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THE IMPACT OF AUTOMOBILE PRODUCTION ON THE GROWTH OF NON-FARM PROPRIETOR DENSITIES IN ALABAMA'S COUNTIES

SOORIYAKUMAR KRISHNAPILLAI[a] AND HENRY KINNUCAN[b*]

[a,b] *Auburn University, U.S.A.*

This paper studies the impact of the auto industry on the growth of non-farm proprietor densities in Alabama's counties. Results show that automobile production in Alabama significantly increases non-farm proprietor 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. Then, appropriate policies to lure industrial development become very important to increase the self employment opportunity. There is significant spatial lag effects and spatial error effects between non-farm proprietor densities and per capita income.

Keywords: Automobile Production, Non-Farm Proprietor Densities, Spatial Dependence, Generalized Spatial Three Stage Least Square, Generalized Method of Moments
JEL classification: O14, R11, R12

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

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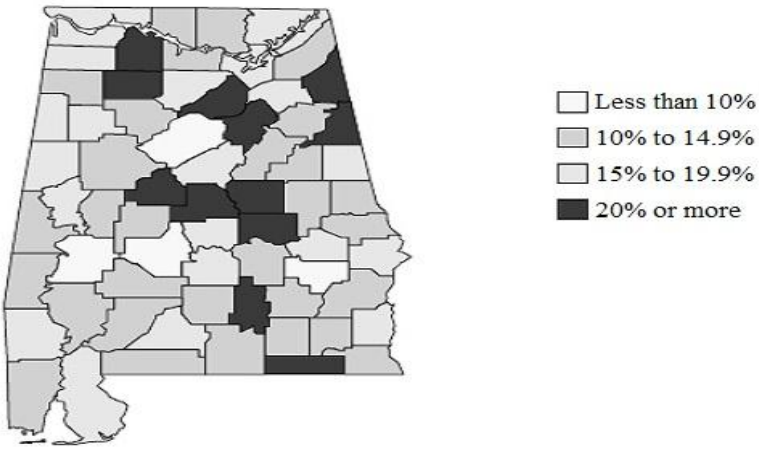
percent to 43.3 percent. Microenterprise employment represented 17.7 percent of U.S nonfarm employment and 16.7 percent of Alabama nonfarm employment. Within Alabama, this ranged from 12.6 percent to 30.5 percent (RUPRI, 2007). Over the past two decades the focus of economic development policy has shifted 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.



Source: U.S. Census Bureau, Nonemployer Statistics and Bureau of Economic Analysis, Regional Economic Information System

Figure 1. Entrepreneurship in Alabama: Self Employed as a Percent of Nonfarm Private Employment, 2003

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; 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:

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

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

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 $NT \times 1$ 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 $N \times N$ 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 $NT \times 1$ 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:

$$PROR_t = \alpha_1 + \beta_{11} PCIR_t + \lambda_{11}((I \otimes W) PROR_t) + \lambda_{12}(I \otimes W) PCIR_t + \delta_1 \ln A_{t-i}^{pro} + \theta_1 BA_{t-i}^{pro} + \sum_{k=1}^{K_1} \gamma_{1K} \ln(X_{t-i,k}^{pro}) - \eta_{11} \ln(PRO_{t-i}) - \eta_{12} \ln(PCI_{t-i}) + u_{t,1}, \quad (3)$$

$$PCIR_t = \alpha_2 + \beta_{21} PROR_t + \lambda_{21}((I \otimes W) PROR_t) + \lambda_{22}(I \otimes W) PCIR_t + \delta_2 \ln A_{t-i}^{pci} + \theta_2 BA_{t-i}^{pci} + \sum_{k=1}^{K_1} \gamma_{2K} \ln(X_{t-i,k}^{pci}) - \eta_{21} \ln(PRO_{t-i}) - \eta_{22} \ln(PCI_{t-i}) + u_{t,2}, \quad (4)$$

where α_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 ($\ln A_{t-i}$), 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. $u_{t.r}$ for $r = 1,2$ are $NT \times 1$ 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:

$$u_{t,r} = \rho_r (I \otimes W) u_{t,r} + \varepsilon_{t,r}, \quad r = 1,2. \quad (5)$$

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 ($\varepsilon_{t,r}$) to be correlated over time, following Baltagi (1995). Therefore, the innovation in the r^{th} equation is given by

$$\varepsilon_{t,r} = Z_\mu \mu_r + \omega_{t,r}, \quad r = 1,2, \quad (6)$$

where $Z_\mu = (I_N \otimes l_T)$, $\mu_r' = (\mu_{1r}, \mu_{2r}, ..., \mu_{Nr})$, $\omega_{t,r}' = (\omega_{11r}, \omega_{12r}, ..., \omega_{1Tr}, ..., \omega_{N1r}, ..., \omega_{NTr})$, I_T and I_N are identity matrices of dimension *T* and *N*, respectively, l_T is a vector of ones of dimension *T*, and $\otimes$ denotes the Kronecker product. μ_r and $\omega_{t,r}$ are random vectors with zero means and covariance matrix (suppressing the time index):

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

where μ_r denotes the vector of unit specific error components and ω_r contains the error components that vary over both the cross-sectional units and time periods. The innovations $\varepsilon_{t,r}$ 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).

$$u_{t,r} = \rho_r (I_T \otimes W) u_{t,r} + (I_N \otimes l_T)\mu_r + \omega_{t,r}, \quad r = 1,2 . \quad (8)$$

The intercepts (α_r for $r = 1,2$) in Equations (3)-(4) 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.

