15

Examining the Bidirectional Relationship Between Entrepreneurship and Economic Growth: Is Entrepreneurship Endogenous?

Maribel N. Mojica-Howell, Wesley L. Whittaker,
Tesfa G. Gebremedhin and Peter V. Schaeffer
Alcorn State University and West Virginia University
USA

1. Introduction

Many scholars and professionals believe that entrepreneurship is critical to maintain an economy's health and that business creation in low income areas is essential for economic development (Goetz and Freshwater, 2001; Acs, 2006; Lichtenstein and Lyons, 2001; Smilor, 1997). As Minniti (1999) argues, entrepreneurs are catalysts for economic growth as they generate a networking innovation that promotes the creation of new ideas and new market formations. Schumpeter (1934) also states that the success of markets lies in the spirit of entrepreneurs who persist in developing new products and technologies and succeed, ultimately, resulting in lower production costs. He also described five cases in which innovative activity increases economic growth. First is the introduction of a new good, which is a new product or an improvement of a product which is not yet known by the consumers in the market; a new method of production, the one that is not yet used in the manufacturing of the product; a new market that has not been entered for a particular product; a new source of supply for raw materials whether it already exists and is eventually discovered or it has to be created; and the evolution of a new organization in an industry like the formation of a monopoly. According to Schumpeter, these activities result in economic opportunities which eventually lead to economic growth. In addition, the works of entrepreneurs lead to more innovations and more profit opportunities and, hence, more growth which becomes a cycle of economic opportunities and for maximizing profit.

Wennekers and Thurik (1999) summarized the influence of entrepreneurship on regional economic growth in two ways. First, entrepreneurship increases the start-up rate of new firms and therefore increases employment. Second, entrepreneurial activities yield efficiency advantages within the existing firms. These result in a social structure that influences the absorptive capacity of a country and promote its ability to adopt new technologies. Hence, when entrepreneurs reap the benefits of their abilities, within the firm and in relation to other firms, their activities are likely to enhance economic growth and development.

Over the years, policymakers have shown great interest in exploring the role of entrepreneurship in generating economic growth and development. Kreft and Sobel (2005) state that economic development policies in the past two decades have been diverted from

attracting large manufacturing firms towards encouraging internal entrepreneurship. Understanding economic development and identifying appropriate policies to foster development requires an understanding of entrepreneurship in a particular environment. In this era of globalization, supporting entrepreneurship becomes indispensable for the United States to regain a competitive lead in the world economy (Baumol, Litan, and Schramm, 2007). An understanding of entrepreneurship becomes important to know how entrepreneurship matters in economic growth and development, and furthermore, how entrepreneurial capacity can be expanded to increase the chance of achieving economic development. Exploring the characteristics of entrepreneurship and its contributions to the local economy can help develop a map for designing specific development policies for a region. The target of these policies is to improve and expand community-based economic development capabilities and initiatives to assist small towns and rural areas in creating new firms, retaining and expanding local businesses, and expanding entrepreneurial development, and eventually helping to alleviate poverty.

Understanding the relationship between entrepreneurship and economic development is crucial for two reasons. First, the international economic development community has learned that the one-size-fits-all approach does not work (Easterly, 2001). Second, economic importance of entrepreneurship and its role in economic development has received significant emphasis in research work in recent years. This suggests that public policy needs to emphasize the dynamics of entrepreneurship and economic development as well as relevant local institutional conditions and region-specific characteristics.

Though considerable attention has been given to examining the links between entrepreneurship and economic development, the central focus of this study is to determine the importance of entrepreneurship in economic development on a regional perspective, specifically in the Appalachian region. The region has been considered by many studies as an area symbolized by underdevelopment and poverty (Pollard, 2003). Forty-two percent of the population is in rural areas compared to the national average of twenty percent. In addition, many parts of the region can be considered remote due to poor infrastructure and topography. Median family income in Appalachia remains substantially below the national average. The poverty rate is higher and labor force participation is lower in the region compared to the United States as a whole. For instance, the poverty rate in the US was 13.2 percent in 1990 and 12.4 percent in 2000. In Appalachia, the poverty rate was from 15.4 percent in 1990 to 13.6 percent in 2000 (US Census). Moreover, the region was concluded to be different from the other parts of the U.S. not only because of its geographical location but because of its social and economic development status relative to the other regions of the country (Isserman, 1996). Therefore, there is a need to determine how entrepreneurship contributes to the well-being of the economy for policy makers to develop appropriate policies to improve the Appalachian environment for business formation that leads to economic development. This study will provide evidence as to whether entrepreneurship contributes to regional economic development. The main objective of this study is to increase the understanding of entrepreneurship, its contributions to economic growth, and its potential as a development strategy for a region characterized by poverty and underdevelopment such as Appalachia. It also examines whether entrepreneurship is endogenous with economic growth. That is, whether entrepreneurship causes economic growth and vice versa.

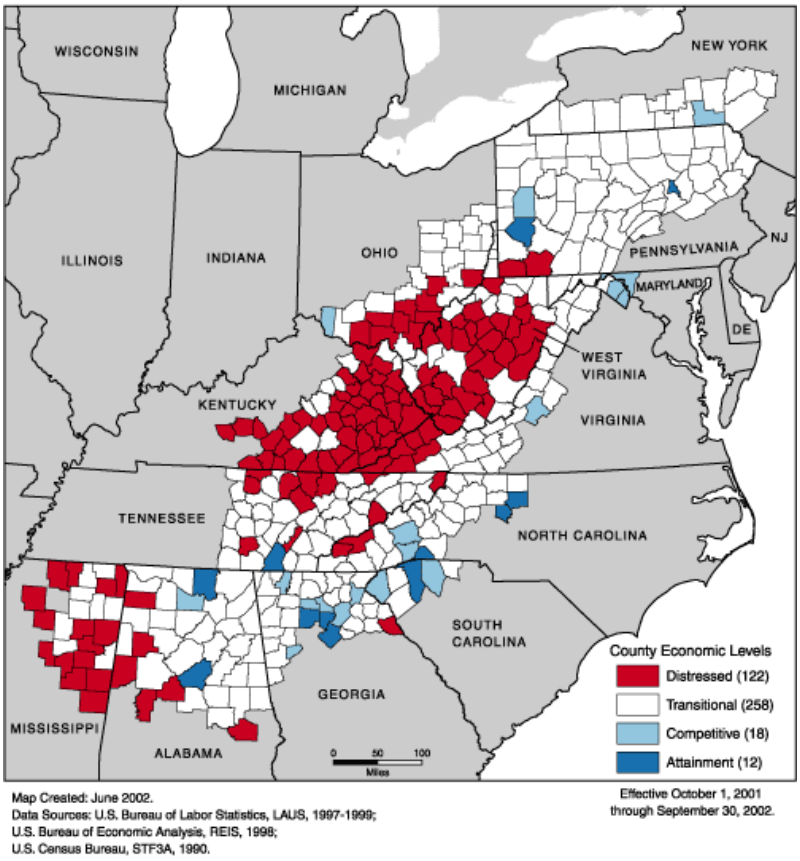
1.1 The study area

The study area comprises the Appalachian region where the relationship between entrepreneurship and economic development is examined. The region, as defined by the Appalachian Regional Commission (ARC), is composed of 13 states with a total of 410 counties as shown in Figure 1. The area includes the whole of West Virginia, most of Pennsylvania, the southern part of New York, southeastern Ohio, the western portions of Maryland, South Carolina and North Carolina, the eastern portions of Kentucky and Tennessee, the northern areas of Alabama and Geogia, and the northeastern part of Mississippi.

Fig. 1. Map of Appalachia

The region has received considerable attention in the literature as it is recognized to have unique characteristics particularly with respect to its economic situation relative to the other parts of the U.S. The region's economy in the past was based on manufacturing, agriculture, and the extraction of natural resources, while it is now diversifying into services, retailing, and tourism (Appalachian Regional Commission, 2008). Considering the economic diversity of the region, the commission has developed a classification system that identifies and monitors the economic status of its counties. The system involves an index of county economic status based on economic indicators including unemployment rate, poverty rate, and per capita income. Using the composite index value, each county is classified into one of five categories of economic status: distressed, at-risk, transitional, competitive, and

attainment. Distressed counties are the most economically depressed counties; at-risk are those at risk of becoming economically distressed; transitional are those transitioning between weak and strong economies; competitive are those who can compete in the national economy, but are not at the top levels of economic status; and attainment are the ones which are economically strongest. As shown in Figures 2 and 3, distressed counties are mostly in central Appalachia. However, between 2002 and 2008, some counties in central Appalachia attained the "at-risk" category. The northern part of Appalachia was mostly in the transitional category between 2002 and 2008 while the southern portion shows diverse changes.

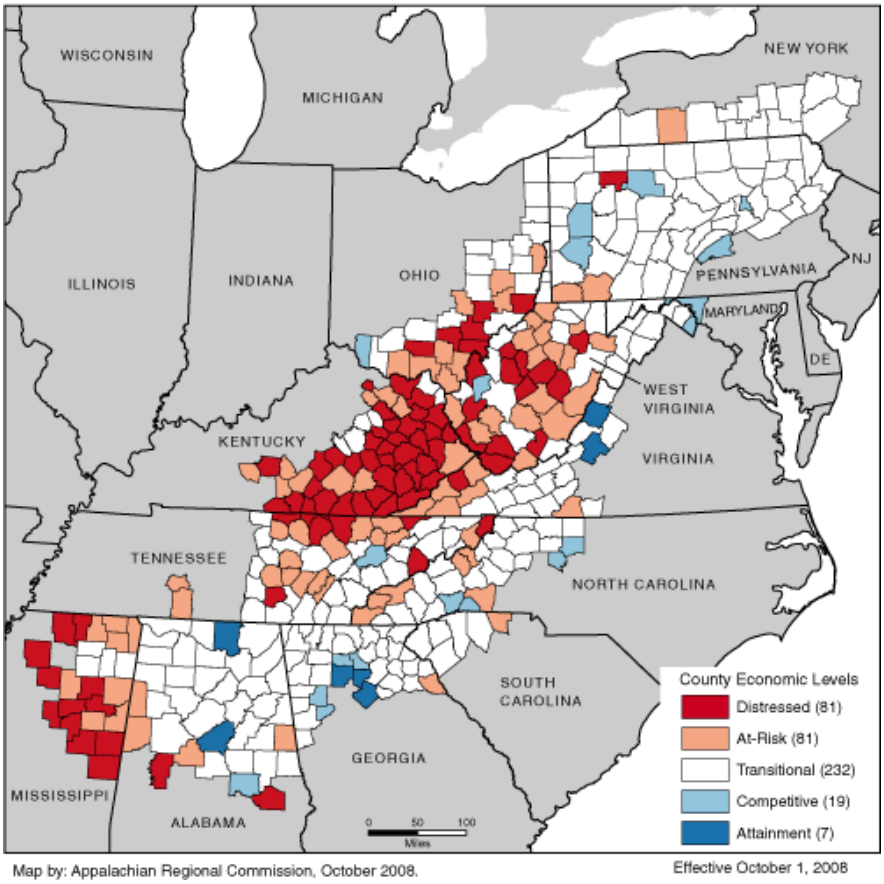


Source: Appalachian Regional Commission, www.arc.gov

Fig. 2. County Economic Levels in Appalachia, 2002

Appalachia is chosen as the area of study considering its economic situation compared to other regions in the country. It has a number of rural states that could show evidence of the effectiveness of supporting entrepreneurship as a development strategy in areas with rural characteristics. The variability in economic status across the region provides variation in data which should enable a viable quantitative analysis leading to the identification of valuable econometric relationships between variables in the model.

