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Abstract: In this study, a spatial growth equilibrium model of business growth is developed and empirically estimated by Generalized Spatial Two-Stage Least Squares (GS2SLS) estimator using cross-sectional data from Appalachian States counties for 1990-2000. Beside the existence of spatial spillover effects, the results suggest that agglomerative effects that arise from both the demand and the supply sides were active in contributing to business growth in the study area during the study period. The policy implications of these findings are: (1) Regional cooperation of counties and communities is advisable and may even in fact be necessary to design appropriate policies that encourage business growth; and (2) Policy makers at the county level may need to design policies that can attract people with high endowment of human capital and higher income into their respective counties.

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1. INTRODUCTION

Although a lot of knowledge has been gained through research and experience, the question of how to generate entrepreneurship and sustainable economic development remains unanswered (Voslee, 1994). The traditional approach to rural development was 'top-down'. Federal development authorities designed programs to provide infrastructure, human capital and investment from outside the rural community. While the investment in infrastructure was beneficial in attracting and supporting commercial activities and enhancing the rural quality of life, it did not necessarily provide a long term growing economic base (Petrin, 1992), and many rural areas were excluded because the cost of such schemes were too high to implement them in all rural areas. Because of such and other shortcoming, rural areas throughout the U.S. are still suffering from a lack of job opportunities, poverty, inadequate public infrastructure, and, as a result, the negative effects of out-migration. Therefore, new ideas were sought, and one that appear promising to many policy makers and scholars, is the development of small business and entrepreneurship.

Confronted with rising concerns about unemployment, job creation, economic growth and international competitiveness in global markets, policy makers at local, state, and national levels have thus responded to this new evidence with a new mandate to promote the creation of new businesses (see Reynolds, 2000). The results of empirical studies show that the new business phenomenon in most cases implies a small business phenomenon, since most of the new businesses start small and more importantly, most of the newly created jobs are generated by new businesses that start small (Acs and

Audretsch, 2001; Audretsch et al., 2000, 2001; Carree and Thurik, 1998, 1999; Wennekers and Thurik, 1999; Fritsch and Falck, 2003). These studies indicate that there has been a structural shift in the industrial sector towards a higher dependence on flexibility and knowledge-intensive production. This is considered to have made the small business sector as a more important feature of both the regional and the national economies.

By focusing on small, usually local, businesses, rural communities capture a greater share of the existing local income, and the focus on entrepreneurship has the potential of increasing the efficiency of existing local establishments and forming new businesses (Woods, Frye and Ralstin 1999). The recognition of the importance of new business formation for regional development also raised the interest to further investigate the reasons why some economic spaces show high rates of new business formation while others do not. The purpose of this paper is to investigate the determinants of regional variation in business growth in Appalachian States. The rest of the paper is organized into five sections. A review of the empirical literature on the determinants of regional variation in business growth is given in section 2. Section 3 presents the empirical model to be estimated. The definitions and descriptions of the data are given in section 4, and section five discusses some estimation issues. Section 6 presents the results, and finally, some conclusions are given in section 7.

2. LITERATURE REVIEW

A long tradition of studies of the determinants of new plant entry has focused on tax rates, transportation costs and economies of scale at the plant level (Bartik, 1989; Kieschnick, 1981; Harrison and Kanter, 1978). More recently, a growing literature has

sought the determinants of variation in new business formation on regional basis (see Reynolds, 1994 and Acs and Armington, 2002 for the United States; Fritsch, 1992 and Audretsch and Fritsch, 1994 for West Germany; Hart and Gudgin, 1994 for the Republic of Ireland; Keeble and Walker, 1994 and Johnson and Paker ,1996 for United Kingdom; Davidson et al., 1994 for Sweden; Guesnier, 1994 for France; Garofoli, 1994 for Italy; Kangasharju, 2000 for Finland; Fotopoulos and Spence, 1999 for Greece; and Callejon and Segarra, 2001 for Spain). Each of these studies attempted to identify the most important influences underpinning spatial variations in new firm (business) formation. In these studies a set of regional characteristics concerning socioeconomic structure of the region are examined in order to explain the variations in new business formation. These include demand-side, supply-side and policy variables.

On the demand-side, most of these researches suggest that new and small businesses tend to serve restricted geographical markets, and are therefore influenced by local variations in level and growth of market demand as measured by variables such as family median income, GDP and resident population statistics. Increases in the demand for goods and services that results from increases in per capita income or GDP per capita is associated with higher business formation (Armington and Acs, 2002). As wealth increases consumer demand for a variety of products and services increases and small businesses are well equipped to supply these new and specialized goods and services (Carree, 2000). Besides, the employment-share of the service sector which is characterized by intensive presence of small business increases with increases in per capita income (Wennekers, Uhlaner and Thurik, 2002). A growing population increases

the demand for consumer goods and services and it is positively related to business formation (Acs and Armington, 2004a).

In addition to their demand-side influences, both population growth and net migration measures incorporate supply-side influences. This is because population growth, which often includes in net migration, also increases the local pool of potential entrepreneurs. Entrepreneurship and small business formation is strongly associated with previous population in-migration, itself powerfully stimulated by residential amenities and preference considerations (Keeble, Broom and Lewis, 1992).

Supply-side variables include the variables that reflect the supply of resources required setting up new business. These include measures of aggregation/externalities, of unemployment, of the structure of production, of availability of capital and entrepreneurial culture.