4. 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:

$$y = \lambda Wy + X\gamma + u , \quad (9)$$

$$u = \rho Wu + \varepsilon , \quad (10)$$

where y is an $NT \times 1$ vector of observations on the dependent variable. Wy is the corresponding spatial lagged dependent variable for weights matrix W , X is

$NT \times K$ matrix of observations on the explanatory variables, u is an $NT \times 1$ vector of error terms. λ is the spatial autoregressive parameter and γ is a $K \times 1$ vector of regression coefficients. ρ is the spatial autoregressive coefficient for the error lag Wu and ε is $NT \times 1$ 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:

$$Y = YB + X\Gamma + WY\Lambda + U \, , \tag{11}$$

$$U = WUC + E \, , \tag{12}$$

$$(Y = y_1,\ldots,y_G; \quad X = x_1,\ldots,x_G; \quad U = u_1,\ldots,u_G; \quad WU = Wu_1,\ldots,Wu_G;$$
$$C = diag_{r=1}^{G}\rho_j; \quad E = \varepsilon_1,\ldots,\varepsilon_G),$$

where y_r is the $NT \times 1$ vector of observations on the dependent variable in r^{th} equation, x_k is the $NT \times 1$ vector of observations on the k^{th} exogenous variable, u_r is the $NT \times 1$ vector of error terms in the r^{th} equation, and B and Γ are parameter matrices of dimension $G \times G$ and $K \times G$ respectively. B is a diagonal matrix. W is $N \times N$ weights matrix of known constants and Λ is $G \times G$ matrix of parameters. Wy_r and Wu_r are spatial lag and spatial autoregressive error term in the r^{th} equation respectively. The solution for the endogenous variable can be revealed through the vector transformation:

$$vecY = vecYB + vecX\Gamma + vecWYA + vecU \, ,$$

$$vecY = vecYB + vecX\Gamma + vecWYA + vecUWC + E \, ,$$

$$vecY = B' \otimes IvecY + \Gamma' \otimes IvecX + \Lambda' \otimes Wy + C' \otimes WvecU + vecE \, .$$

Letting $y = vecY, x = vecX, u = vecU$ and $\varepsilon = vecE$.

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

or

$$y = B' \otimes Iy + \Gamma' \otimes Ix + \Lambda' \otimes Wy + u \, ,$$

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

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:

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

$$u = (I_{nG} - C' \otimes W)^{-1}\varepsilon\ . \tag{14}$$

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 $\ln y_t - \ln y_{t-i}$. One of the exogenous variables in the right hand side of each equation is the predetermined lagged dependent variable ($\ln y_{t-i}$). 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 ($\ln y_{t-i}$).

5. DATA AND SOURCES

Data for sixty seven counties in Alabama are drawn from several sources (Table 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. We used 7 years interval to construct these growths because the latest data for automobile production was available in 2007 during this study period and census data were used for other variables. 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 2.

Table 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

Notes: 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 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

6. 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 overidentification was done to investigate whether the additional instruments are valid in the sense that they are uncorrelated with the error term. That is $E(Q'u_r) = 0$, where E is the expectation operator and Q is an instrument matrix that consists of a subset of linearly independent columns X, WX, W^2X, 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.

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.

7. RESULTS AND DISCUSSIONS

The parameter estimates of the system are given in Table 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 4 and 5.

Table 3. Structural Coefficients

Variable	DPCI Equation		DPRO Equation	
	Coeff.	*z-stat*	*Coeff.*	*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	

Note: [b] *t*-static value, [c] *p*-value.

Table 4. Reduced Coefficients, Long Run Elasticities and 10% Impact of Automobile Production

	Reduced Coefficient		Long Run Elasticity		10% impact	
County	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 5. Reduced Coefficients and Long Run Elasticities of Exogenous Variables

		Reduced Coefficient		Long Run Elasticity	
Variable	Country	ΔDPCI	ΔDPRO	PCI	PRO
autoblack	Bullock	0.0005	0.0008	0.0018	0.0038
	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
unemp	Madison	-0.0579	-0.0324	-0.2186	-0.1521
	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
farm	Madison	-0.0266	0.0043	-0.1005	0.0203
	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
tax	Madison	0.0746	-0.0229	0.2817	-0.1073
	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
protax	Madison	-0.0361	-0.0095	-0.1364	-0.0445
	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
hsch	Madison	0.0844	0.1974	0.3189	0.9251
	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

bach	Madison	0.0004	-0.0932	0.0015	-0.4368
	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

8. 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.

9. 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 depends 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.

10. CONCLUSIONS AND POLICY IMPLICATIONS

The empirical findings suggest that automobile production in Alabama significantly increases nonfarm proprietorship in all counties. 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.

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 [α', β', λ', δ', θ', γ', η'], using an instrument Matrix Q that consists of a subset of X, $(I \otimes W)X$, $(I \otimes W)^2 X$, where X represents a matrix that includes all control variables in the model, I is the identity matrix of dimension T, $\otimes$ is the Kronecker product, and W is a row standardized queen-based contiguity spatial weights matrix. Using estimates for [α', β', λ', δ', θ', γ', η'] 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 [α', β', λ', δ', θ', γ', η'], using a subset of the linearly independent columns of [X, $(I \otimes W)X$, $(I \otimes W)^2 X$] 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 $\omega_{t,r}$, $r = 1,2,3$.

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 [α', β', λ', δ', θ', γ', η'] are obtained by estimating this stacked model.

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Mailing Address: Sooriyakumar Krishnapillai, Department of Agricultural Economics and Rural Sociology, 202, Comer Hall, Auburn University, AL 36849-5406, USA. E-mail: kzs0008@auburn.edu.

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