number of full and part time wage and salary workers grew by only 77% or from 78.8 million in 1969 to 138.8 million workers in 2004. The ratio of self to wage and salary employment nearly doubled, from 0.12 to 0.21, over this period (Goetz and Rupasingha, 2009).

In 2006, nonfarm proprietor employment accounted for 18.8 percent of total nonfarm employment in United States. In Alabama, this percent was 17.8, and ranged from 10.4 percent to 43.3 percent. Microenterprise employment represented 17.7 percent of U.S nonfarm employment and 16.7 percent of Alabama nonfarm employment. Within Alabama, this ranged from 12.6 percent to 30.5 percent (RUPRI, 2007). Over the past two decades the focus of economic development policy has shifted more heavily toward entrepreneurship. This increased interest in the entrepreneur's role in the economy has led to a growing body of research attempting to identify the factors that promote entrepreneurship. Most applied economic research on entrepreneurship uses the number of nonfarm self-employed individuals as a share of the labor force as a measure of entrepreneurship.

Figure 3.1:



The greatest spillover benefit of automobile plants in Alabama is the movement of input suppliers and supporting services to Alabama counties. These firms cluster around automobile plants. Clusters are characterized by a focus on one particular industrial activity and the fact that many small firms specialize in different phases of the production process (OECD, 1996). Clusters enhance the competitiveness of established small businesses and thereby influencing the survival rate of these businesses. Clustering thus can have an impact on the level of entrepreneurship through both entry and exit. Automobile production in Alabama helped spur the formation of new businesses and increased the growth of existing firms.

This paper studies the impact of automobile production on the ratio of non farm proprietorships to all full and part time workers. This study also examines how county level economic, social variables and county level spillover effects influence rates of non-farm proprietorships density. In this study, non-farm proprietorships density and per capita income are considered to be interdependent.

2. Literature Review

Entrepreneurship is important because the competitive behavior of entrepreneurs drives the market process and leads to economic progress (Kirzner 1973). From society's perspective, the profits earned by entrepreneurs represent gains to society as a whole. Entrepreneurs deal with uncertainty about the future, not with risk. Probabilities can be estimated for risky activities and thus are insurable. Since entrepreneurs are dealing with uncertainty about the profitability of their new combinations of resources, entrepreneurs cannot insure against the probability that new goods and services will not be liked. Entrepreneurs bear the burden of the uncertainty associated with the market process (Cantillon et al.1921). Berkowitz and DeJong (2005) find a strong relationship between economic growth and the rate of entrepreneurial activity within a country over the years. Kreft and Sobel (2005) find the same relationship across U.S. states. Henderson (2002) finds it to hold at the local level within the United States.

Most studies of entrepreneurship examine the factors that influence an individual‘s choice between wage employment or self employment. One factor that influences an individual's decision to become an entrepreneur is the availability of funding. Homeownership and housing values significantly improve prospective entrepreneur's ability to borrow capital to initiate new business because homes can be used a major source of loan collateral (Robson

1998a,b). The amount of dollars deposited per capita in local bank can be used as a proxy for availability of capital even though proprietors have access to national credit markets to borrow capital, (Malecki ,1994).

Countries that experience rapid population and work force growth have a growing share of self-employed people in the work force, whereas countries experiencing low population growth have a diminishing share of entrepreneurs in the labor force (ILO, 1990). Population growth may lower wages through increasing the labor supply. However, population growth will also create a future increase in the demand for goods and services. Expectations of potential entrepreneurs of future entrepreneurial opportunities are likely to stimulate start-ups (Reynolds, Hay and Camp, 1999).

High population density in urban areas may be an important reason for the existence of small businesses in urban areas and the startup of new businesses (Reynolds et al., 1994 and Storey, 1994). The age structure of the population may have direct and indirect impact on the level of entrepreneurship. Evans and Leighton (1989a) found that many entrepreneurs start a business in their mid-thirties and that the average age of an entrepreneur is over 40 years.

Goetz and Freshwater (2001) in their study conclude that Individuals with more education are more likely to become entrepreneurs. Bates (1993) found that educated and skilled potential entrepreneurs are highly sensitive to the opportunity costs of self employment because they need to sacrifice high wage positions as employees. Self employment rates increase with age, because of greater experience levels and potential age discrimination in the labor market (Evans and Leghton 1989b).

Several studies have examined the relationship between ethnic diversity and economic development. Alesina and La Ferrara (2000) find that involvement in associational activities is significantly lower in ethnically fragmented localities. Rupasingha et al. (2006) in their study on social capital found that ethnically fragmented societies have less social capital. Social interaction among local entrepreneurs is important for sustaining and enhancing local entrepreneurship. Greater diversity may lead to diversified consumer demand patterns leading to specialization among firms and niche markets. Females are less likely than males to be self employed. Parker (1996) found that the proportion of time allocated by an individual to self-employment is inversely related to the riskiness of returns to self-employment and the degree of risk aversion.

Per capita income also reflects aggregate demand in an economy (Robson 1998b). Large aggregate demand in a given county attracts big firms to migrate in or gives incentives to expand the existing firms. This may also work to deter small business firms from expanding and new small entrepreneur from starting. The impact of economic growth on the level of entrepreneurship is however ambiguous. It appears that economic growth can either have a positive or a negative impact on the level of entrepreneurship, depending on the stage of economic development.