Concentration of people and firms in certain areas decreases both the cost of access to customers and cost of access to suppliers (Reynolds, 1994). Both the consumer and the producer benefit from the easy availability of pooled services in such areas. This encourages new firm formation as a result of the agglomeration effects that come from either the demand effect, such as increase in population, or from regional spillovers, such as labor market characteristics. Krugman (1991a and 1991b) identified three types of spillovers within a region that may lead to the localization of economic activities. The first emanates from the observation by Marshall (1920) that a pooled labor market most commonly associated with agglomerations yields increasing returns at a spatial level. Agglomerations enable the production and provision of non-traded specialized inputs at a greater variety and lower cost. The third source of spillovers emanates from economics

in information flows, or what Jaffe (1989) and Acs, Audretsch and Feldman, (1992, 1994) term it as technological spillovers. Technological spillovers are more beneficial to new small firms than to incumbent large enterprises (Acs et al., 1994). Thus, regions where such spillovers are greatest are more conducive for new business locations.

Regional spillovers are more likely to be most prevalent in areas with high population density because the infrastructure of services and inputs is more developed in densely populated regions. The concentration of several firms in a single location, for example, offers a pooled market for workers with industry-specific skills, ensuring both a lower probability of unemployment and a lower probability of labor shortage (Krugman, 1991a). Localized industries can also support the production of non-tradable specialized inputs. Besides, the informational spillovers that associate agglomeration can give cluster firms a better production function than isolated firms. That is, economies of localization and urbanization yield reduced cost of making transactions. This would suggest that both population density and population growth be positively related to new firm start-ups (Reynolds, 1991). Such agglomerations would also tend to exist where output per capita is relatively high.

The agglomeration effects that contribute to new firm formation can also come from supply factors related to the quality of the local labor market and business climate. Regions with similar demand and business climate patterns still differ in the rates of new firm formation, survival, and growth as a result of differences in their human capital endowment, and the propensity of locally available knowledge to spill over and stimulate new firm formation and growth. More educated population provide more human capital, embodied in their general and specific skills, for implementing new ideas for creating and

growing new businesses (Acs and Armington 2004b). A number of empirical researches have found a strong connection between human capital and new firm formation and growth. Cross (1981), for example, argues that the availability of specialized labor influences the birth of new firms because there is a larger supply of potential entrepreneurs. Specialized workers are better prepared than non-specialized workers to create their own businesses, and workers with management skills favor the creation of new firms (Lloyd and Mason, 1984).

Human capital studies have found that entrepreneurship is related to educational attainment and work experience. People with more educational attainment tend to found business more often than those with less educational attainment (Evans and Leighton, 1990). In the 1990s, there were increases in the incidences of highly educated people stating new businesses, especially in the highly advanced sectors of the economy, like computers, biotechnology, and internet-dependent businesses. Guesneir (1994) finds that the propensity to create a new firm is positively associated with adults with bachelor degree. Highly educated people in most cases have easier access to research and development facilities, and perhaps a good insight into the business world and thus a clear idea about the present and the future needs of the market. Entrepreneurs with good education are also likely to know how to transform innovative ideas into marketable products (Christensen, 2000). People in regions that have a high percentage of college graduates are much more likely to start business than those in regions with high concentration of less skilled workers (Armington and Acs, 2001). Regions with higher average share of adults with college degrees are associated with higher new firm formation rates. Although the actual knowledge acquired with a college degree seldom

suffices as the basis for a successful new business, the analytical methods learned in college facilitates both future acquisition of knowledge and openness to new ideas received as spillover from other activities in the region (Acs and Armington 2004b). However, studies by Hart and Gudgin (1994) have shown that the percentage of population with a university degree is inversely associated with the rate of new firm formation. A comparative study by Uhlaner, Thurik and Hutjes, 2002) in fourteen OECD countries has also shown that countries with higher level of education tend to have a smaller proportion self-employed entrepreneurs. While the educational level of the entrepreneurs may not, however, play a specific role in the survival of individual firms, the general consensus is that education more broadly influences the overall probability of survival of new firms in a region (Storey, 1994).

Past research has found conflicting evidence about whether higher unemployment leads to more new firm formation, or the contrary. Traditionally, regional unemployment rate has been used as a measure of regional economic distress; with high unemployment rates would indicate slack growth, thereby dampening the incentives for new firms to locate within the region. Higher levels of unemployment might also indicate a reduction in aggregate demand throughout a regional economy, thereby putting downward pressure on the rate of new firm formation (Storey and Johnson, 1987). Moreover, unemployed individuals may not have the capital necessary to start their own business (Storey and Jones, 1987; Audretsch and Fritsch, 1994; Garofoli, 1994). Nevertheless, there is substantial literature, which indicates that higher levels of unemployment may lead to higher levels of firm formation. Actually, in many studies of new firm formation in the 1980s, there was a heavy emphasis on the possible positive explanatory power of

unemployment (Evans and Leighton, 1990; Storey, 1991). A higher rate of unemployment may mean lower labor costs for firms and, therefore, favoring the creation of new firms (Highfield and Smiley, 1987). A higher rate of unemployment also indicates that more people have reason to search for alternative ways to make a living. In the absence of alternative job opportunities, some workers take the steps to start their own businesses (Davidsson, Lindmark and Olofsson, 1994; Beesley and Hamilton, 1994; Storey, 1994). This activity, in turn, reduces the unemployment rate as the resulting new firm employs not only the owners, but also others.

The empirical evidence provided at best depends on the methods it is followed to calculate the rate of new firm formation and on the data type used. If the rate of new firm formation is calculated with respect to the number of existing firms/establishments in the region, then higher rates of unemployment are positively associated with new firm formation. However, it is negatively associated with the rate of new firm formation if the latter is calculated with respect to number of employees in the region. Time series analyses point to unemployment being, ceteris paribus, positively associated with new firm formation, whereas studies using cross sectional, or pooled cross sectional analysis appear to indicate the reverse (Storey, 1991). Cross sectional studies by Armington and Acs (2001), however, indicate that unemployment rate is positively related to new firm formation in US in the 1990s. Acs and Armington (2004b) also found that the unemployment rate is positively associated with the rate of new firm formation during recession and negatively associated during growth periods. The impact of unemployment rate on the rate of new firm formation also depends on the type of the sector of activity, with industries that require small capital being more suitable for new firm formation

during periods of higher unemployment (Armington and Acs, 2001). Thus, the direction of the effect of a region's unemployment rate on new firm formation is indeterminate.