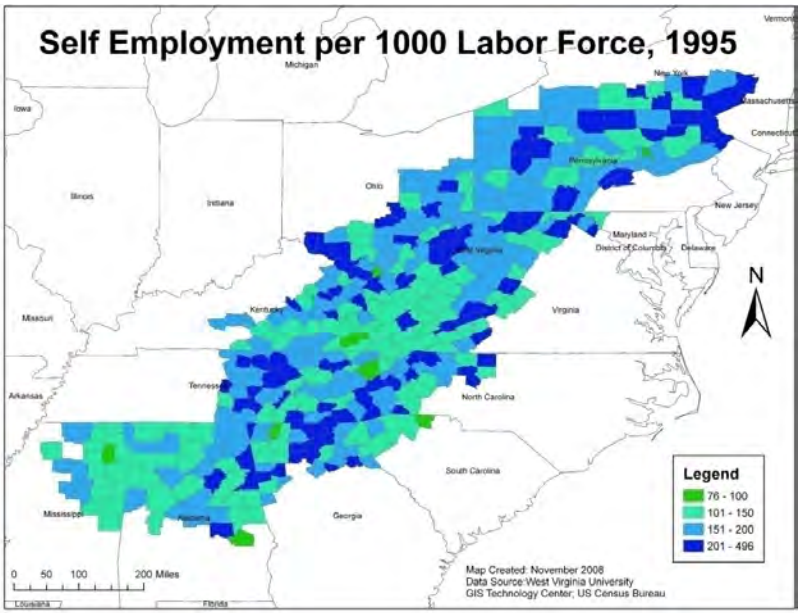
In terms of entrepreneurship, despite the region's geographical and economic disadvantages, Appalachia has many entrepreneurial assets including small, home-grown businesses that play an important role in creating self-sustaining local economies and improving quality of life. The Appalachian Regional Commission (ARC) started an Entrepreneurial Initiative with the goal of promoting the formation of businesses owned by local residents to increase local wealth and provide employment opportunities to the local community. Figures 4 and 5, constructed using data from the Bureau of Economic Analysis (BEA), present the variation in the numbers of self-employed throughout the Appalachia for years 1995 and 2005. Self-employment is one of the most popular measures of entrepreneurship used in the literature. The maps show the heterogeneity of entrepreneurial capacity in the region for the years covered in the data which facilitates the econometric analyses. Counties with higher levels of entrepreneurial capacity are expected to have higher levels of growth compared to the less entrepreneurial counties.



Source: Appalachian Regional Commission, 2008

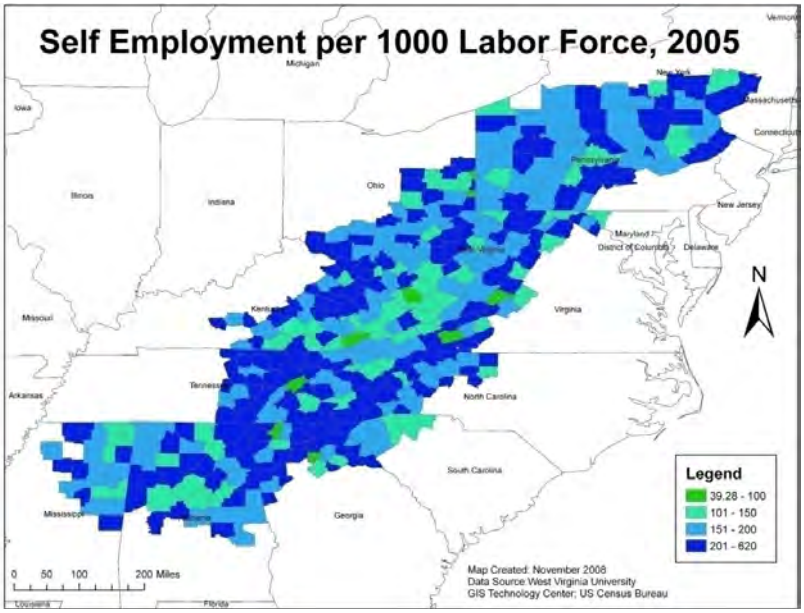
Fig. 3. County Economic Levels in Appalachia, 2008

The number of firm start-ups is another popular measure of entrepreneurial activity. Figures 6 and 7 present the variation in the number of firm births throughout the Appalachia for years 1998 and 2005 since data on firm births in 1995 is not available. The maps are created using published data from Statistics of U.S. Businesses (U.S. Census Bureau).



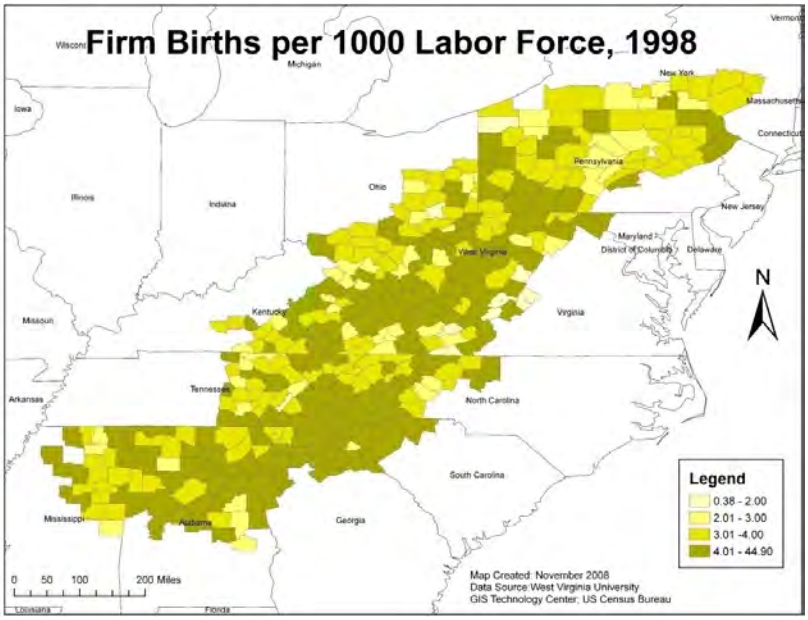
Map Created by the author

Fig. 4.



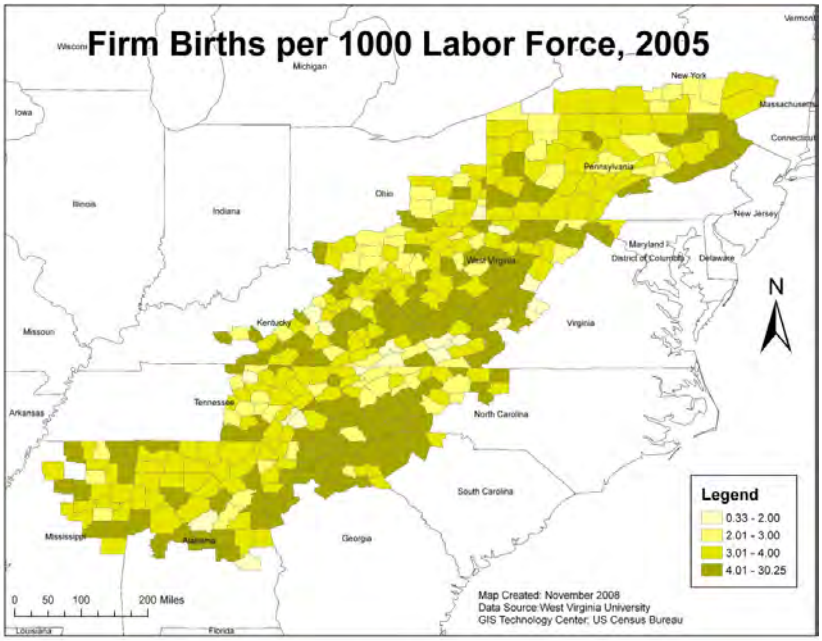
Map Created by the author

Fig. 5.



Map Created by the author

Fig. 6.



Map Created by the author

Fig. 7.

1.2 Literature review

Although empirical research on the role of entrepreneurship is not well-developed, the literature has paid considerable attention to the link between entrepreneurship and economic growth. The first issue in examining the relationship between entrepreneurship and economic growth is the definition of the term "entrepreneurship." Since entrepreneurship is a multidimensional concept and there is no general agreement on the economic theory of entrepreneurship, previous studies have defined and used the term in different ways. Beginning with Schumpeter (1934), he defines an "entrepreneur" as an individual marked with innovative ideas, utilizing new combinations of means of production. Kirzner (1979) emphasized the entrepreneur as an enthusiast in discovering opportunities to make profit. Knight (1921) and Schultz (1980), supporting neo-classical economic theory, described an entrepreneur as an individual who is willing to take risks in performing economic functions, while others (Hagen, 1962; McClelland, 1961; Kihlstrom and Laffont, 1979) argued that an entrepreneur is a person with certain unique psychological characteristics. Although these concepts have contributed greatly to the understanding of entrepreneurship, a universally accepted explanation or measure of the concept has not yet been found. Hence, previous studies have used different concepts according to the purpose of the study, the theory applied, and the availability of information needed for empirical research.

To investigate the link between entrepreneurship and economic growth, Wennekers and Thurik (1999) presented a framework consisting of three parts as a starting point in the field of studying entrepreneurship and economic development. Using theories developed in previous studies on the subject, they argued that the beginning of entrepreneurship is about the characteristics and roles of individuals and the typology of entrepreneurship should start at the micro level. Entrepreneurship takes place in the firm where the entrepreneur transforms his personal traits, attitudes and skills into actions. These actions at the firm level are reflected through "newness" by new products, innovations, and entry to new markets or business start-ups. At the aggregate level, these many entrepreneurs create variety in the industries, regions, and national economies and through competition lead to survival of the most viable firms and industries. This process then transforms the regional and national economies by replacing obsolete firms with highly productive ones which eventually increase international competitiveness and increase profits. Wennekers and Thurik (1999) assumed that the result of this chain linking the entrepreneur to the national economy is economic growth. In addition, their framework suggests that the outcome of this dynamic process depends on a set of conditions where the entrepreneur operates. These conditions refer to the cultural environment in the region and in the national economy as well as the institutional framework defining the incentives and the barriers in transforming entrepreneurial ambitions into actions. Their conclusions suggested to operate in the multidimensional concept of entrepreneurship at higher dimensions such as the industries and national economies, as well as possibly devising a scale to monitor the level of entrepreneurship over time and/or comparing entrepreneurship levels between economies. They also emphasized the conditions for entrepreneurship including cultural and institutional factors, as well as technological, demographic, and economic forces. The last part of the framework linking entrepreneurship and economic development is an attempt to answer why some new start-ups fail, what are the roles of institutions and policies in the performance of entrepreneurship in the national economies, and how to incorporate the results in econometric models which can be used for policy analysis.