Various studies found that economic development is associated with a decrease in the self-employment rate (Kuznetz, 1966; Schultz, 1990; Bregger, 1996). Several arguments have been given to support the theory of negative impact of economic growth on the level of self-employment (Carree, Van Stel, Thurik and Wennekers, 2002). Economic development is accompanied by an increase in wage levels. Higher real wages increase the opportunity costs of self-employment and this makes wage employment more attractive (EIM/ENSR, 1996).

Marginal entrepreneurs may be induced to become employees (Lucas, 1978). At the macro level a high rate of unemployment can negatively impact the level of entrepreneurship because of the decline in the availability of business opportunities induced by a depressed economy. Moreover, the failure rate of established businesses rises because of low revenues (EIM/ENSR, 1996).

The impact of taxes on the level of entrepreneurship is complex and inconsistent. In OECD (1998) it is argued that high tax rates reduce the returns on entrepreneurship and can deter the start-up of new firms and expansion of established firms. On the other hand, it has been hypothesized that self-employment offers better opportunities to avoid tax liabilities than wage-employment (Parker, 1996). Amenities and rural/urban status of a county may also affect the density of proprietorship in a given county. Employment shares by industry influence proprietorship growth in a given county (Malecki 1994; Armington and Acs 2002).

3. Model

In this study, non-farm proprietorships density and per capita income are considered to be simultaneously related to each other. Non-farm proprietor densities in a given county are influenced by returns from self-employment and wage employment and self-employment risk, socio, economic, demographic, regional, and government policy variables and spatial components of non-farm proprietor densities and per capita income of neighboring counties. County-level aggregates are used as a proxy for the characteristics of the pool of individuals from which entrepreneurs potentially emerge, and the local market conditions facing the self-employed. The basic specification of the model is a simultaneous-equation system of the form:

$$PRO_t^* = f_1 \ [(PCI_t^*, (I \otimes W) \ PCI_t^*), \ (I \otimes W) PRO_t^*, \ A_{t-i}, \ BA_{t-i}, | X_{t-i}^{pro}] \qquad (1)$$

$$PCI_t^* = f_2 \ [(PRO_t^*, (I \otimes W) \ PRO_t^*), \ (I \otimes W) PCI_t^*, \ A_{t-i}, \ BA_{t-i}, | X_{t-i}^{pci}] \qquad (2)$$

The equilibrium levels of proprietorship density and per capita income are assumed to be functions of the equilibrium values of the endogenous variable included in right hand side of equation and their spatial lags, automobile production and the vectors of the additional exogenous variables. Where, PRO_t^* and PCI_t^* are vectors of dimension NT x 1 of the equilibrium levels of proprietorship density and per capita income respectively; t denotes time. **I** is an identity matrix of dimension T and, W is a row standardized N x N spatial weights matrix with zero diagonal values. Each element of this spatial weights matrix, w_{ij} , represents a measure of proximity between observation i and observation j. Based on the queen based adjacency criteria, w_{ij} is equal to $1/k_i$, where k_i is the numbers of nonzero elements in row i, if i and j are adjacent, and zero otherwise. Therefore, $(I \otimes W) \ PRO_t^*$ and $(I \otimes W) PCI_t^*$ stands for the equilibrium values of neighboring counties' effect. A_{t-i} is vector of dimension NT x 1 of automobile production. BA_{t-i} is the interaction term of the distressed black belt county and automobile production. The matrices of additional exogenous variables that are included in the proprietorship density and per capita income equations are given by X_{t-i}^{pro} and X_{t-i}^{pci} respectively. Where *i* is 7 years in both equations. These additional exogenous variables are included in the equations to control their effects on the dependent variables. This controlling makes estimates on the relationship between the variables we are interested in more precise. A multiplicative functional form was used for the equations in this system. A lagged adjustment is introduced into our model. This partial-adjustment process replaced unobservable equilibrium which allowed the model to take the general form as follows:

$$PROR_t = \propto_1 + \beta_{11} PCIR_t + \lambda_{11}\left((I \otimes W) PROR_t\right) + \lambda_{12}(I \otimes W) PCIR_t$$

$$+ \delta_1 lnA^{pro}_{t-i} + \theta_1 BA^{pro}_{t-i} + \sum_{k=1}^{K_1} \gamma_{1k} \ln\left(X^{pro}_{t-i,k}\right) - \eta_{11} \ln(PRO_{t-i})$$

$$- \eta_{12} \ln(PCI_{t-i}) + u_{t,1} \qquad (3)$$

$$PCIR_t = \propto_2 + \beta_{21} PROR_t + \lambda_{21}\left((I \otimes W) PROR_t\right) + \lambda_{22}(I \otimes W) PCIR_t$$

$$+ \delta_2 lnA^{pci}_{t-i} + \theta_2 BA^{pci}_{t-i} + \sum_{k=1}^{K_1} \gamma_{2k} \ln\left(X^{pci}_{t-i,k}\right) - \eta_{21} \ln(PRO_{t-i})$$

$$- \eta_{22} \ln(PCI_{t-i}) + u_{t,2} \qquad (4)$$

Where $\propto_r$, β_{rq} , λ_{rl}, δ_r , θ_r , γ_{rk} , η_{rl} for k=1,….,K_r ; r, l = 1,2; and q= 1,2 are the parameter estimates of the model and K_r is the number of exogenous variables in the respective equations. $PROR_t$ and $PCIR_t$ represent the log differences between the end and beginning period values of proprietorship density and per capita income respectively. Then, they represent the growth rates of the respective variables. The variable, automobile production (***lnA_{t-i}***), was constructed as ***ln*** (automobile production/ distance). The subscript t-i denotes to the variable lagged 7 years for study period 1970-2007 and η_r for r =1,2 are the speed of adjustment coefficients, the rate at which proprietorship density and per capita income adjust to their respective steady state equilibrium levels. $\mathbf{u}_{t,r}$ for r=1,2 are NT x 1 vectors of disturbances. A Moran's I test statistic suggested that there is the existence of spatial autocorrelation in the errors. The test results are given in Table 3. Therefore, the disturbance vector in the r^{th} equation is generated as:

$$\boldsymbol{u}_{t,r} = \rho_r \left(\boldsymbol{I}_T \otimes \boldsymbol{W}\right) \boldsymbol{u}_{t,r} + \boldsymbol{\varepsilon}_{t,r}, \quad r = 1,2 \qquad (5)$$