Higher personal household wealth can provide either the financial resources, as equity or loans to finance new business, that is required to start new firm or it reflects wealth and income that can create demand for goods and services that encourages entrepreneurship. In order to capture the availability of finance, several variables have been used in the empirical studies. These include variables such as the distribution of wealth at regional level (Fotopoulos and Spence, 1999); percentage of homes owned by their occupants (Storey, 1982; Ashcrof, Love and Maloy, 1991; Reynolds, 1994; Reynolds, Miller and Maki, 1994; Keeble and Walker, 1994; Garofoli, 1994; Whittington, 1984; Guesnier, 1994), per capita saving deposits in the banking system (Fotopoulos and Spence, 1999; and annual growth rate of bank deposits (Gaygisiz and Koksal, 2003).

The percentage of home owned by their occupants is the variable that is frequently used in the empirical analysis and captures two different effects. A higher percentage of homes owned by their occupants may be an indication that there is a capacity to finance new business by potential entrepreneurs. It could also be a sign that at a regional level there is a demand for new business. Besides, a higher proportion of home ownership influences positively the formation of new firms because homes may be used as collateral for loans to start new business. In his study of the United States, Reynolds (1994) has found that personal household wealth is associated with higher new firm formation in the traditional rural regions. The local availability of personal finance, epitomized and embodied in the value of local owner-occupied housing, appears to play

an important role in enabling or inhibiting new business creation (Keeble and Walker, 1994).

Guesnier (1994) and Garofoli (1994) have, however, found a negative relationship between home ownership and new firm formation. If houses already serve as collateral of bank loans and the burden imposed by those loans is too heavy for families, it may happen that the ability to finance a new business is limited. Besides, the consumption of other goods is lower, influencing therefore the rate of new firm formation through the demand side. The other possibility where a negative relationship between homeownership and the rate of new firm formation can be obtained is when the young with the higher probability of becoming entrepreneurs tend to live in rented homes more than older individuals. This effect may be captured in the variable related with property ownership if we do not control for the percentage of the young individuals in our regression (Guesnier, 1994).

The size structure of existing enterprises can be a factor influencing the rate of new business formation. The shift from manufacturing to services that has resulted from industrial restructuring in the 1980s increased the rate of new firm formation. And many researchers suggest that areas having many small firms are likely to have high rates of new firm formation (Cross, 1981; Storey, 1982; Lloyd and Mason, 1984; O'Farrel and Crouchley, 1984; Garofoli, 1994; Keeble and Walker, 1994; Audretsch and Fritsch, 1994; Hart and Gudgin, 1994; Reynolds, 1994; Armington and Acs, 2002; Acs and Armington 2004b). A local business structure with no dominant large firms may offer fewer barriers to entry of new firms. In a region dominated by small firms there is a much broader population of business owners and more individuals may visualize their own careers as

leading to the founding of independent new firms (Acs and Armington 2004b). Whereas regions that are dominated by large branch plants or firms will have less new firm formation (Gudgin, 1978; Mason, 1994, Garofoli, 1994; Keeble and Walker, 1994; Audretsch and Fritsch, 1994; Hart and Gudgin, 1994; Reynolds, 1994; Armington and Acs, 2002; Acs and Armington 2004b). This is because large firms both provide employment for highly skilled workers in the economy but they fail to provide a suitable training ground for new entrepreneurs. Cross (1981) argues that the small firm is the best incubator of entrepreneurial capacity. A large proportion of entrepreneurs usually spring from having had prior experience in small firms.

The importance of public services for regional growth stems from their effect on production and location decisions of private firms. Public services such as education, highways, public safety, sewer and, water treatment services can be viewed as unpaid inputs in the process of production of private businesses that contribute independently to output.

Many studies have shown that public services have positive and statistically significant effects on business location and growth (Fox, 1979; Charney, 1983; Bartik, 1985, 1989; Helms, 1985; Newman, 1983; Papke, 1991; Deich, 1989; Fisher, 1997; Gaygisiz and Koksal, 2003; Gabe and Bell, 2004). Fox (1979), for example, found a positive location effect for local public services consumed by firms as measured by the expenditures for police and fire protection. A study by Charney (1983) also shows significant positive effects of the availability of water and sanitation infrastructure on location decision by firms. Similarly, Bartik (1991) found that fire protection services and local school spending have the strongest positive effects on small business start-ups. Out

of the 19 studies reviewed by Fisher (1997), education spending has a positive effect on business activities in 12 of them, and a positive and significant effect in 6 of them. More recently, a study by Gabe and Bell (2004) shows a positive and significant effect of local public spending on business location. Besides, Gabe and Bell (2004) find that the benefits of tax-financed public services are more important than the costs (taxes) as determinants of business location. Helms (1985) also found that local tax revenues used to fund transfer payments tend to reduce economic growth, whereas local tax revenues used to finance improvement in public services such as highways, education and public health tend to have a positive growth impact and concluded that a high public service level attracts businesses and economic activity, whereas transfer payments do not have the same positive effect on economic growth. Besides, Helms study shows that the net impact of tax-financed increases in government services is positive.

Studies by Reynolds (1994) Keeble and Walker (1994) and Audretsch and Fritsch, (1994), however, show that there is little evidence that variations in local government spending (on education, highways, public safety) have statistically significant effect on business growth.

