Is Degree of Rurality More Crucial to Small Firm Births than Access to Incubators? An Analysis of States' Relative Efficiencies in Promoting the Birth of Small Firms

Whitney O. Peake
Research Assistant
Purdue University
403 West State Street
West Lafayette, IN 47907, USA
(765) 494-4232
Email: wnoliver@purdue.edu

Maria I. Marshall
Assistant Professor
Purdue University
403 West State Street
West Lafayette, IN 47907, USA
(765) 494-4268
Email: mimarsha@purdue.edu

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Portland, OR, July 29-August 1, 2007

Abstract

Economic development via firm birth has recently been an important topic for many state governments. However, ways in which state governments can influence firm births are not obvious, and their efficiency in fostering firm births in comparison to their peers is even less so. Focusing on the birth of small firms in the contiguous US, regression analysis and non-parametric efficiency testing are employed to determine both the expenditures state governments can target to indirectly promote small firm birth and their relative efficiency in utilizing these expenditures. The regression results reveal three significant expenditure inputs and one significant controlling factor in determining firm birth, while the efficiency tests regarding states' use of these expenditure inputs give insight as to how they compare to their peers in terms of efficient target expenditure use.

1. Introduction and Background

Over the past century, firm births have been increasingly credited for advances in technological innovation, job creation, and consequently regional economic growth and development (Schumpeter, 1934; Birch, 1981; Kirchkoff and Philips, 1988; Reynolds and Maki, 1990; Davidsson et al., 1994; Reynolds, 1994; Luger and Koo, 2003). These contributions are not sufficient in themselves to merit the attention firm births have received over firm expansions, since firm expansions likewise create jobs and subsequently promote regional growth. Kirchhoff and Phillips (1988) discovered that from 1976 to 1984, firm births accounted for 74% of new job creation, while expansions were responsible for only the remaining 26%. With firm births creating nearly three times as many jobs as expansions, the focus placed on fostering firm birth by local and state governments appears warranted.

Since firms births are often considered a significant indicator regarding a state's performance in terms of fostering business development, there is no doubt state governments have made promoting firm birth and the retention of businesses a major topic of interest. Birley (1986) contends governments at all levels have incorporated strategies to foster entrepreneurial activity and firm birth. Baumol (2002) also asserts that both politicians and practitioners are keenly aware of the significance of entrepreneurship in spurring new employment and innovation.

In response to this importance, states have placed a great deal of attention on their ability to promote state economic development through firm birth and retention. For example, Kentucky has recently created a Cabinet for Economic Development, which provides information to both businesses considering relocation to Kentucky and to entrepreneurs who are considering starting a business in the state. Indiana has also been working to promote business development and retention. In February 2005, Indiana replaced its Department of Commerce with the Indiana Economic Development Corporation (IEDC). The focus of this new governmental entity is both to develop and retain businesses within Indiana and to attract new businesses to the state. Goetz and Freshwater (2001) suggest the attention to firm births within states is appropriately placed, since economic development policies adopted by states are increasingly viewed as significant influences of economic development patterns.

Indiana Governor Mitch Daniels is quoted as saying, “Government does not create jobs; it only creates conditions that make jobs more or less likely” (2005). Both the literature and private organizations seem to agree that states do indeed exert at least some degree of influence on entrepreneurial decision-making (Goetz and Freshwater, 2001). Organizations such as the Corporation for Enterprise Development (CFED) rank the business climates of states relative to their counterparts. Their *Development Report Card for States* provides both individuals and government officials with an evaluation of each state’s economy, along with other dimensions the CFED considers to be essential in economic development. The literature related to state economic development policy also appears to be centered on the nature of the programs states incorporate to further promote business development (Elsinger, 1988; Foster, 1988; Bartik, 1991; Isserman, 1994; Bradshaw and Blakely, 1999).

As the relevant literature suggests, one of state governments' key concerns is the conditions they can influence to make jobs more likely within their respective states. The difficulty in formulating such policy, however, is two-fold. The first difficulty lies in pinpointing the conditions affecting firm births which state governments can influence, as opposed to those conditions beyond their control. Secondly, it is extremely tricky for states to assess their efficiency in using these determinants to further promote business development and subsequently, the economy. The problem in determining relative efficiency stems from the variability in firm formation throughout the U.S. However, these issues may be mitigated to the extent that an analysis can be conducted with some degree of confidence.