Acs et al. (2005) used start-ups of new firms as a measure of entrepreneurship that facilitates spillover of knowledge. This is based on the theory of endogenous growth where knowledge was added as a factor explaining economic growth aside from the traditional factors of production, capital and labor. Entrepreneurship was used as a mechanism that transforms knowledge into growth. The study used a fixed effects and simultaneous equations model to empirically examine the impacts of entrepreneurship on economic growth using country-level data for years 1981-1998. The models used lagged values of Gross Domestic Product (GDP) as a measure of economic growth regressed against variables explaining economic growth such as investments in knowledge, level of entrepreneurship, and a set of other variables. The level of entrepreneurship was represented by using the self-employment rate and was found to have a positive impact on economic growth in both models. Countries with higher degrees of entrepreneurial activity were found to have higher rates of economic growth.

Another cross-country analysis was performed by Beck, Demirguc-Kunt, and Levine (2005) who found a positive and statistically significant relationship between small and medium enterprises (SMEs) and economic growth. SMEs are found to have high levels of innovation in skill intensive industries (Acs and Audretsch, 1987) and are used to measure

entrepreneurial levels in the literature. The study used a database on the share of SME labor in the total manufacturing sector of the countries as a variable to explain economic growth measured by real GDP per capita. Several policy variables were included in the growth model such as government expenditures as a share of GDP, share of exports and imports in GDP, inflation rate, share of credit to the private sector by financial institutions in GDP, and variables measuring business environment. Using ordinary least squares (OLS) regression, the results revealed that the share of SME employment in total manufacturing employment is associated with greater levels of growth in GDP per capita. To control for endogeneity, a second model using instrumental variables (IVs) was employed. Though the result yielded a positive relationship between SMEs and GDP per capita, it was not statistically significant.

Audretsch and Keilbach (2005) introduced the concept of entrepreneurship capital, referring to the society's capacity to create entrepreneurial activity specifically to generate new firms. The study hypothesized that a region with more entrepreneurship capital shows a higher economic performance. This is based on the theory of entrepreneurship serving as a mechanism to transform knowledge spillovers to economic growth. Specifically, the study measured the impact of entrepreneurship on regional labor productivity and on the regional growth of labor productivity in Germany. Entrepreneurship capital was measured using the number of startup enterprises relative to the region's population. In addition, entrepreneurship capital was classified into three types: startups in all industries, high-technology startups, and startups in Information Communication and Technology (ICT) industries. This was done to capture the effects of the two latter measures on economic performance since they involve R&D as well as greater financial risks. The results of the regression revealed that all three measures of entrepreneurship capital significantly affect the region's labor productivity. However, the results for the second model on the effect of entrepreneurship capital on the growth of labor productivity showed statistically significant effects only on the R&D intensive industries.

Acs and Armington (2005) also examined the relationship between entrepreneurship and economic growth, using the Census Business Information Tracking Series (BITS) dataset. These data cover US private sector businesses and track their employment and firm ownership. They were used to estimate a regression model of regional variation in rates of employment growth as determined by entrepreneurship. Economic growth was represented by average annual employment growth while entrepreneurial activity was measured using the formation rate of firms with less than 500 employees and the business-owner share of the labor force. In addition, measures of agglomeration effects and human capital were included in the model. As hypothesized, the results revealed a positive and statistically significant coefficient on the firm birth rate. Business-owner share of the labor force was also found to make a positive and statistically significant contribution to employment growth. Specifically, the study reported that an increase in the new firm formation rate of one standard deviation from its mean causes the employment growth rate to increase by one-half standard deviation from its mean.

Van Stel and Suddle (2005) used regional data in the Netherlands to examine the relationship between new firm formation and change in regional employment. In addition, they investigated the relationship considering the difference in time period, sector, and degree of urbanization. They found that the maximum effect of new firms on regional development is reached after about six years. Fixed effects estimation was employed using

employment growth as the dependent variable regressed against startup rate, wage growth, and population density. To control for differences in time periods, the sample was divided into two time periods and the results showed that the impact of new firm formation to employment growth has been stable and exactly the same in both periods. Moreover, the study investigated the relationship between employment growth and startup rates across different sectors. They found that the effect of startup rate is highest in the manufacturing sector. Finally, they also found that the degree of urbanization significantly affects the growth of employment. The effect of startup rate was bigger in the Western side compared to the Northern provinces where the average degree of urbanization is 51 percent and 12 percent, respectively.

Another study which used employment as the dependent variable was done by Folster (2000) utilizing simultaneous equations to determine whether entrepreneurs create jobs. The first equation captures the individual's choice to pursue self-employment due to a fall in employment or as a result of demand fluctuation in the market and structural changes in business conditions. The second equation represented demand for labor as a function of wage rate, business environment, and the share of self-employed. The data set is a pooled time-series cross section data on 24 Swedish counties for years 1976 to 1995. Simultaneity issues between self-employment and total employment was addressed by employing instrumental variables and estimating the equations using 2-stage least squares regression. Results show a statistically significant and positive relationship between self-employment and total employment.

Using 54 European regions, Beugelsdijk and Noorderhaven (2004) empirically estimated the relationship between entrepreneurial attitude and economic growth. This is based on Wennekers and Thurik's (1999) summary of the influence of entrepreneurial activity on regional economic growth that when entrepreneurs benefit from their actions, the result is enhanced growth at a macro level. The study used data on European Values Studies (EVS) which is a large scale, cross-national survey program on basic human values. Entrepreneurial characteristics were estimated using the answers to questions such as ascribed reasons for personal failure or success, values instilled in children, attitudes towards future developments, preference for equality versus freedom, and the attitude towards a number of social issues. The answers were used as proxies to measure need for entrepreneurial characteristics such as need for achievement, ability to control and taking risks, and an innovative attitude, while economic growth was measured using GDP per capita. They tested whether regions characterized as "entrepreneurial" grow faster than regions that score lower on entrepreneurial characteristics. Entrepreneurial attitude was determined by comparing the characteristics of self-employed individuals with the general population and with wage earners. The variation in entrepreneurial characteristics was found to have an important role in explaining growth differentials across the regions. High scores for entrepreneurial characteristics were correlated with high rates of regional economic growth.

Henderson (2006) also considered differences between rural and urban areas in examining the relationship between entrepreneurial activity and economic growth. Using county level data, entrepreneurship activity in the first model was represented by using business startup measures such as the number of business startups, the number of new businesses that survived five years, and the number of new business startups that survived and achieved

high growth. In the second model, business ownership factors such as the average share of non-farm employment and the average annual growth rate in entrepreneurs were used as indicators of entrepreneurial activity. In addition to entrepreneurship measures, employment growth was regressed against other factors that are believed to be affecting economic growth such as transportation infrastructure, labor characteristics, agglomeration forces, natural amenities, property taxes, and regional dummy variables. The results of testing the model using business ownership variables support the notion that entrepreneurial activity positively affects employment growth. This is also true for the models using business startup indicators. However, when all three measures of business startups were tested in one model, only the coefficient for the number of new firms with high growth was found to be positive and significant. Considering the analysis between metropolitan and non-metropolitan areas, the study found that employment growth was stronger in metro counties in relation to the number of business startups and the number of new businesses that survived. However, there was no significant difference for the relationship between high growth business startups and employment growth between metro and non-metro counties.

Camp (2005) reported that the most entrepreneurial regions in the U.S. had 125 percent higher employment growth, 58 percent higher wage growth, and 109 percent higher productivity. The study supports the view that entrepreneurship is the link between innovation and regional economic growth and development. Regression results revealed that a four-year lag between measures of entrepreneurship and economic growth, the positive and significant coefficients for entrepreneurship activity and the high levels of expected variation in the analyses suggest that entrepreneurship is a driver of regional economic growth. Moreover, Kreft and Sobel (2005) support entrepreneurship as the "missing link" between economic freedom and economic growth. Economic freedom generates growth as it promotes entrepreneurial activity. This relationship was studied using sole proprietorship and patent activity as measures of entrepreneurship and the freedom index. The freedom index is composed of a number of public policies affecting economic freedom. The results further support entrepreneurship as a conduit towards economic growth.

These studies have supported the theory that entrepreneurship contributes positively to economic growth. However, empirical analyses examining the role of entrepreneurship in fostering economic growth at a county-level perspective are lacking, particularly for specific regions of the US. Most studies have used cross-country analysis and regions in a particular country while some recent research used labor market areas (LMAs) as the geographical unit of empirical analyses. A labor market area is a central city surrounded by counties which is considered to have integrated economic activities. By using county-level data in a specific region like Appalachia, this study will examine more closely the relationships between entrepreneurship and economic growth. This will investigate the impacts of entrepreneurial activity on economic progress in the Appalachian region and will verify the impacts of entrepreneurship as a strategy to achieve economic progress in communities that are continuously in search for new engines of growth. Furthermore, this study will add information to the literature on linking entrepreneurship and economic growth by employing changes in population and income levels as additional measures of economic growth. Most studies have used change in employment as endogenous variable, while

country-level studies have used GDP growth. Using increases in population and per capita income will add a different dimension to measuring economic progress, in addition to employing change in employment as a measure of growth. In addition, this study will contribute to the existing literature by using different methods to empirically analyze the relationship between entrepreneurial activity and economic growth.

1.3 Defining entrepreneurship

Though entrepreneurship has gained significant attention in previous studies, there is no general consensus on the definition of the concept. Within the entrepreneurship literature, the definitions have been problematic and "the failure to establish definitions has disrupted the evolution of a framework for the entrepreneurship discipline" as quoted by Carland et al. (1995) which has resulted in a study of the entrepreneurial process in different approaches. In search of the meaning of entrepreneurship, Hebert and Link (1989) summarized three intellectual traditions in the conceptual development of entrepreneurship in the literature. These include the German tradition based on von Thünen, Schumpeter, and Baumol, the Austrian tradition of Kirzner, von Mises, and Menger, and the neo-classical tradition of Schultz, Knight, and Marshall. The Schumpeterian concept emphasized the entrepreneur as an initiator of creative destruction which is a beneficial phenomenon leading to disequilibrium. Schumpeter's theory argued that new firms with entrepreneurial characteristics displace less innovative firms which eventually results in higher economic growth (Schumpeter, 1934). On the other hand, the neo-classical tradition highlighted the entrepreneur as a leader towards equilibrium in the markets through entrepreneurial activities. The Austrian tradition stressed the abilities of the entrepreneur in perceiving profit opportunities.

The Schumpeterian tradition had the greatest impact on the economic literature. However, despite its significant influence in the field of entrepreneurship studies and its emphasis on startup enterprises, there is no generally accepted definition of entrepreneurship. Hebert and Link (1989, p.47) then proposed a "synthetic" definition of an entrepreneur as "someone who specializes in taking responsibility for and making judgmental decisions that affect the location, form, and the use of goods, resources, or institutions."

The literature has characterized the entrepreneur in many different ways. Low, Henderson, and Weiler (2005) described the entrepreneur as an individual who started his own business with several characteristics distinguishing him from other persons in the business world. These qualities include risk bearing, ability to make decisions, and being innovative. However, entrepreneurs vary in terms of their qualities measured through the impacts they make in a locality. Lifestyle entrepreneurs, referring to business starters who built businesses to achieve a certain lifestyle, mainly contribute to the region's entrepreneurial breadth by adding to the number of entrepreneurs in the region while improving local quality of life. On the other hand, high-value entrepreneurs focus on creating wealth, increasing profits, and adding jobs leading to economic growth. Describing these contrasting types of entrepreneurs creates a diversity of entrepreneurship.