3. MODEL DEVELOPMENT

Consistent with the profit maximization assumption, business firm location is assumed to be determined by demand and cost factors. These include access to labor and output markets, local demand, the cost and availability of commercial land and labor, local taxes, and local public services. In addition, different locations are likely to have different characteristics that raise or lower firm costs of production. These could include, for example, agglomeration economies associated with dense urban settlement,

transportation costs, or site specific attributes. Following Carlton (1983), Friedman, Gerlowski, and Silberman (1992), Guimaraes, Figueiredo, and Woodward (2000), and Gabe and Bell (2004), the expect profit, π_{jk} ,earned by business firm j in county k can be given by:

$$\pi_{j,k} = \boldsymbol{\beta}'\boldsymbol{\Xi}_{j,k} + e_{j,k} \tag{1}$$

where, $\boldsymbol{\beta}$ is a vector of parameters, $\boldsymbol{\Xi}_{j,k}$ is a vector of county specific attributes, and e_{jk} is a random error term. Profit maximization behavior asserts that businesses will locate and invest in the county that provides the highest expected profits. Thus, business firm j will locate in county k if the expected profits in county k are greater than the expected profits the business could earn elsewhere. That is,

$$\pi_{j,k} > \pi_{j,i}, \quad \text{for all i} \neq k$$

In equilibrium, no business firm can improve its profits by moving. Thus, equilibrium requires that profits be equalized at some level π^* across all locations,

$$\pi_{j,k} = \pi^*, \quad \text{for all k}$$

For each business firm, the profit function can also be formulated as maximizing the following expression:

$$\pi_k = p_k Q_k - \sum_{i=1}^{n} w_{i,k} x_{i,k} \tag{2}$$

where π_k is the profit at k, p_k is the tax inclusive price of output at k, Q_k is quantity sold at k, $w_{i,k}$ is a vector of tax inclusive input prices at k, and x_{ik} is a vector of inputs at k.

Using a cost function in the production of Q and the first order profit maximization conditions, $\pi_k = p_k Q_k - \sum_{i=1}^{n} w_{i,k} x_{i,k}$ can be rewritten as:

$$\pi_k = \pi\left(p_k, w_{i,k}, CA_k\right) \tag{3}$$

where CA_k is a vector of other covariates that affect profits at k, and the other notations are as defined before. Note that the cost factors include the wage rate and hence differentiating with respect to the wage rate gives the business firm's demand for labor. Thus, the demand for labor at location k by firm j can be written as:

$$EMP_{j,k} = EMP\left(p_k, w_{i,k}, CA_k\right) \tag{4}$$

where $EMP_{j,k}$ is employment level at location k by firm j, and the other notations are as defined above.

In a comparative static framework, the percentage change in employment is related to the changes in the right-hand side variables as one move from an initial equilibrium to another equilibrium position. $EMP^*_{j,k}$ is the level of employment when firm j's profit at location k is in equilibrium (i.e., $\pi_{j,k} = \pi^*$).

The observed business growths (employment expansions) consist of individual business firm decisions that are aggregated over all potential newly locating and expanding business firms. Thus, the equilibrium level of employment at location k, EMP^*_k, is dependent on the access to labor and output markets, local demand, the cost and availability of commercial land and labor, local taxes, and local public services. A log-linear specification of the equilibrium condition can thus be expressed as:

$$\mathbf{EMPR}_{kt} = \sum_{j=1}^{J} x_j \ln \mathbf{X}_{jkt} - \eta \ln \mathbf{EMP}_{kt-1} \tag{5}$$

where $\mathbf{EMPR}_{kt}$ is the growth rate in employment $(\ln(\mathbf{EMP}_{it}) - \ln(\mathbf{EMP}_{it-1}))$, $x_j, j = 1,...J$ are exponents with *J* being the total number of variables included in vector $\mathbf{X}$, $\mathbf{X}$ is a vector of right-hand side include exogenous variable, η is the speed of adjustment parameter and $\mathbf{EMP}_{kt-1}$ is the employment level at the base period.

Regional factors that affect firms' decisions are, however, more likely to exhibit lack of independence in the form of spatial autocorrelation. Spatial autocorrelation or spatial dependence refers to the statistical property where the dependent variable or error term at one location is correlated with observations on the dependent variable or error term at other locations (Anselin, 1988, 2003). Tests for spatial dependences also indicate the existence of spatial dependence in both the dependent variable and in the error term. The results are given in Table 4. The model given in equation (5) can thus be extended to account for these spatial interdependences as follows:

$$\mathbf{y} = \rho \mathbf{W}\mathbf{y} + \mathbf{X}\beta + \mathbf{u} \tag{6}$$

with

$$\mathbf{u} = \lambda \mathbf{W}\mathbf{u} + \boldsymbol{\varepsilon}$$

where **y** is an (418x1) vector of county employment growth rate, **Wy** is the corresponding spatial lagged dependent variable for weights matrix **W**, **X** is (418x J) matrix of observations on the explanatory variables, ρ is the spatial autoregressive parameter, β is a (Jx1) vector of regression coefficients, **u** is an (418x1) vector of error terms, that is assumed to follow a spatial autoregressive process, with λ as the spatial autoregressive

coefficient for the error lag **Wu**, and ε is (418x1) vector of innovations or white noise error. We use a row standardized queen-based contiguity weights matrix **W.**

4. DATA TYPES AND SOURCES

The data for the 1096 Appalachian States counties used for the empirical analysis were collected and compiled from County Business Patterns, Bureau of Economic Analysis, Bureau of Labor Statistics, Current Population Survey Reports, County and City Data Book, U.S. Census of Population and Housing, U.S. Small Business Administration, and Department of Employment Security. Data for county employment was collected for 1990 and 2000.