This specification relates the disturbance vector in the rth equation to its own spatial lag. A one-way error component structure was utilized to allow the innovations ($\boldsymbol{\varepsilon}_{t,r}$) to be correlated over time, following Baltagi (1995). Therefore, the innovation in the rth equation is given by

$$\boldsymbol{\varepsilon}_{t,r} = \boldsymbol{Z}_{\mu}\, \boldsymbol{\mu}_r + \boldsymbol{\omega}_{t,r}\ ,\ r = 1,2 \qquad (6)$$

Where $\boldsymbol{Z}_{\mu} = (\, I_N \otimes \iota_T),\ \mu_r^{'} = (\, \mu_{1r}, \mu_{2r}, .., \mu_{Nr}),\ \omega_{t,r}^{'} = (\omega_{11r}, \omega_{12r}, \dots, \omega_{1Tr}, \dots, \omega_{N1r}, .., \omega_{NTr})$

I_T and I_N are identity matrices of dimension T and N, respectively, ι_T is a vector of ones of dimension T, and $\otimes$ denotes the Kronecker product. $\boldsymbol{\mu}_r$ and $\boldsymbol{\omega}_{t,r}$ are random vectors with zero means and covariance matrix (suppressing the time index):

$$E\begin{pmatrix}\mu_r\\ \omega_r\end{pmatrix}(\, \mu_r^{'}\ \omega_r^{'}) = \begin{bmatrix}\sigma_{\mu rr}^{2}\ I_N & 0\\ 0 & \sigma_{\omega rr}^{2}\ I_{NT}\end{bmatrix} \qquad (7)$$

Where, $\boldsymbol{\mu}_r$ denotes the vector of unit specific error components and $\boldsymbol{\omega}_r$ contains the error components that vary over both the cross- sectional units and time periods. The innovations $\boldsymbol{\varepsilon}_{t,r}$ are not spatially correlated across units but they are auto-correlated over time. However, this specification allows innovations from the same cross sectional unit to be correlated across equations. Therefore, the vectors of disturbances are spatially correlated across units and across equations as given in (8) as was used by Kapoor, Kelejian, and Prucha (2007); Baltagi, Song, and Koh (2003)).

$$\boldsymbol{u}_{t,r} = \rho_r\, (\boldsymbol{I}_T \otimes \boldsymbol{W})\, \boldsymbol{u}_{t,r} + (\, \boldsymbol{I}_N \otimes \boldsymbol{\iota}_T)\boldsymbol{\mu}_r + \boldsymbol{\omega}_{t,r}\ ,\ r = 1,2 \qquad (8)$$

The intercepts ($\propto_r$ for $r = 1,2$) in equations (9) –(10) represent the combined influences of changes in the suppressed exogenous variables; the β_r for r = 1,2 coefficients are structural elasticities corresponding to the endogenous variables; and the δ_r for r = 1 coefficients are structural elasticities corresponding to automobile production. We add the interaction terms to test whether the automobile production boom differentially affected the growth rate of proprietorship density in the distressed Black Belt counties. We incorporate spatial components to capture the role of proprietorship density and per capita income of neighboring counties

3.1 Reduced Form Estimates and Long run Elasticity

The reduced form equations are obtained by solving structural equations derived from Generalized Spatial Three Stage Least Square (GS3SLS) model. A spatial autoregressive model, in the context of single equation and in panel data setting, is expressed as:

$$y = \lambda W y + X\gamma + u \qquad (9)$$

$$u = \rho W u + \varepsilon \qquad (10)$$

Where **y** is an NT x 1 vector of observations on the dependent variable. **Wy** is the corresponding spatial lagged dependent variable for weights matrix **W**, X is NT X K matrix of observations on the explanatory variables, u is an NT X 1 vector of error terms. λ is the spatial autoregressive parameter and γ is a K X 1 vector of regression coefficients. ρ is the spatial autoregressive coefficient for the error lag Wu and ε is NT x 1 vector of innovations or white noise error. This single spatial autoregressive model can be extended to a system of spatially interrelated equations. A standard G system of equations can be written as:

$$\boldsymbol{Y} = \boldsymbol{YB} + \boldsymbol{X\Gamma} + \boldsymbol{WY\Lambda} + \boldsymbol{U} \qquad (11)$$

$$\boldsymbol{U} = \boldsymbol{WUC} + \boldsymbol{E} \qquad (12)$$

Y = $\mathbf{y}_1$, ……, $\mathbf{y}_G$ **X = $\mathbf{x}_1$,…….., $\mathbf{x}_G$** **U = $\mathbf{u}_1$,……., $\mathbf{u}_G$**

WU = $\mathbf{Wu}_1$,….., $\mathbf{Wu}_G$ $\boldsymbol{C} = \boldsymbol{diag}_{r=1}^{G}\boldsymbol{\rho_j}$ $\boldsymbol{E} = \boldsymbol{\varepsilon_1}, \dots \dots, \boldsymbol{\varepsilon_G}$