Montanye (2006) defined entrepreneurship as "the process by which individuals acquire ownership (property rights) in economic rents of their creation." The creation and capture of economic rent are the individual's objectives, not only in business enterprise but in all

aspects of life. The emphasis in the definition is in the actions of an entrepreneur generating economic rent as well as ownership interest which define entrepreneurship. Entrepreneurship, according to Montanye, is defined by the individual's objective success in acquiring property rights to some economic benefit leaving the individual better off than if he is under a system of perfect competition. The definition provides a useful basis for distinguishing theories of entrepreneurship from the many distinct variations within the economic literature and also serves as a distinguishing factor between entrepreneurship and management. The key to the definition is the holistic appreciation of entrepreneurial profit also conventionally known as economic rent. Economic rent is "that portion of a payment to an input which elicits no increase in output, that is, whose marginal product yield to the economy is zero" (Baumol, 1993). The point that is not emphasized in neoclassical economics is that unlike the incentive to produce goods and services under perfect competition, which is unaffected by the removal of economic rent, the incentive to act entrepreneurially diminishes as prospects for rent production and capture decrease. In sum, he defines entrepreneurship as "the successful creation and capture of economic rents in the face of uncertainty and scarcity, enables talented individuals to realize rewards that exceed the equilibrium level of perfect competition and so to live better than others as gauged in subjective utility terms."

Still other authors in the literature recommend different approaches of defining an entrepreneur. Gartner (1988) in his article "Who is an 'Entrepreneur' is a Wrong Question" discussed the trait approach of defining an entrepreneur. In the trait approach, the entrepreneur is characterized to have a particular personality and a fixed state of existence. However, he concluded that this definition is inadequate and that behavioral approaches will be a more productive perspective for future research in entrepreneurship. The behavioral approach defines an entrepreneur as part of a complex process of creating an organization. This approach to the study of entrepreneurship shows the organization as the primary level of analysis and the entrepreneur is viewed in terms of his actions for the organization to come into existence. The emphasis of the behavioral approach is on what the entrepreneur does and not who the entrepreneur is. This supports Cole's behavioral viewpoint by quoting Say (1816) who defined the entrepreneur as an economic agent who "unites all means of production and who finds in the value of products which result in their employment the reconstitution of the entire capital he utilizes, and the value of the wages, the interest, and the rent which he pays, as well as profits belonging to himself" (Cole, 1946). Gartner concluded that organization creation is the idea that separates entrepreneurship from other disciplines. He believes that to truly understand entrepreneurship and in order to encourage its growth, the focus should be on the process by which organizations are created. The individual who creates the organization is the entrepreneur who takes other functions at each possible stage of the life of the organization. The entrepreneur becomes the innovator, the manager, the small business owner, the vice president, and other roles identified by a set of behaviors linking them to organization creation.

On linking entrepreneurship and economic growth, Wennekers and Thurik (1999, p. 46) defined entrepreneurship as the "ability and willingness of individuals to perceive and create new economic opportunities and introduce their ideas in the market, in the face of uncertainty and other obstacles, by making decisions on location, form and the use of resources and institutions." This definition takes a holistic approach of defining

entrepreneurship as it considers newness, uncertainty, and the use of resources in taking the action to fulfill economic opportunities. They also emphasized that the entrepreneur is not a fixed state of existence but rather entrepreneurship is a role that individuals undertake to create organizations, a behavior to create opportunities for entrepreneurial activities.

For the purpose of this study, entrepreneurship will be viewed under the economic perspective of the Schumpeterian tradition. Wennekers and Thurik's definition of entrepreneurship will be adopted, in addition to the synthetic definition of Hebert and Link from which the discussion as well as the selection of variables for the analyses is based upon.

1.4 Measuring entrepreneurship

To analyze the relationship between entrepreneurship and regional economic growth, it becomes necessary to first identify measures of entrepreneurship. This has challenged professionals as defining entrepreneurship has not been an easy task. There is a growing desire to understand the entrepreneurship process and the literature has shown indicators which helped researchers in quantifying entrepreneurship. Measurement is critical for comparing entrepreneurial capacities in different regions and countries and will enable policy makers to identify sound policies that work. However, the development of indicators to assist the analysis and exploration of entrepreneurship has been limited by the availability of data. Though the importance of entrepreneurship is recognized in various fields of study, the term remains ill-defined and interpreted in many ways. As a result, the existing literature on entrepreneurship studies shows that researchers have used different variables as proxies in measuring entrepreneurship. For instance, a number of studies measured entrepreneurship activity using the number of startup businesses (Audretsch and Keilbach, 2005; Camp, 2005; van Stel and Suddle, 2005; Baptista, Escaria, and Madruga, 2005; Acs et al., 2005; and Acs and Armington, 2004). Recently, the number of startups became the most popular indicator used in measuring the level of entrepreneurship. Acs and Armington (2005) used firm formation rate and business-owner share of the labor force as indicators of entrepreneurship.

Self-employment is another popular measure of entrepreneurship used in the literature because of data availability (Acs et al., 2005; Henderson, 2006; Evans and Leighton, 1989; Folster, 2000). Other approximations of entrepreneurship include employment share of surviving young firms in the manufacturing industries (Audretsch, 1995) and share of small firms (Audretsch and Thurik, 1997; Carree and Thurik, 1998). To obtain estimates on the effects of government policies on entrepreneurship across the states of the US, Garrett and Wall (2006) defined the rate of entrepreneurship as the share of the working population (16 to 64 years) who are proprietors.

Low, Henderson, and Weiler (2005) used proxies to measure breadth and depth of entrepreneurial capacity in the U.S. Breadth characterizes quantity reflecting the size and variety of small businesses in a region that employ local resources, generate local income, and improve the quality of life. Entrepreneurial depth, on the other hand, measures quality which represents value created by the entrepreneurs for themselves and the local economy. Measures of entrepreneurship were used as dependent variables in regression equations to examine the factors determining entrepreneurial capacity in U.S. counties.

Entrepreneurial breadth is measured using self-employment to total employment ratio calculated by dividing the number of self-employed by total employment. This measure makes it possible to compare quantities of entrepreneurs in different areas with varying populations. Another measure used in the article is assessing entrepreneurial depth to gauge whether entrepreneurs add value to a region by creating wealth, income, and jobs. Average income and revenue capture were both used as measures of depth of entrepreneurship used to determine the heterogeneity of entrepreneurial depth in different regions. Average income is the ratio of proprietor income to proprietor employment in a county. As a measure of depth, it assumes that entrepreneurs with higher incomes add more value in the local economy. Revenue capture, a second measure of entrepreneurial depth, is calculated by dividing income by total sales which gives the percentage of total sales that ends up as income for the entrepreneurs. Data on nonfarm proprietor income over nonemployer receipt data were used to calculate revenue capture. It assumes that by generating more income per dollar of revenue, entrepreneurs add more value in the local economy.

Firm birth is another popular measure used to quantify entrepreneurship. One important factor in defining business births is timing – that is, whether births should be identified at the time when employees are hired or sometime before that. Another factor is whether the "employment" concept should be the basis of measuring business birth. If employment is the basis, self-employed individuals are counted as recommended by the EUROSTAT, the statistical arm of European Union. On the other hand, the Organization for Economic Cooperation and Development uses only businesses with hired employees as the basis of birth counts. In the U.S., the Census Bureau's Statistics of U.S. Businesses publishes data on firm births and deaths with definitions that are different than the Bureau of Labor Statistics (BLS). The Census estimates of births exclude self-employment and define births as "establishments that have zero employment in the first quarter of the initial year and positive employment in the first quarter of the subsequent year." However, a more precise measure is entrepreneurship rate defined as the number of business births per 1000 persons in the labor force. This also allows comparison of entrepreneurial capacities between regions. Sadeghi (2008) analyzed the merits of five possible definitions of establishment birth based on two concepts. First is establishment birth based on the first appearance in the registry and second is on the basis of positive employment reported. The first basis includes new businesses registered with positive employment for the first time while the latter includes not only births but also businesses that have not been active for more than one year but reported positive employment again in the current quarter. Sadeghi (2008) estimated alternative measures and the results were compared over time. Results showed some differences in the magnitude of births using different methods but no significant differences in the pattern of change over time. The study concluded the estimation of births of positive employment in the third month of a quarter and a zero employment in the previous four quarters as the preferred measure of births. The same estimation was done with establishment deaths and the preferred measure is the record with positive employment in the third month of a quarter followed by four consecutive quarters with zero employment during the third month. The advantages of the preferred measures include consistency with published data and symmetry in dealing with establishment births and deaths.

In an effort to come up with a more reasonable measure of entrepreneurship, Xue (2007) used a confirmatory factor analysis where entrepreneurship was treated as a latent variable, that is, a variable that is not directly observed but can be represented by a set of indirectly observed variables. He included variables such as technology patents, small business innovation rewards, venture capital disbursements, and technology firm establishments as indicators of entrepreneurship. Confirmatory factor analysis was employed to come up with an index called performing technology entrepreneurship index (PEI) based on the four indicators used in the analysis.

In his article "How many entrepreneurs does it take to change a nation?" Davis (2006) explained the need for measures of entrepreneurship that can be used and compared among different countries. He concluded that it is possible for all methods of measuring entrepreneurial capacity to converge into an agreed-upon method that can be used on a national basis. He suggested a Danish approach with three components including a model of framework for the entrepreneurship process; a method that permits comparisons of performance based on various measures that relate policies to factors affecting entrepreneurship; and government objectives defined in quantifiable terms. The framework is suggested as a foundation to enable development or adjustment of policies that relate to the factors affecting entrepreneurship. The model shows that market demand for goods and services interacts with the supply of ideas, skills, and capital that constitute the supply of potential entrepreneurs. The supply and demand forces operate in the market defined in terms of the incentive structure and the motivation of people to engage in entrepreneurial activity. Using the framework is expected to help guide the work on measurement and analysis of entrepreneurial capacity in different countries.

Following Acs et al. (2005), Henderson (2006), Evans and Leighton (1989), and Folster, (2000), this study employs self-employment as a measure of entrepreneurial activity. Although this may not be the ideal measure of entrepreneurial activity, this measure as specifically represented by the number of nonfarm proprietors is available for county-level analysis in various years. Furthermore, the self-employment rate has been used as a standard measure of entrepreneurship in the literature. In addition, measures of entrepreneurship derived from published data in US Census Bureau's Statistics of U.S. Businesses on firm births are used to construct entrepreneurship variables included in the analyses.

2. Empirical model and data description

2.1 Growth model

The main objective of this study is to examine the role of entrepreneurship in economic development represented by changes in employment, income, and population. In addition to entrepreneurship, the empirical tests include several socio-economic variables affecting economic growth. Based on previous studies, this study adopts the use of regional economic growth models in examining the relationship between entrepreneurship and economic growth. The simultaneous equation model in this study is based on the classic two-equation model of Carlino and Mills (1987). Their model employs population and employment dynamics in determining how regional factors affect patterns of growth. The emphasis is that households and firms aim to maximize utility by consuming goods and services,

residential location relative to the place of work, and non-market amenities. The Carlino-Mills model recognizes that population growth interacts with employment growth in the same field. That is, without constraints on capital mobility and other barriers among regions, equilibrium of population and employment growth is reached when factors of production in all regions get the same economic return. The model has been widely used in estimating how different regional factors affect long-run economic growth.