Dependent Variable

The dependent variable used in the empirical analysis includes the growth rate of employment (**EMPR**). The growth rate of employment is measured by the log-difference between the 2000 and the 1990 levels of private non-farm employment. Empirical studies indicate that most newly created jobs are generated by new businesses that start small (Acs and Audretsch, 2001; Audretsch et al., 2000; Carree and Thurik, 1998, 1999; Wennekers and Thurik, 1999; Fritsch and Falck, 2003). Research by the U.S. Small Business Administration also shows that job creation capacity in the U.S. is inversely related to the size of the business. Between 1991 and 1995, for example, enterprises employing fewer than 500 people created new jobs as follows (size of enterprise in parenthesis): 3.843 million (1-4), 3.446 million (5-19), 2.546 million (20-99), and 1.011 million (100-499). During the same period, enterprises employing 500 or more people lost 3.182 million net jobs (U.S. Small Business Administration, 1999).

The spatial lag of the Growth Rate of Employment (**WEMPR** is included on the right hand side of each equation of (6). This spatially lagged endogenous variable is created by multiplying the dependent variable by a row standardized queen-based contiguity spatial weights matrix **W** .

Independent Variables

The independent variables include demographic, human capital, labor market, housing, industry structure, and amenity and policy variables. In line with the literature, unless otherwise indicated, the initial values of the independent variable are used in the analysis. This type of formulation also reduces the problem of endogeneity. All the independent variables are in log form except those that can take negative or zero values. The descriptions of each of the independent variables of the models are given below (see also Table 1 for the description and sources of the data).

Equation (6) includes a vector of control variables **X** which includes human capital, agglomeration effects, unemployment, and other regional socio-economic variables that are assumed to influence county employment growth (business growth) rate. Human capital is measured as the percentage of adults (over 25 years old) with college degrees and above (POPCD. It is expected that educational attainment is positively associated with employment growth. To control for agglomeration effects from both the supply and demand sides, the percentage of the population between 25 and 44 of age (POP25-44) is included and it is expected that agglomeration effects to have a positive impact on employment growth. The proportion of female household header families (FHHF) is included to control for the effect of local labor market characteristics on employment. The county unemployment rate (UNEMP) is included as a measure of

local economic distress. Although a high county unemployment rate is normally associated with a poor economic environment, it may provide an incentive for individuals to form new businesses that can employ not only the owners, but also others. Thus, we do not know *a priori* whether the impact of UNEMP on employment growth is positive or negative. Establishment density (ESBd), which is the total number of private sector establishments in the county, divided by the county's population, is included to capture the degree of competition among firms and crowding of businesses relative to the population. The coefficient of ESBd is expected to be negative. Vector $\mathbf{X}$ also includes OWHU (owner occupied housing) to capture the effects of the availability of resources to finance businesses and create jobs on employment growth in the county. The percentage of owner-occupied dwellings is expected to be positively associated with employment growth in the county. Also included in X are property tax per capita (PCPTAX), percentage of private employment in manufacturing (MANU), percentage of private employment in whole sale and retail trade (WHRT), Natural Amenities Index (NAIX), and highway density (HWD). To control for the impacts of population movements and the impacts of the size of the economy and the actions of local governments, the model also includes measures of gross in-migration (INM), Gross out-migration (OTM), median household income(MHY) and local government expenditures per capita (GEX).

The initial level of employment (EMPt-1) is also included in equation (6). This variable is treated as predetermined variable because its value is given at the beginning of each period and hence is not affected by the endogenous variable. Table 1 provides the full list of the endogenous, and of the spatial lag and control variables, their descriptions and the sources of the data.

5. ESTIMATION ISSUES

Since the right-hand side spatial lag dependent variable (**Wy**) is correlated with the error term, Ordinary Least Squares (OLS) cannot give consistent estimates of the parameters of equation (6) as it stands. The reduced form of the system in (6) is non-linear in parameters and can be given by:

$$y = \left(I_n - \rho W\right)^{-1} X\beta + \left(I_n - \rho W\right)^{-1}\left(I_n - \lambda W\right)^{-1}\varepsilon \tag{7}$$

Equation (7) cannot be estimated consistently by OLS either.

Thus, we estimate the parameters of the model given in (6) using efficient GMM method following Kelejian and Prucha's(1998). In order to define the GMM estimator, we first rewrite equation (6) as follows:

$$\mathbf{y} = \mathbf{Z}\boldsymbol{\delta} + \mathbf{u} \tag{7}$$

with

$$\mathbf{u} = \lambda\mathbf{W}\mathbf{u} + \boldsymbol{\varepsilon}$$

where $\mathbf{Z} = \left(\mathbf{X}, \mathbf{W}\mathbf{y}\right)$ and $\boldsymbol{\delta} = \left(\boldsymbol{\beta}', \boldsymbol{\rho}'\right)'$.The GMM method identifies $\boldsymbol{\delta}$ by a moment condition which is the orthogonality between the set of instruments **H** and the error term **u** given by:

$$E\left(\mathbf{H}'\mathbf{u}\right) = \mathbf{0} \tag{8}$$

where **H** is defined as a subset of the linearly independent columns of $\left(\mathbf{X}, \mathbf{W}\mathbf{X}, \mathbf{W}^2\mathbf{X}\right)$. It is assumed that the elements of **H** are uniformly bounded in absolute value. Besides, **H** is full column rank non-stochastic instrument matrix (see Kelejian and Prucha (1999) for the description of its prosperities). The GMM estimator is given by