Where $\mathbf{y}_r$ is the NT x 1 vector of observations on the dependent variable in r^{th} equation **,** $\mathbf{x}_k$ is the NT x 1 vector of observations on the k^{th} exogenous variable, $\mathbf{u}_r$ is the NTx1 vector of error terms in the r^{th} equation, and **B** and **Γ** are parameter matrices of dimension G x G and K x G respectively. **B** is a diagonal matrix. **W** is N x N weights matrix of known constants and **Λ** is G x G matrix of parameters. $\mathbf{Wy}_r$ and $\mathbf{Wu}_r$ are spatial lag and spatial autoregressive error term in the rth equation respectively. The solution for the endogenous variable can be revealed through the vector transformation:

$$vec\ Y = vec\ YB + vec\ X\Gamma + vec\ WYA + vec\ U$$

$$vec\ Y = vec\ YB + vec\ X\Gamma + vec\ WYA + vec\ UWC + E$$

$$vec\ Y = B' \otimes I\ vec\ Y + \Gamma' \otimes I\ vec\ X + \Lambda' \otimes Wy + C' \otimes W vecU + vecE$$

Letting **y** = vec Y , **x** = vec X, **u**= vec U and $\boldsymbol{\varepsilon} = vec\ E$

$$\boldsymbol{y} = \boldsymbol{B}' \otimes \boldsymbol{Iy} + \boldsymbol{\Gamma}' \otimes \boldsymbol{Ix} + \boldsymbol{\Lambda}' \otimes \boldsymbol{Wy} + \boldsymbol{C}' \otimes \boldsymbol{Wu} + \boldsymbol{\varepsilon}$$

or

$$\boldsymbol{y} = \boldsymbol{B}' \otimes \boldsymbol{Iy} + \boldsymbol{\Gamma}' \otimes \boldsymbol{Ix} + \boldsymbol{\Lambda}' \otimes \boldsymbol{Wy} + \boldsymbol{u}$$

$$\boldsymbol{u} = \boldsymbol{C}' \otimes \boldsymbol{Wu} + \boldsymbol{\varepsilon}$$

or

$$\boldsymbol{y} = [\boldsymbol{B}' \otimes \boldsymbol{I} + \Lambda' \otimes W]\boldsymbol{y} + \boldsymbol{\Gamma}' \otimes \boldsymbol{Ix} + \boldsymbol{u}$$

$$\boldsymbol{u} = \boldsymbol{C}' \otimes \boldsymbol{Wu} + \boldsymbol{\varepsilon}$$

After all the spatial effects and the other endogenous variables effects are controlled, the relations between the dependent variables and the exogenous variables x can be expressed as:

$$y - [\boldsymbol{B}'\otimes\boldsymbol{I} + \Lambda'\otimes W]\boldsymbol{y} = \boldsymbol{\Gamma}'\otimes\boldsymbol{I}\boldsymbol{x} + \boldsymbol{u}$$

$$I - [\boldsymbol{B}'\otimes\boldsymbol{I} + \Lambda'\otimes W]\boldsymbol{y} = \boldsymbol{\Gamma}'\otimes\boldsymbol{I}\boldsymbol{x} + \boldsymbol{u}$$

$$\boldsymbol{u} = \boldsymbol{C}'\otimes\boldsymbol{W}\boldsymbol{u} + \boldsymbol{\varepsilon}$$

The reduced form can be written as:

$$y = I_{nG} - [\boldsymbol{B}'\otimes\boldsymbol{I} + \Lambda'\otimes W]^{-1}(\boldsymbol{\Gamma}'\otimes\boldsymbol{I}\boldsymbol{x} + \mathbf{u}) \tag{13}$$

$$\boldsymbol{u} = (\boldsymbol{I}_{nG} - \boldsymbol{C}'\otimes\boldsymbol{W})^{-1}\boldsymbol{\varepsilon} \tag{14}$$

The system of spatial structural equations was solved to obtain a system of reduced form equations. Since spatial weight matrix was constructed on the queen based adjacency criteria, this system of spatial equations control spatial spillover effects of neighboring counties (Nzaku and Bukenya, 2005; Trendle, 2009; Gebremariam,2010). Reduced coefficients of significant variables in the structural equations were estimated for the counties where automobile plants locate and for its neighboring counties. The long run elasticity of automobile production and other exogenous variables in the per capita income and nonfarm proprietor density of these counties was calculated from these reduced form coefficients.

In this system of equations, the dependent variables are the change in per capita income and nonfarm proprietor density during the specific period. Exogenous variables are the initial value of those variables at the beginning of specific period. The dependent variables are constructed as the difference between the $\mathbf{lny}_t - \mathbf{lny}_{t-i}$. One of the exogenous variables in the right hand side of each equation is the predetermined lagged dependent variable ($\mathbf{lny}_{t-i}$). The long run elasticity of exogenous variable is calculated by dividing the coefficient of exogenous variable by negative value of the coefficient of the predetermined lagged dependent variable ($\mathbf{lny}_{t-i}$).