Deller et al. (2001) expanded the model into a three-equation framework by incorporating the role of income in regional economic growth. This is based on the assumption that households and firms also consider labor quality to maximize utility. In sum, the model represents that firms choose an optimal location based on location cost and revenue advantages, agglomeration benefits, and labor quality.

Following Deller et al. (2001) and Deller (2007), this study employs the model representing the relationship among population (P), employment (E), and income (I). The general form of the three-equation model is:

$$P^* = f\left(E^*, I^* / \Omega^P\right) \tag{1}$$

$$E^* = g\left(P^*, I^* / \Omega^E\right) \tag{2}$$

$$I^* = h\left(P^*, E^* / \Omega^I\right) \tag{3}$$

where P^**, E^*, and I^* represent the equilibrium levels of population, employment, and per capita income, respectively, and Ω^P, Ω^E, and Ω^I are a set of variables describing initial conditions, measures of entrepreneurship, and other variables that are traditionally linked to economic growth. From the equilibrium framework of the model, a simple linear relationship among the variables can be presented as:

$$P^* = \alpha_{0P} + \beta_{1P}E^* + \beta_{2P}I^* + \sum \delta_{IP}\Omega^P \tag{4}$$

$$E^* = \alpha_{0E} + \beta_{1E}P^* + \beta_{2E}I^* + \sum \delta_{IE}\Omega^E \tag{5}$$

$$I^* = \alpha_{0I} + \beta_{1I}P^* + \beta_{2I}E^* + \sum \delta_{II}\Omega^I \tag{6}$$

Furthermore, population, employment, and income are likely to adjust to their equilibrium levels with initial conditions (Mills and Price, 1984). These distributed lag adjustments are incorporated to the model expressed as:

$$P_t = P_{t-1} + \lambda_P(P^* - P_{t-1}) \tag{7}$$

$$E_t = E_{t-1} + \lambda_E(E^* - E_{t-1}) \tag{8}$$

$$I_t = I_{t-1} + \lambda_I(I^* - I_{t-1}) \tag{9}$$

where P_{t-1}, E_{t-1}, and I_{t-1} are initial conditions of population, employment and per capita income, respectively; λ_P, λ_E, and λ_I are speed adjustment coefficients to the desired level of population, employment, and income, which are generally positive, with larger values indicating faster growth rates. Current employment, population and income levels are functions of their initial conditions and the change between the equilibrium values and initial conditions at their respective values of speed of adjustment (λ). Substituting equations 7, 8, and 9 into equations 4, 5, and 6 while slightly rearranging the terms gives the model to be estimated and expressed as:

$$\Delta P = \alpha_{0P} + \beta_{1P}P_{t-1} + \beta_{2P}E_{t-1} + \beta_{3P}I_{t-1} + \gamma_{1P}\Delta E + \gamma_{2P}\Delta I + \sum \delta_{IP}\Omega^{P} \quad (10)$$

$$\Delta E = \alpha_{0E} + \beta_{1E}P_{t-1} + \beta_{2E}E_{t-1} + \beta_{3E}I_{t-1} + \gamma_{1E}\Delta P + \gamma_{2E}\Delta I + \sum \delta_{IE}\Omega^{E} \quad (11)$$

$$\Delta I = \alpha_{0P} + \beta_{1I}P_{t-1} + \beta_{2I}E_{t-1} + \beta_{3I}I_{t-1} + \gamma_{1I}\Delta E + \gamma_{2I}\Delta P + \sum \delta_{II}\Omega^{I} \quad (12)$$

where ΔP, ΔE, and ΔI are the region's changes in population, employment and per capita income, respectively. The speed of adjustment becomes embedded in the coefficient parameters α, β, and δ. Following Deller (2007), this model captures structural relationships while simultaneously isolating the influence of the level of entrepreneurship on regional economic growth. The equations estimate short-term adjustments of population, employment and income (Δ*P*, Δ*E*, and Δ*I*) to their long-term equilibrium (P^*, E^*, *and* I^*).

For the purpose of this study, measures of entrepreneurship are incorporated in the model, in addition to the variables that are traditionally linked to economic growth. These variables include measures of human capital, infrastructure, agglomeration, and a vector of additional socio-economic variables. The model estimation also investigates whether the degree of urbanization impacts economic growth. This is done by using a dummy variable to identify metro and non-metro counties. This specifically determines the effect of agglomeration to economic growth as rural areas are found to be more likely to engage in entrepreneurship than the metro areas, although urban areas are more successful in turning a business start into a high-growth business (Drabenstott, 2004).

2.2 Endogeneity test

Most studies found a positive effect of entrepreneurship on economic growth revealing that entrepreneurship increases employment and income levels. However, some studies showed that economic growth is also found to influence entrepreneurship (Storey, 2003). Entrepreneurship is likely to be endogenous in the model since counties with high levels of economic growth have a strong incentive for individuals to start businesses. Hence, a test for possible endogeneity is done as model estimation is biased when entrepreneurship variables are endogenous. In this study, Hausman's test under the null hypothesis of no endogeneity is employed to test whether entrepreneurship is endogenous. If the entrepreneurship index is exogenous, the model presented above will be estimated in reduced form. That is, the simultaneous equations can be solved equation by equation, given that the conditions for identification are satisfied. Estimation procedures are heavily drawn from the methods of Greene (1997) and Wooldridge (2002). The Statistical Packages for the Social Sciences (SPSS) is used for the empirical tests.

If the entrepreneurship measure is found to be endogenous and there exists a simultaneous relationship between the growth measures and the entrepreneurship index, the model will be expanded into a four-equation model expressed as:

$$P^* = f\left(E^*, I^*, En^* / \Omega^P\right) \tag{13}$$

$$E^* = g\left(P^*, I^*, En^* / \Omega^E\right) \tag{14}$$

$$I^* = h\left(P^*, E^*, En^* / \Omega^I\right) \tag{15}$$

$$En^* = f\left(E^*, I^*, P / \Omega^{En}\right) \tag{16}$$

where P^*, E^*, I^*, and En^* represent the equilibrium levels of population, employment, per capita income, and entrepreneurship respectively, and Ω^P, Ω^E, Ω^I,and Ω^{En}, are a set of variables describing initial conditions, and other variables that are traditionally linked to economic growth. Following the equations above, the model to be estimated can be expanded as:

$$\Delta P = \alpha_{0P} + \beta_{1P}P_{t-1} + \beta_{2P}E_{t-1} + \beta_{3P}I_{t-1} + \beta_{4P}En_{t-1} + \gamma_{1P}\Delta E + \gamma_{2P}\Delta I + \gamma_{3P}\Delta En + \sum \delta_{IP}\Omega^P \tag{17}$$

$$\Delta E = \alpha_{0E} + \beta_{1E}P_{t-1} + \beta_{2E}E_{t-1} + \beta_{3E}I_{t-1} + \beta_{4E}En_{t-1} + \gamma_{1E}\Delta P + \gamma_{2E}\Delta I + \gamma_{3E}\Delta En + \sum \delta_{IE}\Omega^E \tag{18}$$

$$\Delta I = \alpha_{0I} + \beta_{1I}P_{t-1} + \beta_{2I}E_{t-1} + \beta_{3I}I_{t-1} + \beta_{4I}En_{t-1} + \gamma_{1I}\Delta E + \gamma_{2I}\Delta P + \gamma_{3I}\Delta En + \sum \delta_{II}\Omega^I \tag{19}$$

$$\begin{aligned}\Delta En = {} & \alpha_{0En} + \beta_{1En}P_{t-1} + \beta_{2En}E_{t-1} + \beta_{3En}I_{t-1} + \\ & \beta_{4En}En_{t-1} + \gamma_{1En}\Delta P + \gamma_{2En}\Delta E + \gamma_{3En}\Delta I + \sum \delta_{IEn}\Omega^{En}\end{aligned} \tag{20}$$

where ΔP, ΔE, ΔI, and ΔEn are the region's changes in population, employment, per capita income, and entrepreneurship, respectively.

2.3 Specification of variables

The specified model of growth is used to analyze the impact of entrepreneurship to regional economic growth using changes in population, employment and per capita income growth as endogenous variables. Following the existing literature on entrepreneurship and economic growth (Acs and Armington, 2005; Camp, 2005; van Stel and Suddle, 2005; and Henderson, 2006), the model employs growth measures as endogenous variables. The model is specified as an equation with dependent variables as functions of entrepreneurship, human capital, infrastructure, agglomeration, and a set of socio-economic variables.

The choice of variables to represent entrepreneurship is based on theoretical considerations presented in Chapter 3 and on previous studies on entrepreneurship and economic growth. The entrepreneurship variables derived from data on self employment include number of

proprietors in a county (PROP), number of proprietors in a county per 1000 people in the labor force ($PROP_{LF}$), number of proprietors in a county per 1000 people in the labor force between 1995 and 2005 ($CHPROP_{LF}$) and the growth in the number of proprietors per county (CHPROP). Measures of entrepreneurship derived from firm births per county (BIRTH), firm births per 1000 people in the labor force per county ($BIRTH_{LF}$), change in the number of firm births in a county per 1000 people in the labor force ($CHBIRTH_{LF}$), change in the number of firm expansion per county (CHEXPAND), change in the number of firm deaths per county (CHDEATH) and number of firm deaths per county per 1000 labor force ($DEATH_{LF}$). A positive relationship between the measures of entrepreneurial activity and economic growth is hypothesized based on theory and the results of previous studies. On the other hand, a negative relationship between measures of firm deaths and growth measures is hypothesized.

In addition to entrepreneurship, additional explanatory variables are included in the employment growth model to better understand the factors affecting economic growth in the Appalachian region. Human capital variables which reflect the quality of labor force is measured using share of the population with high-school education ($EDUC_{HI}$). A higher share of the population with high school education indicates a higher quality of the labor force in the county. Furthermore, a higher quality of the labor force is expected to be more efficient and therefore reduces the average cost of the business leading to a higher employment and income growth. Hence, a positive relationship between the human capital variable and the measures of economic growth is hypothesized.

Infrastructure variables include the county's miles of road per square mile (ROADDEN) and miles of state road per square mile (STROADDEN). The quality of infrastructure affects the firm's average cost and is expected to affect employment and income growth. A positive relationship between the growth measures and the quality levels of a county's infrastructure is expected as infrastructure defines the ease of distribution of goods and services between the firms and the market.

Agglomeration of firms is found to positively affect growth by reduced costs of information transfer and knowledge spillovers arising from diversity (Henderson, 2006). To measure agglomeration, the empirical models include population density (POP_{DEN}) and a dummy variable to identify metropolitan counties (METRO). Agglomeration factors are expected to have a positive effect to both employment and income growth when agglomerations increase network externalities (Ciccone and Hall, 1996).