$$\hat{\boldsymbol{\delta}} = \left(\bar{\mathbf{Z}}_{(\hat{\lambda})}' \bar{\mathbf{Z}}_{(\hat{\lambda})} \right)^{-1} \bar{\mathbf{Z}}_{(\hat{\lambda})}' \mathbf{y}_{(\hat{\lambda})} \tag{9}$$

where $\bar{\mathbf{Z}}_{(\hat{\lambda})} = \mathbf{P}_H \left(\mathbf{Z} - \hat{\lambda} \mathbf{W} \mathbf{Z} \right), \mathbf{y}_{(\hat{\lambda})} = \mathbf{y} - \hat{\lambda} \mathbf{W} \mathbf{y}$ and $\mathbf{P}_{\mathrm{H}} = \mathbf{H} \left(\mathbf{H}' \mathbf{H} \right)^{-1} \mathbf{H}'$. This is the result of the third step in the three step generalized moment procedure suggested by Kelejian and Prucha. In the first step, the parameter vector $(\boldsymbol{\delta})$ consisting of betas and rho $[\beta', \rho']$ is estimated by two stage least squares (2SLS) using the instrument matrix **H** that consists of a subset of $\mathbf{X}, \mathbf{WX}, \mathbf{W^2X}$, where **X** is the matrix that includes all control variables in the model, and **W** is a weight matrix. The disturbance term in the model is computed by using the estimates for betas and rho (ρ) from the first step. In the second step, this estimate of the disturbance term is used to estimate the autoregressive parameter lambda (λ) using Kelejian and Prucha's generalized moments procedure. In the third step, a Cochran-Orcutt-type transformation is done by using the estimate for lambda (λ) from the second step to account for the spatial autocorrelation in the disturbance. The GS2SLS estimators for betas and rho (ρ) are then obtained by estimating the transformed model using $\left[\mathbf{X}, \mathbf{WX}, \mathbf{W^2X} \right]$ as the instrument matrix as given in (9).

6. RESULTS AND DISCUSSION

The GS2SLS parameter estimates of the system given in (6) are reported in Table 3. The parameter estimates are mostly consistent with the theoretical expectations. The results suggest a positive and significant parameter estimate for lambda that indicate that employment growth rate tends to spillover to neighboring counties and have a positive

effect on their employment growth rates. This is important from a policy perspective as it indicates that employment growth in one county has positive spillover effects to EMPRs in neighboring counties. The result is also important from an economic perspective because this significant spatial lag effect indicates that EMPR does not only depend on characteristics within the county, but also on that of its neighbors. Hence, spatial effects should be tested for in empirical works involving employment growth rates. The model specification in this study also incorporates spatially autoregressive spatial process (effect) besides the spatial lag in the dependent variable. The results in Table 2 suggest a negative parameter estimate for rho indicating that random shocks into the system with respect to EMPR do not only affect the county where the shocks originated and its neighbors, but create negative shock waves across Appalachian States.

The model in this study includes measure of population statistics such as the percentage of population between 25 and 44 years old (POP25_44) to control for agglomeration effects. The coefficient on POP25-44 is positive and statistically highly significant. The results show that POP25_44 has positive and significant effects on EMPR, even after the potential spatial spillover effects are controlled for. This result is consistent with the literature (Acs and Armington, 2004a) which indicates that a growing population increases the demand for consumer goods and services, as well as the pool of potential entrepreneurs which encourage business formation. This result is important from a policy perspective. It indicates that counties with high population concentration are benefiting from the resulting agglomerative and spillover effects that lead to localization of economic activities, in line with Krugman's (1991a, 1991b) argument on regional spillover effects. Consistent with the theoretical expectations, the results also

show initial human capital endowment as measured by the percentage of adults (over 25 years old) with college degree (POPCD) is positive and statistically significant at the one percent level. Highly educated people in most case have more access to research and development facilities, and perhaps a good insight to the business world and thus a clear idea about the present and the future needs of the market. As Christensen (2000) contends, entrepreneurs with good education are also more likely to know how to transform innovative ideas into marketable products. Thus, people with more educational attainment tend to establish business, and to be more successful when they do, more often than those with less educational attainments. This result is also consistent with Acs and Armington's (2004b) findings which indicates that the agglomerative effects that contribute to new firm formation could come from the supply factors related to the quality of local labor market and business climate. More educated people would mean more human capital embodied in their general and specific skills, for implementing new ideas for creating and growing new businesses. One possible implication of these findings is that regions or counties with different levels of human capital endowment and different propensities of locally available knowledge to spill over and stimulate new firm formation tend to have different rates of new firm formation, survival and growth. The percent of female householder families (FHHF) is another conditioning demographic variable included in the model. Female householder families tend to have low labor participation rate. The coefficient on FHHF is negative and statistically significant at the five percent level, indicating that FHHF has negative impact on EMPR. This is consistent with theoretical expectations and empirical findings. FHHF affects both the supply-side (as source of labor input) and the demand-side (as source of demand for consumer goods)

of the market. Thus, this result suggests that Appalachian counties with higher proportion of female household header in their communities tend to show lower growth in business or employment.

We have also included county unemployment rate (UNEMP) in our vector of exogenous variables as a measure of local economic distress. Our results suggest that high unemployment rate is associated with low business growth. This indicates that the poor economic environment in Appalachian States did not provide incentive for individuals to form new business that can employ not only the owner, but others. Unemployed individuals may not have capital to start their own business. A high level of unemployment is also an indication of a reduction in aggregate demand in the region which puts downward pressure on new firm formation. This result is also in line with the study by Acs and Armington (2004b) which found that unemployment is associated negatively with new firm formation during growth periods and positively during recession periods.