4. Data and Sources

Data for sixty seven counties in Alabama are drawn from several sources (Table 3.1). These data were collected for study periods which are from 1970 to 2007. In this study, the non-farm proprietorship density is constructed as the ratio of non farm proprietorship to total employment. The growth of non-farm proprietor density and per capita income are constructed using 7 years interval between the beginning and end period, like 1970-1977, 1980-1987, 1990-1997 and 2000-2007. Independent variables include demographic, human capital, labor market, automobile production, interaction term of automobile production and distressed black belt county and policy variables. The initial values of the independent variables are used as 7 year lagged values. This formulation reduces the problem of endogeneity. All independent variables are in log form except those that can take negative or zero values. The initial non-farm proprietorship density and per capita income are included in this model to control for the relative size of the existing proprietor base and per capita income in the county and to test for conditional convergence with their respective endogenous variable. The descriptive statistics of the variables are given in Table 3.2.

5. Estimation Issues

Panel models can be used to control unobserved heterogenity and to investigate inter-temporal changes. Since panel data provides more information and variables, the degree of freedom and efficiency increases and multicollinearity is less likely to occur. For this study, a panel model was estimated containing three time periods for 67 counties. A total of 268 observations are used in the panel model. Following Baltagi (1995), one way error component structure model was utilized for the panel data in this study.

This system of equations has econometric issues regarding feedback simultaneity, spatial autoregressive lag, and spatial cross-regressive lag simultaneity with spatially autoregressive disturbances. These simultaneities create problems in estimation and identification of each equation. The order condition for identification in a linear simultaneous equations model is that the number of dependent variables on the right hand side of an equation must be less than or equal to the number of predetermined variables in the model but not in the particular equation. Lagged dependent variables also can be considered as predetermined variables. Kelejian and Prucha considered that the spatially lagged dependent variables can be treated as predetermined (Kelejian and Prucha, 2004). The order condition for each equation of the system in (3) – (4) is fulfilled.

A Hausman test (1983) for over identification was done to investigate whether the additional instruments are valid in the sense that they are uncorrelated with the error term. That is $E(\mathbf{Q}'\mathbf{u}_r) = 0$, Where E is the expectation operator and **Q** is an instrument matrix that consist of a subset of linearly independent columns $\mathbf{X}, \mathbf{WX}, \mathbf{W}^2\mathbf{X}$, where **X** is the matrix that includes the control variables in the model. All equations are appropriately identified because the hypothesis of orthogonality for each equation cannot be rejected even at P= 0.05 as indicated by the NR_u^2 test statistic in Table 3.3.

When the spatial autoregressive lag and spatial cross-regressive lag simultaneities are present, the conventional three-stage least squares estimation to handle the feedback simultaneity would be inappropriate. Therefore, the Method of Moments approach was used rather than maximum likelihood because maximum likelihood would involve significant computational complexity. Generalized Spatial Three-Stage Least squares (GS3SLS) approach outlined by Kelejian and Prucha (2004) into a panel data setting was used to estimate the model. This new procedure is performed in a five-step routine as given in Appendix .

6. Results and Discussions

The parameter estimates of the system are given in Table 3.3. In general, the results are consistent with theoretical expectations and previous studies. In the model, the negative and significant coefficient of the lagged dependent variable in each equation indicates the conditional convergence with respect to the respective endogenous variable of each equation. The results show the existence of simultaneities between growth of proprietorship density and per capita income growth. This indicates that there is strong interdependence between growth of proprietorship density and per capita income growth. The signs of the coefficients are consistent with theoretical expectations. The reduced coefficient and long run elasticities of significant variables in the structural equations of the system were calculated and given in Table 3.4.

6.1 Proprietorship Density Growth Equation

In the equation for growth of proprietorship density, the per capita income growth is negatively and highly associated with the growth of proprietorship density. Several studies have found the negative impact of economic growth on the level of self-employment (Carree, Van Stel, Thurik and Wennekers, 2002). The structural coefficient of the variable automobile production is positive and significant at 5% level. The reduced coefficient and long run elasticity suggests that automobile production of a plant positively influences the proprietorship density of a county where a plant locates and on its neighboring counties. Long run elasticity of automobile production indicates that if automobile production of a given plant can increase by 10%, the proprietorship density of a county where the given plant locates will increase by 0.6 % and the proprietorship density of neighboring counties will increase by the range of 0.011% - 0.021%. The structural coefficient of the interaction term of automobile production and distressed Black Belt County is significant at 10% level there might be differential impact of automobile production on proprietorship density between distressed black counties and other counties. Long run elasticity of interaction term suggests that proprietorship density of distressed Black Belt Counties may rise by about 0.04 % for a 10% increase in automobile production.

The negative structural and reduced coefficients of unemployment rate equations indicate that the proprietorship density in a given county is negatively associated with unemployment rate. The long run elasticity of unemployment rate (-0.15) suggests that a 10 % increase in unemployment rate will decrease the proprietorship density by 0.15% in long run. This result is consistent with many research studies related to proprietorship density. The proprietorship density in a given county is positively associated with the percentage of high school degree and higher education. The long run elasticity of the percentage of high school degrees and above (0.924) indicates that a 10% increase in the percentage of the percentage of high school degrees and higher education in a given country is associated with 0.92% increase in the proprietorship density in the given county. But the long run elasticity of bachelor degrees of above (-0.437) implies that the proprietorship density in a given county is negatively associated with the percentage of bachelor degrees and above.

The coefficient of the spatial lag of endogenous variables is significant. This indicates the presence of spatial autoregressive lag effect in this study period. This means that the growth of proprietorship density in neighboring counties has positive spillover effects on the growth of proprietorship density in a given county. Global Moran's I statistic and ρ_1 indicate there is a spatial spillover effect with respect to the error terms in this study period. This indicates that random shocks originated in a given county will affect its neighbors.