Other socio-economic variables such as per capita income taxes (PCTAX), property taxes (PROPTAX), government expenditure per capita (GOVEX), and percent of families below poverty (POVERTY) will also be included in the empirical analyses. Taxes are expected to have a negative relationship with the measures of economic growth as it reduces demand for consuming goods and services as well as reducing firm profits. Government expenditure is hypothesized to have a positive relationship with employment and income growth as it reflects investments for the welfare of the public. On the other hand, a negative relationship between percent of families below poverty and the measures of economic growth is expected. A higher percentage of families in poverty indicates slower increases in employment and income levels. CRIME is hypothesized to have a negative effect on measures of economic growth while percent of population 35 to 64 years old is expected to

have a positive effect. Summary of the variables used in the analyses are presented in Tables 1, 2, and 3.

2.4 Types and sources of data

Data on 410 counties of the Appalachian region drawn from several sources are used in the empirical analysis. Endogenous variables include county level growth in population, employment and per capita income (wage levels) for years 1995 to 2005 as indicators of economic growth. These data as well as their initial values are drawn from the publications of the Regional Economic Information System - Bureau of Economic Analysis (http://www.bea.gov/regional/reis/) for various years. Table 1 presents the summary of the definition and sources of the endogenous variables and their initial values.

Exogenous variables include entrepreneurship measures as well as socio-economic variables such as changing demographics of the workforce and other economic variables affecting economic growth. Controlling for these factors in addition to entrepreneurship measures increases the understanding of economic development in the Appalachian region.

Variable	Definition	Sources
Dependent variables /Growth measures		
ΔP	Change in population between the years 1995 and 2005	REIS-BEA
ΔE	Change in employment between the years 1995 and 2005	REIS-BEA
ΔI	Change in per capita income between the years 1995 and 2005	REIS-BEA
Initial Conditions		
P_{t-1}	Population in 1995	REIS-BEA
E_{t-1}	Employment in 1995	REIS-BEA
I_{t-1}	Per capita income in 1995	REIS-BEA

Table 1. Definition and Sources of Endogenous Variables and their Initial Conditions

To measure entrepreneurship, the number of nonfarm proprietors in the counties drawn from the publications of the Regional Economic Information System (REIS-BEA) from the Bureau of Economic Analysis is used. REIS draws information on proprietorship from income tax files of sole proprietors and partnerships and publishes county level estimates of the number of farm and nonfarm proprietors and their incomes. The data are used to construct four variables used as indicators of entrepreneurial activity in a county. These are the number of proprietors in the county in 1995 (PROP), the number of proprietors in a county per 1000 people in the labor force ($PROP_{LF}$) which is derived by dividing the number of proprietors by the total nonfarm employment multiplied by a thousand. This is based on the labor market approach of controlling for different absolute sizes of the geographical unit, in this case the counties, where the denominator is the size of the work force. The Labor Market approach assumes that entrepreneurial firms arise from the work force (Baptista, Escaria, and Madruga, 2005). The third and the fourth measures of entrepreneurial capacity are change in the number of proprietors in a county per 1000 people in the labor force between 1995 and 2005 ($CHPROP_{LF}$) and the growth in the number of proprietors (CHPROP).

Additional measures of entrepreneurship are based on firm birth data including firm births per county (BIRTH), firm births per 1000 people in the labor force per county ($BIRTH_{LF}$), change in the number of firm births in a county per 1000 people in the labor force ($CHBIRTH_{LF}$), change in the number of firm expansion per county (CHEXPAND), change in the number of firm deaths per county (CHDEATH) and number of firm deaths per county per 1000 labor force ($DEATH_{LF}$). Data on firm births are from the publications of the US Census Bureau's Statistics of US Businesses (SUSB). SUSB use data extracted from the Business Register, corresponding to a file of single and multi-establishment employer companies maintained by the U.S. Census Bureau. Definition and data sources of entrepreneurship variables are summarized in Table 2.

Variable	Definition	Sources
Entrepreneurship Variables		
PROP	Number of proprietors per county in 1995	REIS-BEA
$PROP_{LF}$	Number of proprietors in a county per 1000 people in the labor force in 1995	Constructed
$CHPROP_{LF}$	Change in the number of proprietors in a county per 1000 people in the labor force between 1995 and 2005	Constructed
CHPROP	Change in the number of proprietors in a county between 1995 and 2005	Constructed
BIRTH	Number of firm births per county in 1998	SUSB-U.S. Census
$BIRTH_{LF}$	Firm births per 1000 people in the labor force in 1998	Constructed
$CHBIRTH_{LF}$	Change in the number of firm births in a county per 1000 people in the labor force between 1998 and 2005	Constructed
CHEXPAND	Change in the number of firm expansion per county between 1998 and 2005	Constructed
CHDEATH	Change in the number of firm deaths per county between 1998 and 2005	Constructed
$DEATH_{LF}$	Number of firm deaths per county per 1000 labor force in 1998	Constructed

Table 2. Definition and Data Sources of Entrepreneurship Variables

In addition to measures of entrepreneurship, the exogenous variables used in analyzing the factors affecting economic growth are included in the empirical models. These variables are categorized into human capital or the quality of the labor force, infrastructure, agglomeration, and other socio-demographic characteristics of the county as summarized in Table 3. Human capital or the quality of the labor force is measured using the share of the population with high-school education ($EDUC_{HI}$). To control for the county's quality of infrastructure, data on the miles of road per square mile (ROADDEN) and miles of state road per square mile (STROADDEN) are used in the models.

To measure agglomeration, the empirical models include population density (POPDEN) and a dummy variable to identify metropolitan counties (METRO). Other socio-economic variables such as per capita income taxes (PCTAX), property taxes on businesses (PROPTAX), government expenditure per capita (GOVEX), and percent of families below

Variable	Definition	Sources
Entrepreneurship Variables		
human capital		
$EDUC_{HI}$	Share of the population with high-school education	U.S. Census
infrastructure		
ROADDEN	Miles of road per square mile	NRAC-WVU
STROADDEN	Miles of state road per square mile	NRAC-WVU
agglomeration		
POPDEN	Population density	REIS-BEA
METRO	Dummy variables to identify metropolitan counties	U.S. Census
other variables		
PCTAX	Per capita income taxes	County and City Data
PROPTAX	Property tax per capita	County and City Data
GOVEX	Government expenditure per capita	County and City Data
POVERTY	Percent of families below poverty	County and City Data
NATAMER	Natural amenities ranking	ERS-USDA
CRIME	Crimes reported per 100,000 of population	County and City Data
POP35_64	Share of population 35 to 64 years old	County and City Data

Table 3. Definition and Data Sources of Socio-Demographic Variables

poverty (POVERTY) are included in the empirical analyses. Natural amenities ranking (NATAMER) of the Economic Research Services (ERS-USDA) is used to account for endowment of natural amenities in Appalachian counties. Additional variables include crimes reported per 100,000 population (CRIME) and percent of population 35 to 64 years old (POP35_64). Data on explanatory variables are from the publications of the BEA-REIS, the Census Bureau, and the Economic Research Service (ERS) of the United States Department of Agriculture (USDA), and the Natural Resource Analysis Center-West Virginia University (NRAC-WVU).

Tables 4, 5, and 6 present the summary of descriptive statistics of endogenous variables and their lagged values, the entrepreneurship variables, and the variables that are traditionally

Variable	Minimum	Maximum	Mean	Standard Deviation
Endogenous Variables				
ΔP	-88141	252636	3589.30	16359.21
ΔE	-5119	118600	3398.39	8692.32
ΔI	2880	14738	7765.54	1720.59
Initial Conditions				
P_{t-1}	2566	1322460	53692.63	91220.84
E_{t-1}	1203	825870	27139.84	56668.27
I_{t-1}	10180	28369	16790.71	2832.76

Table 4. Descriptive Statistics of Endogenous Variables and Initial Conditions

linked to economic growth. The tables present the minimum, maximum, mean and standard deviation of 410 counties in Appalachia which are included in the analyses.

Variable	Minimum	Maximum	Mean	Standard Deviation
PROP	262.00	96914.00	4001.57	6962.20
$PROP_{LF}$	76.51	496.06	173.99	53.47
$CHPROP_{LF}$	-164.52	266.81	41.28	55.08
CHPROP	-2645.00	31539.00	1469.00	2883.39
$BIRTH_{LF}$	0.38	2816.00	11.50	139.04
$CHBIRTH_{LF}$	-20.94	204.00	0.08	10.40
BIRTH	-19.00	2946.00	116.40	239.22
CHBIRTH	-357.00	438.00	2.17	46.16
CHEXPAND	-355.00	7884.00	18.78	392.49
CHDEATH	-147.00	2802.00	6.45	140.98
$DEATH_{LF}$	0.16	46.71	4.08	3.09

Table 5. Descriptive Statistics of Entrepreneurship Variables

Variable	Minimum	Maximum	Mean	Standard Deviation
$EDUC_{HI}$	35.50	87.20	61.19	10.16
METRO	0.00	1.00	0.26	0.44
POPDEN	7.18	1811.17	108.06	139.97
POVERTY	2.90	46.80	15.41	7.41
ROADDEN	0.08	0.74	0.33	0.12
STROADDEN	0.00	0.61	0.22	0.11
NATAMER	-3.72	3.55	0.13	1.16
GOVEX	1168.00	33391.00	3791.97	2340.03
PCTAX	43.00	1317.00	286.01	160.46
PROPTAX	22.20	99.10	72.54	17.17
CRIME	0.00	8487.00	2262.91	1556.56
POP35_64	27.78	47.08	39.60	2.29

Table 6. Descriptive Statistics of Education, Agglomeration, Infrastructure, Natural Amenities, Government Expenditure, Taxes, and Crime Rate

2.5 Model estimation methods

The estimation methods are drawn heavily from Greene (1997) and Wooldridge (2002). The system of simultaneous equations is a complete system of equations since the number of equations is equal to the number of endogenous variables. The reduced form implies that the model can be solved equation by equation given there are no restrictions on parameter space and that orthogonality holds for the error terms. However, to guarantee that the system of equations has unique solutions, the conditions for identification must be satisfied. These include the rank and order conditions. To satisfy the rank condition, the number of exogenous variables excluded from an equation should be equal or greater than the number of endogenous variables included in the equation. This is a necessary condition to ensure

that the system has at least one solution. The rank condition requires that there is at least one non-zero determinant in the array of coefficients of the excluded variables which appears in the other equations. The rank condition ensures that there is exactly one solution for the structural parameters. In the model, there are more than one excluded variable in each equation, hence, both the order and rank conditions hold.

Ordinary least square (OLS) gives a biased and inconsistent estimate of the structural model if independent variables include endogenous variables. The simultaneity bias comes from the correlation between the right-hand side endogenous variable with the error terms. The models presented above imply simultaneity or reverse causation between dependent variables. Therefore, the estimation is done using two-stage least squares (2SLS) regression. 2SLS is a method used frequently to deal with endogenous variables. It uses instrumental variables that are uncorrelated with the error terms to compute estimated values of the problematic predictors in the first stage and then uses those computed values to estimate a linear regression model of the dependent variable in the second stage. Since the computed values are based on variables that are uncorrelated with the errors, the result of the two-stage estimation is optimal.