The percentage of people employed in manufacturing (MANU) and the percentage of people employed in whole sale and retail trade (WHRT) are included in the model to control for the influence of sectoral concentration of employment on the overall employment of business growth rate. The coefficient on MANU is positive and statistically significant at the one percent level, indicating a direct relationship between growths in overall employment or business expansion and manufacturing employment at the beginning of the periods. The coefficient on WHRT is also positive and significant at the five percent level, indicating the positive role played by the service sector in expanding employment and business in Appalachian States during the study period.

Thus, these results tend to suggest that Appalachian States counties who had higher proportion of their labor force employed in manufacturing and whole sale and retail trade at the beginning the periods experienced higher growth rates in overall employment. This is not unrealistic because during most of the study period many areas in Appalachian States has experienced a shift from coal mining-based economic activities to manufacturing and even more to services.

The coefficient on the natural amenity index (NAIX) is positive and statistically significant at the one percent level. This result is inconsistent with McGranahan (1999) who found weaker overall association between natural amenities and employment change. High-way density (HWD) is included in the model to measure the influence of accessibility to business and employment growth. The positive and statistically significant coefficient on HWD shows a positive association between the concentration of roads and employment growth. This result suggests that Appalachian States counties with higher road densities show increases in the growths of employment, compared to counties with low road densities, during the study period. This finding is consistent with both theory and empirical findings (see Carlino and Mills, 1987).

Establishment density (ESBd), which is the total number of private sector establishments in the county divided by the total county's population, is included in our model to capture the degree of competition among firms and crowding of businesses relative to the population. The coefficient on ESBd is negative and statistically significant at the one percent level, indicating that Appalachia region has reached the threshold where competition among firms for consumer demands crowds businesses. According to the results, high ESBd is associated with low growth in Employment

(business growth), indicating that firms tend not to locate near each other possibly due to high competition for local demand.

The coefficient on the variable representing the percentage of home owned by their occupants (OWHU) is positive and significant at one percent level. This result indicates that high home ownership is positively associated with business formation in Appalachian States. This is consistent with theoretical expectation that high home ownership is an indication that there is a capacity to finance new business by potential entrepreneurs, either by using the house as collateral for loan or as indication of availability of personal financial resources to start new business. It also gives support to empirical findings in the literature (see Reynolds, 1994; Keeble and Walker, 1994).

The results indicate that the county employment level is dependent on gross in-migration, gross out-migration, and median household income. The coefficient for INM, for example, is positive and significant at the five percent level. The coefficient for OTM is negative and statistically significant at the one percent level. These are consistent with theoretical expectations and empirical findings (Borts and Stein,). In-migration tends to shift both the labor supply and labor demand curve right-wards, and out-migration tends to lead to leftward shift of the curves. Thus, in-migration leads to increases in employment, whereas out-migration leads to decreases in employment. A growing population increases the demand for consumer goods and services and it is positively related to business formation (Acs and Armington, 2004a).

Consistent with theoretical expectations and empirical findings, the coefficient for MHY is positive and statistically significant at one percent level. Increases in the

demand for goods and services that result from increases in family median or per capita income are associated with increases in employment (Armington and Acs, 2002).

An interesting observation from our results pertains to the role of local government on business growth. Our model predicts that local governments, through their spending and taxation functions, have critical roles in creating enabling economic environments for businesses to prosper. The results of our model, however, indicate that local governments had not played significant roles in employment growth in Appalachian States. Given the economic hardship and high level of underdevelopment in most areas in these states, these results are indications that local governments may need step up their efforts to create incentives in order to encourage business growth in the region.

Finally, the elasticity of EMPR with respect to the initial employment level (EMPt-1) is negative and statistically significant indicating convergence in the sense that counties with initial low level of employment at the beginning of the period tend to show higher rate of growth of business than counties with high initial levels of employment conditional on the other explanatory variables in the model. This result supports prior results of rural renaissance in the literature (Deller *et al.*, 2001; Lunderberg, 2003). The speed of adjustment η_{em} is calculated as 0.10267 and it indicates that about 10.267 percent of the equilibrium rate of growth in employment was realized during the ten-year period (1990-2000). This is comparable to the findings in the literature.

7. CONCLUSIONS

The main objective of this study is to investigate the determinants of regional variation in business growth rates in Appalachian States counties. To do this, a spatial growth equilibrium model is developed and the model is estimated by Generalized Spatial Two-

Stage Least Squares (GS2SLS) estimator using county-level data covering all 1096 Appalachian States counties for the 1990-2000. The parameter estimates are consistent with theoretical expectations and empirical findings in the equilibrium growth literature. In particular, we find that EMPR in one county is positively affected by EMPR in neighboring counties. The policy implication of this is that neighboring counties may need to pool their resources in creating enabling environments (business climate) to make their counties attractive to firms. Our results also indicate the presence of spatial correlation in the error terms. This implies that a random shock into the system spreads across the region. The results also indicate convergence across counties in Appalachia with respect to EMPR conditional upon the initial conditions of the explanatory variables in the model. The speed of adjustment is relatively slow, about one percent of the equilibrium rate of growth of employment is realized each year.

The results also indicate the presence of significant agglomerative effects. Counties that had population with higher level of Educational attainment and income at the beginning of the decade showed significant business growth. This information may encourage policy makers at the county level to design policies that can attract people with these characteristics to their respective counties.

Although road quality differences are not accounted for in this study, the results indicated that increases in road density had positive and significant impacts on the growth rate of employment. Transportation is a critical bottle neck in the growth and development of business activities in a given area. Cost reduction as the result of the availability of roads and the increase in consumer demand that results from increased access to shopping centers boosts businesses.