6.2 Per Capita Income Growth Equation

The reduced coefficient and long run elasticity suggests that automobile production of a plant positively influences the per capita income of the county where a plant locates and of its neighboring counties. The long run elasticity of automobile production indicates that if automobile production of a given plant can increase by 10%, the per capita income of a county where the given plant locates will increase by 0.12 % and the per capita income of neighboring counties will increase by the range of 0.018% - 0.037%. The structural coefficient of the interaction term of automobile production and distressed Black Belt County is significant at 5% level. There is a differential impact of automobile production on per capita income in distressed Black Belt counties. The long run elasticity of a interaction term suggests that per capita income of a distressed Black Belt County may rise by about 0.03 % for a 10% increase in automobile production.

The reduced coefficient and long run elasticity of the percentage of employed labor in farming suggest that a large dependence on employment in farming negatively influences the per capita income of a county. The per capita income in a given county is negatively associated with the initial level of unemployment rate and per capita property tax and positively associated with initial level of percentage of high school degree or higher education. These results are consistent with previous research (Nzaku and Bukenya, 2005).

The results show the existence of spatial autoregressive lag effects and spatial cross-regressive lag effects with respect to endogenous variables. These results imply that the per capita income growth of a particular county is depend on the average growth of proprietorship density and per capita income of neighboring counties. This is important from policy perspectives because the per capita income depend not only on the characteristics of that county, but also on the characteristics of its neighbors. The disturbances from the equation indicate the existence of spatial dependencies in the error terms. This means that random shocks to the system affect not only a county where the shock originates and its neighbors, but also the entire study area.

7. Conclusions and Policy Implications

The empirical findings suggest that automobile production in Alabama significantly increases nonfarm proprietorship in all counties. A appropriate policies to lure industrial development are thus very important to increase self employment opportunities. There is significant spatial lag effects and spatial error effect between non-farm proprietor densities and per capita income. This interdependence provides the need of economic development policy coordination among the counties.

Table 3.1: Variable Description and Data Sources

Variable	variable Description	unit	Source
DPRO	Growth rate of non-farm proprietor density	%	A,B
DP	Growth rate of per capita income, t	%	A,B
lpci	per capita income, t-7	$/person	B
lpro	non-farm proprietor density,t-7	nonfarm proprietor/ employment	A,B
lpop	population, t-7	number	B
lemp	employment, t-7	number	B
unemp	unemployment rate, t-7 years	%	E
auto	No. of automobile/distance, t-7 years	number/mile	A,J,K
autoblack	Interaction of auto and Black Belt county		
d17years	% of population below 17years, t-7	%	C,D
d16years	% of population above 65years, t-7	%	C,D
hsch	% of high school degree or above,t-7	%	C,D
bach	% of bachelor degree or above,t-7	%	C,D
farm	% employed in farming, t-7	%	B
manu	%employed in manufacturing, t-7	%	B
serv	%employed in services, t-7	%	B
tax	per capita local tax, t-7	$/person	D
protax	per capita property tax, t-7	$/person	D
anfpin	average non-farm proprietor's income,t-7	$/person	B
awas	average wage and salary,t-7	$/person	B
popden	population density, t-7	number/square mile	A,B
nonwhite	% of nonwhite, t-7 years	%	D
owner	owner occupied housing in percent, t-7	%	D
dista	distance from metro area	mile	J
amenity	Natural Amenities Index, t-7	ERS index	H
hway	road density, t-7	mile/square mile	I
metro	dummy variable for metro area		
cv	coefficient of variation of anfpin, t-7		A,B
female	female labor participation,t-7	%	D
bdep	Bank deposits,t-7	$	D
mvh	median housing value,t-7	$	D
lpov	poverty rate, t-7	%	D
$(I \otimes W)$DPRO	spatial lag of DPRO	%	A,B
$(I \otimes W)$DPCI	spatial lag of DPCI	%	A,B

A- Computed, B- US Department of Commerce, Bureau of Economic Analysis (REIS database), C- County & City Data Book, D- U.S Census Bureau, E- Bureau of Labor Statistics, F- American Medical Association, G-Federal Bureau of Investigation, H- Economic Research Service, USDA, I – US Bureau of Transportation Statistics, J- Map Quest, K - Mercedes-Benz U.S. International, Tuscaloosa, AL, Honda Manufacturing of Alabama, Lincoln, AL, Hyundai Motor Manufacturing Alabama, Montgomery, AL, Toyota Motor Manufacturing Alabama, Huntsville, AL, Automotive News Market Data Book

Table 3.2: Descriptive Statistics for Alabama Counties, 1970-2007

Variable	Variable Description	Mean	Stdev
DPRO	Growth rate of non-farm proprietor density	1.07	0.16
DP	Growth rate of per capita income, t	1.14	0.10
lpci	per capita income, t-7	18225.76	4978.40
lpro	non-farm proprietor density,t-7	0.20	0.06
lpop	population, t-7	59149.84	93442.84
lemp	employment, t-7	28441.48	55516.72
unemp	unemployment rate, t-7 years	8.80	4.93
auto	No. of automobile/distance, t-7 years	494.70	4892.61
autoblack	Interaction of auto and Black Belt county	55.24	283.85
d17years	% of population below 17years, t-7	30.03	4.99
d16years	% of population above 65years, t-7	12.74	2.53
hsch	% of high school degree or above,t-7	53.37	14.97
bach	% of bachelor degree or above,t-7	9.95	5.61
farm	% employed in farming, t-7	9.03	6.69
manu	%employed in manufacturing, t-7	25.40	10.42
serv	%employed in services, t-7	16.98	5.87
tax	per capita local tax, t-7	208.02	181.56
protax	per capita property tax, t-7	81.21	80.50
anfpin	average non-farm proprietor's income,t-7	11312.53	4988.92
awas	average wage and salary,t-7	14314.31	8104.24
popden	population density, t-7	71.93	86.59
nonwhite	% of nonwhite, t-7 years	29.14	20.97
owner	owner occupied housing in percent, t-7	72.97	7.10
dista	distance from metro area	34.72	25.18
amenity	Natural Amenities Index, t-7	1.87	1.79
hway	road density, t-7	0.13	0.03
metro	dummy variable for metro area	1.31	0.66
cv	coefficient of variation	0.16	0.09
female	female labor participation,t-7	42.30	4.38
bdep	Bank deposits,t-7	594538.77	1382885.90
mvh	median housing value,t-7	66720.39	20393.22
pov	poverty rate, t-7	23.09	10.33
$(I\otimes W)$DPRO	spatial lag of DPRO	1.05	0.07
$(I\otimes W)$DPCI	spatial lag of DPCI	1.12	0.04