The estimation involves the use of two-stage least squares regression (2SLS) in estimating a four-equation model with changes in population, employment, per capita income, and an entrepreneurship index as endogenous variables. The entrepreneurship index represents the change in entrepreneurial activity constructed using principal component analysis. Selected variables used as measures of entrepreneurial activity in the previous estimations are used to construct an index that represents measures of entrepreneurship from the data on self-proprietorships and firm births. Principal component analysis is used to seek a linear combination of variables such that the maximum variance is extracted from the variables. The eigenvalues from the principal component analysis are presented in Table 7. Five measures of entrepreneurial activity are used to construct the entrepreneurship index. Change in the number of proprietors per 1000 labor force ($CHPROP_{LF}$) has the strongest contribution in extraction with an eigenvalue of 1.606. This is followed by the change in the number of proprietors (CHPOP) with an eigenvalue of 1.471. Figure 8 shows the map of the constructed entrepreneurship index for Appalachia.

The theoretical simultaneity between the individual measures of growth and the entrepreneurship index is tested using Hausman test for endogeneity in the four-equation model. If entrepreneurship is endogenous, the equations are estimated using two-stage least squares (2SLS) regression to correct the endogeneity problem. The procedure for Hausman test is heavily drawn from Wooldridge (2002). The first step is a regression of the endogenous variable ΔEn (entrepreneurship index) with all the exogenous variables. The residuals are then saved and included as an additional regressor in the estimation of the original equations. After running an OLS regression for each dependent variable (change in population, employment, and per capita income), a t-test for the coefficient of the first stage residuals is performed with a null hypothesis of no endogeneity. A p-value less than 0.10 indicates entrepreneurship index as endogenous. The results show that entrepreneurship is endogenous with population growth and employment growth but not with per capita income growth. Therefore, the population growth equation and employment growth equation are estimated while treating entrepreneurship also as endogenous. Since

Component	Eigenvalues		
	Total	% of Variance	Cumulative %
$CHPROP_{LF}$	1.606	32.115	32.12
CHPROP	1.471	29.412	61.53
$CHBIRTH_{LF}$	0.970	19.395	80.92
CHBIRTH	0.538	10.762	91.68
CHDEATH	0.416	8.316	100.00

Table 7. Results of Principal Components Analysis

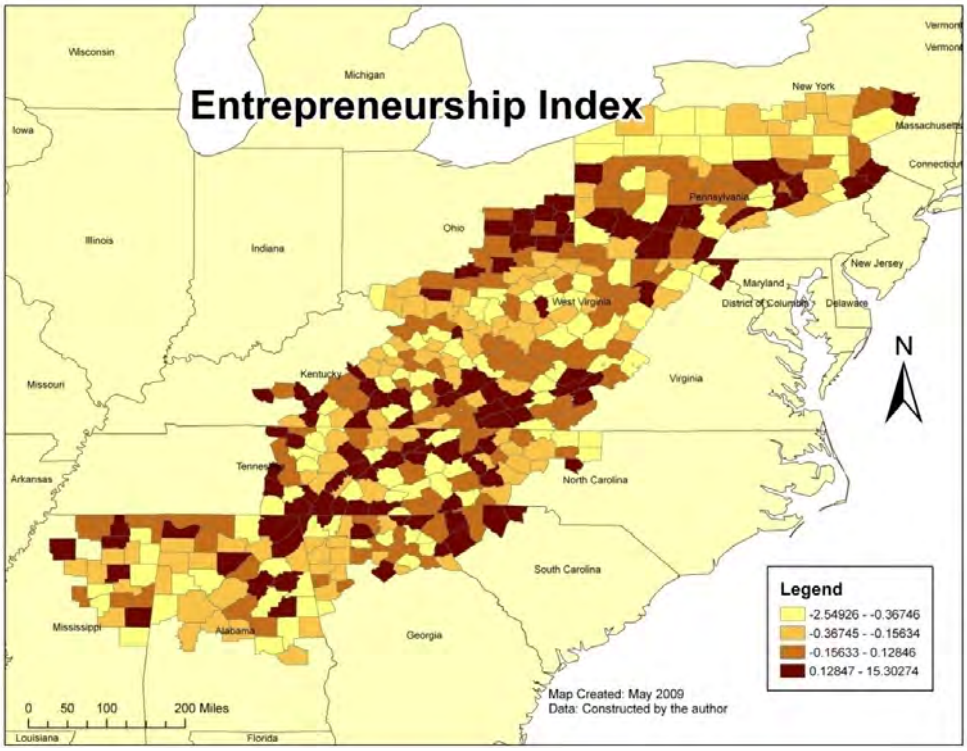


Fig. 8. Entrepreneurship Index for Appalachian Counties

entrepreneurship is not endogenous with per capita income growth, the ΔI equation is estimated with only population growth and employment growth used as endogenous variables. The results of Hausman test are summarized in Table 8.

	Hausman statistic	p-value
Population equation	0.112**	0.017
Employment equation	0.062*	0.077
Per capita income	0.037	0.403

***, **, * Significant at 1 %, 5 %, and 10%, respectively

Table 8. Results of Hausman Test for Endogeneity

3. Two-Stage Least Squares estimation (2 SLS) results

This section of the study is a discussion of the results in estimating the four-equation model where an entrepreneurship index is treated as an endogenous variable in addition to the measures of economic growth. The index is constructed using principal component analysis and tested for endogeneity against population growth, employment growth, and per capita income growth using the Hausman test. The result is a four-equation model where entrepreneurial growth is also estimated against other endogenous variables in the model as well as exogenous variables. The results are presented in Table 9.

3.1 Change in population

The result of Hausman test reveals that entrepreneurship is endogenous with population growth. Therefore, to account for the endogeneity issue, the structural equation is estimated using two-stage least squares (2-SLS) estimation. Population growth (ΔP) is regressed against the endogenous variables – employment growth (ΔE), per capita income growth (ΔI) and growth in entrepreneurship (ΔEn), its lagged value (P_{t-1}), and other variables linked to economic growth. The results in Table 9 show that employment growth (ΔE) is positive and significantly affecting population growth. This supports the hypothesis that "people follow jobs". The coefficient indicates that an increase in total employment leads to a 1.5 increase in population. This supports the theory of the positive interaction between population growth and employment growth as hypothesized in previous studies.

The lagged value of population is significant and the sign of the coefficient is negative. This means that counties with lower initial population had higher population growth which further supports the hypothesis. The education variable is also negative which means that counties with a higher proportion of the population with high school education had lower rates of population increase. The coefficient for miles of road per square mile (ROADDEN) is significant and positive as expected. This supports the theory of the positive effect of better quality infrastructure in attracting people. The figure shows that a mile increase of road per square mile results to a 0.05 increase in population.

3.2 Change in employment

Using two-stage least squares (2-SLS) estimation, the change in employment (ΔE) equation is regressed against the endogenous variables – population growth (ΔP), per capita income growth (ΔI), and entrepreneurship (ΔEn), its initial value (E_{t-1}), and a set of socio-economic variables. The results in Table 9 indicate a significant and positive relationship between population growth and employment growth which supports the "people follow jobs" hypothesis. Specifically, an increase in population gives a 0.98 increase in employment. Other variables used in the estimation are not statistically significant.

3.3 Change in per capita income

Since the result of endogeneity test revealed that per capita income growth is not endogenous with entrepreneurship, the ΔI equation is estimated as a function of the endogenous variables- population growth and employment growth, its lagged value (I_{t-1}), a set of other variables linked to economic growth and entrepreneurial growth which is treated as an exogenous variable. The results show a significant and positive relationship

between per capita income growth and its lagged value. This indicates that Appalachian counties with higher growth in per capita income initially had higher per capita income.

The education variable also has a significant and positive coefficient supporting the hypothesis of the contribution of education in increasing income. The result indicates that a percentage increase in population with high school education increases per capita income by $0.16.

3.4 Change in entrepreneurial activity

The constructed entrepreneurship index (ΔEn) is tested for endogeneity against three measures of growth – population growth (ΔP), employment growth (ΔE), and per capita income growth (ΔI). The result of Hausman test showed that entrepreneurship is endogenous with population growth and employment growth, but not with per capita income growth. Therefore, the entrepreneurship equation (ΔEn) is estimated as a function of the endogenous variables - change in population and change in employment and the set of variables traditionally linked to economic growth. The results in Table 9 indicate a significant and positive relationship between growth in entrepreneurial activity and employment growth. This provides evidence on the role of entrepreneurship in increasing job creation. The coefficient for population growth is also statistically significant; however, the sign is negative which is contrary to hypothesis. This means that counties with lower population increases had higher growths in entrepreneurial activity. The per capita income variable (ΔI), treated as exogenous, is also found to be significant in determining entrepreneurial growth. However, the coefficient is negative.

	CHPOP Equation		CHEMP Equation		CHPCI Equation		ENTREP Equation	
Variable	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Endogenous Variables								
ΔP	-	-	0.981*	0.074	-0.319	0.433	-0.534***	0.004
ΔE	1.543***	0.000	-	-	0.143	0.588	1.340***	0.000
ΔI	0.127	0.296	-0.141	0.628	-	-	-	-
ΔEn	-0.126	0.472	-0.401	0.583	-	-	-	-
Initial Conditions								
P_{t-1}	-0.850***	0.000	-	-	-	-	-	-
E_{t-1}	-	-	1.107	0.253	-	-	-	-
I_{t-1}	-	-	-	-	0.455***	0.000	-	-
Other variables								
ΔI	-	-	-	-	-	-	-0.127**	0.024
ΔEn	-	-	-	-	0.038	0.744	-	-
$EDUC_{HI}$	-0.103*	0.064	0.096	0.291	0.161**	0.038	-0.088	0.123
POPDEN	-	-	-	-	-	-	-	-
METRO	-	-	-	-	-	-	-0.072	0.155
POVFAM	-	-	-	-	0.039	0.662	-	-
ROADDEN	0.051*	0.091	-	-	-	-	-	-
STROADDEN			-	-	-	-	0.005	0.891
NATAMER	0.039	0.170	-	-	-	-	-	-
GOVEX	-	-	-	-	-0.046	0.408	-	-
PCTAX	0.013	0.691	-0.009	0.792	-0.076	0.230	0.015	0.779
PROPTAX	0.044	0.151	-	-	-	-	-	-
CRIME	-	-	-0.152	0.433	-	-	-	-
POP35_64	-	-	0.007	0.886	-	-	-	-

***, **, * Significant at 1 %, 5 %, and 10%, respectively

Table 9. Estimation Results of 4-Equation Model

4. Conclusions

The entrepreneurship index is constructed from selected measures of entrepreneurial activity using principal component analysis (PCA). PCA is employed to seek a linear combination of five entrepreneurship variables to come up with a single measure of entrepreneurial capacity. The index is used as a dependent variable in the four-equation growth model to determine simultaneous relationships between entrepreneurship and the measures of economic growth. The Hausman test is used to determine causal relationships between the entrepreneurship index and the growth measures. Results reveal that entrepreneurship is endogenous with population growth and employment growth, but not with per capita income growth. Therefore, the population growth equation is estimated while entrepreneurship as an endogenous variable and empirically estimated using instrumental variables. The employment growth equation is estimated the same way. However, since entrepreneurship is exogenous with per capita income growth, the per capita income equation and the entrepreneurship equation are empirically estimated while treating per capita income and entrepreneurship as exogenous. The estimation of the entrepreneurship equation in the four-equation model shows significant relationships with all the other endogenous variables. However, a positive association is observed only between the employment growth and the growth in entrepreneurial activity.