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Table 1: Variable Description and Data Sources

Variable Code	Variable Description	Source
Endogenous Variable		
EMPR	Growth Rate of Employment, 2000-1990	Computed
Spatially lagged Endogenous Variable		
WEMPR	Spatial Lag of EMPR	Computed
Regional and Policy Variables		
POP25-44	Percent of population between 25 -44 years old , 1980, 1990	U.S. Bureau of the Census
FHHF	Percent of Female Householder, Family Householder, 1980, 1990	County & City Data Book
POPCD	Persons 25 years and over, % bachelor's degree or above, 1990	County & City Data Book
OWHU	Owner-Occupied Housing Unit in percent,1990	U.S. Bureau of the Census
UNEMP	Unemployment Rate , 1990	Bureau of Labor Statistics
MANU	Percent employed in manufacturing , 1990	County & City Data Book
WHRT	Percent employed in wholesale and retail trade ,1990	County & City Data Book
PCPTAX	Property Tax per Capita ,1992	County & City Data Book
NAIX	Natural Amenities Index , 1990	USDA
HWD	Highway Density , 1990	US Highway Authority
ESBd	Establishment Density ,1990	County Business Pattern
INM	In-migration,1990	Internal Revenue Service
OTM	Out-migration , 1990	Internal Revenue Service
MHY	Median Household Income, 1989	Bureau of Economic Analysis
GEX	Local Public Expenditures per Capita,1992	U.S. Bureau of the Census
EMPt-1	Employment,1990	County & City Data Book

Table 2: Descriptive Statistics for Appalachian States Counties, 1990-2000.

Variable	Variable Description	Mean	Std Dev	Minimum	Maximum
EMPR	Growth Rate of Employment,1990-2000	0.21631	0.28342	-1.38629	1.48355
WEMPR	Spatial Lag of EMPR	0.2172	0.13657	-0.38154	0.90014
POP25-44	Percent of population between 25 -44 years old, 1990	3.26197	0.10216	2.79817	3.68456
FHHF	Percent of Female Householder, Family Householder,1990	2.30595	0.26513	1.51909	3.12621
POPCD	Persons 25 years and over, % bachelor's degree or above, 1990	2.22241	0.42362	1.02985	3.80531
OWHU	Owner-Occupied Housing Unit in percent,1990	4.28707	0.1249	2.75366	4.48413
UNEMP	Unemployment Rate ,1990	1.97106	0.34817	0.75614	3.17018
MANU	Percent employed in manufacturing ,1990	29.08324	10.97778	2.38955	61.54639
WHRT	Percent employed in wholesale and retail trade ,1990	17.24798	3.38547	6.7223	29.05923
PCPTAX	Property Tax per Capita ,1992	4.99455	0.64917	2.3979	7.31455
NAIX	Natural Amenities Index , 1990	-0.19613	1.17298	-3.98	3.55
HWD	Highway Density , 1990	0.71309	0.52604	-1.31852	3.16725
ESBd	Establishment Density ,1990	2.70538	0.3537	0.66964	4.20076
INM	In-migration,1990	7.38515	1.17883	4.41884	11.27714
OTM	Out-migration , 1990	7.38134	1.18227	4.41884	11.31004
MHY	Median Household Income, 1989	9.50561	0.23205	8.79785	10.30932
GEX	Local Public Expenditures per Capita,1992	6.63035	0.33133	4.00733	8.50856
EMPt-1	Employment,1990	8.75613	1.46331	3.95124	13.44

Note: All variables except NAIX are in log form

Table 3: Generalized Spatial Two-Stage Least Squares(GS2SLS) Estimation Results

Variable	Variable Description	Coefficient	t-statistic
Constant	Growth Rate of Employment,1990-2000	-0.612391	-0.911833
WEMPR	Spatial Lag of EMPR	0.481525***	6.93699
POP25-44	Percent of population between 25 -44 years old ,1990	0.627672***	5.65045
FHHF	Percent of Female Householder, Family Householder, 1990	-0.068485**	-2.01177
POPCD	Persons 25 years and over, % bachelor's degree or above, 1990	0.181579***	6.34648
OWHU	Owner-Occupied Housing Unit in percent,1990	0.206435***	2.58807
UNEMP	Unemployment Rate ,1990	-0.076238**	-2.49075
MANU	Percent employed in manufacturing , 1990	4.39E-03***	3.34915
WHRT	Percent employed in wholesale and retail trade ,1990	0.013484**	2.53829
PCPTAX	Property Tax per Capita ,1992	-0.015748	-0.990659
NAIX	Natural Amenities Index , 1990	0.012051**	2.05176
HWD	Highway Density , 1990	0.048384***	2.77643
ESBd	Establishment Density ,1990	-0.210267***	-2.73198
INM	In-migration,1990	0.055369**	2.22727
OTM	Out-migration , 1990	-0.22611***	-3.47263
MHY	Median Household Income, 1989	0.0757**	2.45011
GEX	Local Public Expenditures per Capita,1992	1.66E-03	0.061512
EMPt-1	Employment,1990	-0.102666***	-5.56412
RHO(ρ)	Spatial Autoregressive Parameter	-0.29177	-11.49178
ETA (η_{em})	Speed of Adjustment Parameter	0.102666	
	Half-Life	6.7206	
NR^2~X^2(20)	Orthogonality test	43,1732	0.3581
N	Sample Size	1096	

Note: **, **, and *** denote statistical significance level at 10 percent, 5 percent and 1 percent, respectively*

Table 4: Diagnostics for Spatial Dependence

TEST	MI/DF	VALUE	PROB
Moran's I (error)	0.06521	2.6539601	0.0079554
Lagrange Multiplier	1	5.6296426	0.0176592
Robust LM (lag)	1	1.334387	0.2480263
Lagrange Multiplier	1	4.2956933	0.038209
Robust LM (error)	1	0.0004377	0.983308
Lagrange Multiplier	2	5.6300804	0.0599023