Table 3.3. Structural Coefficients

Variable	DPCI Equation Coeff.	DPCI Equation z-stat	DPRO Equation Coeff.	DPRO Equation z-test
DPCI			-0.698	-4.02
DPRO	-0.221	-4.7		
lpci	-0.247	-4.42	-0.142	-1.26
lpop	0.027	0.74	0.075	0.95
ltem	-0.024	-0.82	-0.070	-1.03
lpro			-0.174	-3.53
auto	0.006	2.46	0.014	3.04
autoblack	0.008	2.56	0.009	1.6
unemp	-0.062	-5.83	-0.069	-3.17
hsch	0.121	2.25	0.244	2.1
bach	-0.019	-0.93	-0.089	-2.22
farm	-0.025	-2.42	-0.013	-0.6
manu	0.000	0.01	-0.029	-1.35
service	-0.019	-0.89	-0.025	-0.64
anfpin	-0.026	-1.34	0.034	0.98
popden	-0.018	-0.89	-0.021	-0.54
nonwhite	-0.003	-0.43	-0.018	-1.14
tax	0.067	3.6	0.027	0.73
protax	-0.037	-2.93	-0.033	-1.28
d17years	0.041	0.62	0.151	1.21
d65years	0.005	0.14	-0.004	-0.05
dista	-0.009	-0.86	-0.027	-1.47
amenity	-0.004	-0.84	0.001	0.14
hway	0.020	1.15	0.030	0.94
metro	-0.015	-0.41	-0.083	-1.3
pov	0.004	0.22		
awas			8.780	1.63
owner			-0.078	-0.62
cv			-0.004	-0.23
female			0.056	0.43
bdep			-0.021	-0.88
mvh			-0.041	-0.54
$(I \otimes W)$ DPCI	0.336	3.51	0.254	1.38
$(I \otimes W)$ DPRO	0.147	2.41	0.493	4.54
const	2.252	4.03	0.292	0.22
Rho	-0.249	-3.26[b]	-0.338	-2.89[b]
sigv	0.003	17.58[b]	0.010	9.68[b]
sig1	0.003	10.16[b]	0.010	5.66[b]
NR^2 – $X^2(50,45)$	47.2	0.59[c]	40.3	0.67[c]
Moran I	0.144	0.03	0.150	0.02
N	268		268	

b: t- static value, c: p - value

Table 3.4: Reduced Coefficients, Long Run Elasticities and 10% Impact of Automobile Production

County	Reduced Coefficient		Long Run Elasticity		10% impact	
	ΔPCI	ΔPRO	PCI	PRO	PCI	PRO
Toyota						
Jackson	0.0015	0.0007	0.0058	0.0034	0.0365	0.0213
Limestone	0.0012	0.0006	0.0044	0.0027	0.0302	0.0185
Madison	0.0032	0.0126	0.0121	0.0593	0.1208	0.5928
Marshall	0.0007	0.0004	0.0027	0.0021	0.0175	0.0133
Morgan	0.0010	0.0005	0.0037	0.0026	0.0235	0.0164
Hyundai						
Autauga	0.0010	0.0005	0.0036	0.0024	0.0265	0.0177
Bullock	0.0015	0.0013	0.0055	0.0063	0.0345	0.0391
Crenshaw	0.0008	0.0004	0.0030	0.0020	0.0182	0.0123
Elmore	0.0008	0.0004	0.0031	0.0021	0.0214	0.0146
Lowndes	0.0012	0.0011	0.0046	0.0053	0.0317	0.0359
Macon	0.0012	0.0012	0.0047	0.0053	0.0293	0.0332
Montgomery	0.0031	0.0125	0.0120	0.0592	0.1200	0.5923
Pike	0.0008	0.0004	0.0031	0.0021	0.0187	0.0129
Honda						
Calhoun	0.0010	0.0005	0.0037	0.0025	0.0251	0.0173
Clay	0.0010	0.0005	0.0037	0.0025	0.0251	0.0173
Cleburne	0.0010	0.0006	0.0037	0.0026	0.0240	0.0168
Coosa	0.0008	0.0004	0.0031	0.0021	0.0192	0.0132
St. Clair	0.0008	0.0004	0.0031	0.0021	0.0195	0.0134
Shelby	0.0008	0.0004	0.0030	0.0020	0.0192	0.0129
Talladega	0.0032	0.0125	0.0120	0.0592	0.1203	0.5925
Mercedes - Benz						
Bibb	0.0008	0.0004	0.0031	0.0021	0.0198	0.0136
Fayette	0.0010	0.0005	0.0037	0.0025	0.0229	0.0156
Greene	0.0015	0.0013	0.0056	0.0064	0.0358	0.0411
Hale	0.0015	0.0013	0.0055	0.0063	0.0352	0.0399
Jefferson	0.0008	0.0004	0.0030	0.0020	0.0179	0.0119
Pickens	0.0015	0.0014	0.0057	0.0066	0.0370	0.0426
Tuscaloosa	0.0032	0.0125	0.0120	0.0592	0.1203	0.5925
Walker	0.0007	0.0004	0.0026	0.0018	0.0159	0.0110