5. Limitations and future research

5.1 Limitations of the study

This study has expanded the examination of the determinants of regional economic growth by adding entrepreneurship factors in a regional model using simultaneous equations. However, improvements in the study can be done considering its limitations. The first limitation is in the construction of the entrepreneurship index. Exploring ways to construct the index would affect the results of the estimations and using different combinations of data that measure entrepreneurial activity will give different estimates that will facilitate comparison of results.

The second limitation is in the choice of variables included in the analyses. For example, additional amenity indicators could have been used in the estimation and/or other measures of amenity endowment could have been explored to enhance the performance of the models. Using different measures of the factors linked to economic growth can help in comparing results towards a more robust estimation.

5.2 Recommendations for future studies

The above limitations can provide opportunities for the improvement and expansion of the study in the future. Several aspects of the study can also be expanded to further the investigation of the link between entrepreneurship and economic growth. First, the effects of entrepreneurial activity can be further investigated by industry. For example, variables representing self-employment, firm births, and firm deaths in different industries such as manufacturing, construction, trade, transportation, and other sectors can be integrated in future work to extend the examination of the effects of entrepreneurship in the economy. Particularly, this will categorize the contribution of entrepreneurial activity from different

sectors and will identify the industries that contribute towards the achievement of economic growth.

Second, the model can be specified as a spatial econometric model to incorporate the role of space in examining the relationship entrepreneurship in economic growth. Spatial distribution of economic activity has received great interest from economists concerned with location decisions, urban growth, regional growth, land use change, and other areas of regional studies. Integrating spatial aspects in the analyses will determine spatial dependence in regional growth patterns and capture spillover effects.

Third, the study could be extended to a national-level analysis to increase variation in the data through increased sample size. Increasing the scope of the study will yield insights on a greater perspective with more general applications.

6. References

Acs, Z. (2006). How is Entrepreneurship Good for Economic Growth? *Innovations,* Vol.1, No. 1, pp. 97-107

Acs, Z. & Armington, C. (2004). The Impact of Geographic Differences in Human Capital on Service Firm Formation Rates. *Journal of Urban Economics,* Vol.56, pp. 244-278

Acs, Z. & Armington, C. (2005). Using Census BITS to Explore Entrepreneurship, Geography, and Economic Growth. Small Business Research Summary No. 248, U.S. Small Business Administration's Office of Advocacy

Acs Z. & Audretsch, D. (1987). Innovation, Market Structure and Firm Size. *Review of Economics and Statistics,* Vol. 69, pp. 567-574.

Acs, Z.; Audretsch, D.; Braunerhjelm, P. & Carlsson, B. (2005). Growth and Entrepreneurship: An Empirical Assessment. Discussion Paper 3205, Max Planck Institute of Economics, Jena, Germany

Appalachian Regional Commission (2008). November 21, 2008, Available from www.arc.gov

Audretsch, D. (1995). *Innovation and Industry Evolution*, MIT Press, ISBN 0262011468, Cambridge, Massachusetts

Audretsch D. & Thurik, A. (1997). Sources of Growth: The Entrepreneurial versus the Managed Economy, Discussion Paper TI97-109/3, Tinbergen Institute, Erasmus University Rotterdam

Audretsch D. & Keilbach, M. (2005). Entrepreneurship Capital and Regional Growth. *The Annals of Regional Science,* Vol.39, pp. 457-469.

Baptista, R.; Escaria, V. & Madruga, P. (2005). Entrepreneurship, Regional Development and Job Creation : the Case of Portugal. Discussion Paper 605, Max Planck Institute into Economic Systems, Jena, Germany.

Baumol, W. (1993). *Entrepreneurship, Management, and the Structure of Payoffs*, MIT Press, ISBN 0262023601, Cambridge, Massachusetts

Baumol, W.; Litan, R & Schramm, C. (2007). *Good Capitalism, Bad Capitalism, and the Economics of Growth and Prosperity*, Yale University Press, ISBN 0300109415, New haven, CT

Beck, T.; Demirguc-Kunt, A. & Levine, R. (2005). SMEs, Growth, and Poverty. In: *NBER* Working Paper No. W11224, January 28, 2009, Available from: <http://www.nber.org/papers/w11224.pdf>

Beugelsdijk, S. & Noorderhaven, N. (2004). Entrepreneurial Attitude and Economic Growth: a Cross-Section of 54 Regions. *The Annals of Regional Science,* Vol. 38, pp. 199-218

Camp, M. (2005). The Innovation-Entrepreneurship NEXUS: A National Assessment of Entrepreneurship and Regional Economic Growth and Development. Small Business Research Summary No. 256, Advanced Research Technologies, Powell, OH

Carland, J.; Carland, J & Carland III, J. (1995). A Model of Entrepreneurship: The Process of Venture Creation. January 23, 2009, Available from <http://www.sbaer.uca.edu/research/sbida/1995/pdf/02.pdf>

Carlino, G. & Mills, E. (1987). The Determinants of County Growth. *Journal of Regional Science,* Vol. 27, pp. 39-54

Carree, M. & Thurik, A. (1998). Small Firms and Economic Growth in Europe. *Atlantic Economic Journal,* Vol.26, No.2, pp. 137-146

Cole, A. (1946). An Approach to the Study of Entrepreneurship: a Tribute to Edwin F. Gay. *The Tasks of Economic History (Supplement VI of the Journal of Economic History*), pp. 1-15

Davis, T. (2006). How many entrepreneurs does it take to change a nation? *Business Strategy Review,* Vol. 17, No.4, pp. 68-73

Deller, S.; Tsai, T.; Marcouiller, D. & English, D. (2001). The Role of Amenities and Quality of Life in Rural Economic Growth. *American Journal of Agricultural Economics*, Vol.83, No.2, pp. 352-365

Deller, S. (2007). The Role of Microenterprises in Economic Growth: A Panel Study of Wisconsin Counties 1977 to 1997. *Proceedings of the 47th Southern Regional Science Association Meeting*, Arlington VA- Washington, DC, March 27-30, 2008

Drabenstott, M. (2004). A New Map for Rural America's New Economic Frontier. *Economic Development America*, (Summer) pp. 5-7

Easterly, W. (2001). The lost decade: Developing countries' stagnation in spite of policy reform 1980-1998. *Journal of Economic Growth,* Vol.6, p. 135.

Folster, S. (2000). Do Entrepreneurs Create Jobs? *Small Business Economics,* Vol.14, No.2, pp.137-148

Evans, D. & Leighton, L. (1989). Some Empirical Aspects of Entrepreneurship. *The American Economic Review,* Vol.79, No.3, pp. 519-535

Garrett, T. & Wall, H. (2006). Creating a Policy Environment for Entrepreneurs. Federal Reserve Bank of St. Louis Working Paper 2005-064B

Gartner, W. (1988). Who is an 'Entrepreneur?' Is the Wrong Question. *American Journal of Small Business,* Vol.12, No.4, pp. 11-32

Goetz, S. & Freshwater, D. (2001). State-level Determinants of Entrepreneurship and a Preliminary Measure of Entrepreneurial Climate. *Economic Development Quarterly,* Vol.15, pp. 58-70

Greene, W. (1997). *Econometric Analysis*, Prentice Hall, ISBN 0023466022, Saddle River, New Jersey

Hagen, E. (1962). *On the Theory of Social Change: How Economic Growth Begins*, Homewood, I11: Dorsey Press.

Hebert, R. & Link, A. (1989). In Search of the Meaning of Entrepreneurship. *Small Business Economics*, Vol.1, No.1, pp. 39-49

Henderson, J. (2006). Understanding Rural Entrepreneurship at the County Level: Data Challenges. Federal Reserve Bank of Kansas City, Omaha.

Isserman, A. (1996). Socioeconomic Review of Appalachia – Appalachia Then and Now: An Update of The Realities of Deprivation. Reported to the President in 1964, Appalachian Regional Commission. Regional Research Report.

Kihlstrom R. & Laffont, J. (1979). A General Equilibrium Entrepreneurial Theory of Firm Formation Based on Risk Aversion. *Journal of Political Economy*, Vol. 87, No.4, pp.719-748

Kirzner, I. (1979). *Perception, Opportunity, and Profit: Studies in the Theory of Entrepreneurship*, The University of Chicago Press, ISBN 0226437736, Chicago, IL

Knight, F. (1921) *Risk, Uncertainty, and Profit*, Houghton Mifflin Company, ISBN 9780984061426, Boston Massachusetts

Kreft, S. & Sobel, R. (2005). Public Policy, Entrepreneurship, and Economic Freedom. *Cato Journal*, Vol.25 (Fall), pp. 595-616

Lichtenstein, G. & Lyons, T. (2001). The Entrepreneurial Development System: Transforming Business Talent and Community Economies. *Economic Development Quarterly,* Vol.15, No.1, pp. 3-20

Low, S.; Henderson, J. & Weiler, S. (2005). Gauging a Region's Entrepreneurial Potential. *Economic Review*, Vol.90, No.3, pp. 61-89

Minniti, M. (1999). Entrepreneurial Activity and Economic Growth. *Global Business and Economic Review*, Vol.1, No.1, pp. 31-42

Montanye, J. (2006). Entrepreneurship. *Independent Review*, Vol.10, No.4, pp. 547-569

Pollard, K. (2003). Appalachia at the Millenium: An Overview of the Results from census 2000. Population Reference Bureau, Washington, DC.

Sadeghi, A. (2008). The births and deaths of business establishments in the United States. *Monthly Labor Review*, Vol.131, No.12, (December 2008), pp. 3-18

Schultz, T. (1980). Investment in Entrepreneurial Ability. *Scandinavian Journal of Economics,* Vol.82, pp. 437-448

Schumpeter, J. (1934). *The Theory of Economic Development*, Harvard University Press, ISBN 0878556982, Cambridge, Massachusetts

Smilor R. (1997). Entrepreneurship and Community Development, *Proceedings of Kaufmann Center for Entrepreneurship, Leadership Conference on Entrepreneurship as a Community Development Strategy*, Kansas City, MO, April 1997

Storey, D. (2003). Entrepreneurship, Small and Medium Sized Enterprises and Public Policies, In: *Handbook of Entrepreneurship Research*, Z. Acs & D. Audretsch, pp. 473-514, Springer, Boston

van Stel A. & Suddle, K. (2005). The Impact of New Firm Formation on Regional Development in the Netherlands.

Research Paper ERS-2005-075-ORG, Erasmus Research Institute of Management (ERIM), ERIM is the joint research institute of the Rotterdam School of Management, Erasmus University and the Erasmus School of Economics (ESE) at Erasmus University

Wennekers S. & Thurik, A. (1999). Linking Entrepreneurship and Economic Growth. *Small Business Economics,* Vol.13, pp. 27-55

Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*, MIT Press, ISBN 0262232197, Boston, Massachusetts

Xue, J. (2007). *Three Essays on Entrepreneurship: Theory, Measurement, and Environment*. Unpublished PhD Dissertation, University of Missouri-Columbia.