Table 3.5: Reduced Coefficients and Long Run Elasticities of Exogenous Variables

		Reduced Coefficient		Long Run Elasticity	
Variable	county	ΔDPCI	ΔDPRO	PCI	PRO
	Bullock	0.0005	0.0008	0.0018	0.0038
autoblack	Greene	0.0005	0.0008	0.0019	0.0038
	Hale	0.0005	0.0008	0.0018	0.0038
	Lowndes	0.0004	0.0007	0.0015	0.0032
	Macon	0.0004	0.0007	0.0016	0.0032
	Pickens	0.0005	0.0008	0.0019	0.0039
	Madison	-0.0579	-0.0324	-0.2186	-0.1521
unemp	Montgomery	-0.0573	-0.0320	-0.2184	-0.1514
	Talladega	-0.0574	-0.0321	-0.2185	-0.1517
	Tuscaloosa	-0.0574	-0.0321	-0.2185	-0.1516
	Madison	-0.0266	0.0043	-0.1005	0.0203
farm	Montgomery	-0.0264	0.0044	-0.1005	0.0206
	Talladega	-0.0264	0.0043	-0.1005	0.0205
	Tuscaloosa	-0.0264	0.0043	-0.1005	0.0205
	Madison	0.0746	-0.0229	0.2817	-0.1073
tax	Montgomery	0.0739	-0.0228	0.2817	-0.1079
	Talladega	0.0740	-0.0228	0.2817	-0.1077
	Tuscaloosa	0.0740	-0.0228	0.2817	-0.1077
	Madison	-0.0361	-0.0095	-0.1364	-0.0445
protax	Montgomery	-0.0358	-0.0093	-0.1364	-0.0441
	Talladega	-0.0358	-0.0094	-0.1364	-0.0443
	Tuscaloosa	-0.0358	-0.0094	-0.1364	-0.0442
	Madison	0.0844	0.1974	0.3189	0.9251
hsch	Montgomery	0.0834	0.1954	0.3178	0.9239
	Talladega	0.0836	0.1958	0.3182	0.9243
	Tuscaloosa	0.0836	0.1957	0.3181	0.9243
	Madison	0.0004	-0.0932	0.0015	-0.4368
bach	Montgomery	0.0005	-0.0924	0.0021	-0.4367
	Talladega	0.0005	-0.0925	0.0019	-0.4367
	Tuscaloosa	0.0005	-0.0925	0.0019	-0.4367

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Appendix: Method of Estimation in Panel Data Spatial Simultaneous Equations Model

This estimation procedure has five-step. In the first step, Generalized Two-Stage Least Squares (G2SLS) is used to estimate the parameter vector consisting of [$\propto', \beta', \lambda', \delta', \theta', \gamma', \eta'$] , using an instrument Matrix Q that consists of a subset of X, (I⊗W)X, (I⊗W) ^{2}X, where X represents a matrix that includes all control variables in the model, I is the identity matrix of dimension T, ⊗ is the Kronecker product, and W is a row standardized queen-based contiguity spatial weights matrix. Using estimates for [$\propto', \beta', \lambda', \delta', \theta', \gamma', \eta'$] from G2SLS, the disturbances for each equation are computed.

In the second step, The computed disturbances are used to estimate the spatial autoregressive parameter ρ and the variance components, σ_w^2 and σ_1^2, using the generalized moment procedure suggested by Kapoor, Kelejian and Prucha's (2004). For this generalized moment procedure, two orthogonal and symmetric idempotent matrices, P and H, are defined. Where P is a matrix that averages the observations across time for each individual and H is a matrix which obtains the deviations from the individual means. These P and H matrices are used to define the generalized moment estimators of ρ, σ_w^2 and σ_1^2 in terms of six moment conditions. This second step has two parts. In the first part, un-weighted initial generalized moment estimators of ρ, σ_w^2 and σ_1^2 are computed. In the second part, weighted GM estimators of ρ, σ_w^2 and σ_1^2 are computed.

In the third step, the weighted GM estimators of the spatial autoregressive parameter ρ are used to transform the data, using Cochran –Orcutt-type transformation. Then, the transformed data are further transformed using the variance components σ_w^2 and σ_1^2 by their weighted GM estimators.

In the fourth step, these transformed data were used to estimate the Feasible Generalized Spatial Two Stage Least Squares (FGS2SLS) estimates for [$\propto'$, β', λ', δ', θ', γ', η'], using a subset of the linearly independent columns of [X, (I⊗W)X, $(I \otimes W)^2X$] as the instrument matrix. Even though this GS2SLS takes the spatial correlation into account, it does not take into account the potential cross equation correlation in the innovation vectors $\boldsymbol{\omega}_{t,r}$, r = 1,2,3.

In the fifth step, the full system information is utilized by stacking the transformed equations in order to jointly estimate them. The FGS3SLS estimators of [$\propto'$, β', λ', δ', θ', γ', η'] are obtained by estimating this stacked model.