Examination of US Census Data regarding firm births reveals that during the time period 1999-2003, the forty-eight contiguous states in the US have averaged approximately 727,500 total firm births per year. On average, when a small business is defined as one having less than 500 employees, small business firm births make up 86% of that total amount over the same time period. Figure 1 illustrates the average percentage of small business firm births each year during the 1999-2003 periods. Sole proprietorships and very small firms, businesses with 1-4 employees, represent the majority of total firm births over this time period, accounting for 60% on average each year. Table 1 displays the five-year average for each firm birth size category included in the census data. These results indicate that small business firm births make up the majority of total firm births in the contiguous U.S. This study specifically focuses on what governments can do to facilitate the birth of small firms since they are the primary component of all firm births in the contiguous U.S.

A great number of other factors are also significant influencers of firm births within states. Singh-Knights, Smith, and Budumuru (2006) and Goetz and Freshwater (2001), suggest that factors such as available grants, business incubators, human capital, and financial capital serve as important determinants of entrepreneurship within states. Bartik (1985) found that the land area of the state, unionization percentages, corporate tax rates, and existing manufacturing activity were consistently significant factors in business location decisions. The results of these studies and others (Armington and Acs, 2001; Mata, 1996) indicate that there are certainly factors beyond the control of governments that affect firm birth. Since other pertinent factors exist, which are not captured by the expenditure variables, a controlling factor may be included to account for some of these effects.

Likewise, it is apparent that state governments are not single-minded in their goals of outcomes associated with budget appropriation. It would be unwise to believe they are solely focused on the single output of firm birth, which is simply one of multiple outputs they hope to achieve through their allocation of funds. However, for simplification purposes, we assume that it is the primary objective of states' to produce a well-educated, healthy workforce with many infrastructural endowments. Since these elements indirectly foster firm births within a state, we assume that firm birth is the ultimate goal of states when expenditure selection is made.

This analysis takes a somewhat different approach from previous studies in determining the factors state governments can affect to encourage firm birth. As mentioned previously, our contention is that through their selection of expenditures, state governments can indirectly affect a great number of factors: education level and health of workforce, transportation, etc. The purpose of this study is to determine specific state government expenditures that positively affect firm births in the 48 contiguous states and the relative efficiency of state governments in appropriating the expenditures that do indeed impact the birth of small firms. Expenditure factors affecting firm birth over a four-year time horizon are evaluated via panel regression methods. In addition, a comparison between two regression models is made to determine which of two control variables provides more interesting estimates in accounting for a portion of the other factors affecting firm birth beyond the scope of governmental expenditures. In one equation we test the effect of the number of incubators within the state, while in the other we test the effect of the states' relative rurality.

Assessment of state governments' relative efficiencies in promoting firm births employs nonparametric efficiency testing through linear programming techniques. Through this two-step approach, it is hoped that some insight may be gained as to (1) the actions governments can take to promote the birth of small firms, (2) how particular control factors within states affect firm births, and (3) how efficient state governments are at employing the significant expenditure factors over time relative to other states. A deeper understanding of both the expenditures that affect firm births and their relative efficiency in using those expenditures, allows state governments to make more insightful and informed decisions regarding their attempts at state economic development. In short, this study provides a useful and accessible tool through which states can discover how they rank in comparison to their counterparts in fostering firm births through their expenditures.

2. Methodology

Essentially what we suggest above is that states have a production function consisting of an output (firm birth) and inputs (expenditures). In the first stage of our analysis, we determine whether the inputs under consideration truly are significant factors in promoting firm birth.

Secondly, we test the productive efficiency of states in employing those positive and significant factors, where productive efficiency reveals whether more output can be achieved given the observed inputs (Farrell, 1957).

Farrell also asserts that by measuring the productive efficiency of an industry, key implications may be discovered and applied for both economic theorists and policymakers alike. Efficiency measurement is most often applied using either an econometric or mathematical programming approach, and implementation of the latter approach is often referred to as Data Envelopment Analysis, or DEA (Charnes et al, 1978). An advantage of using DEA is that it employs minimal assumptions about the functional form of the production function that describes the technology for producing output from inputs (Färe, 1985; Coelli and Perelman, 1999). Other technical efficiency testing methods are available with advantages of their own; however, as Coelli and Perelman (1999) discovered in their application to railway companies, parametric linear programming (PLP), DEA, and corrected ordinary least squares (COLS) provide “reassuringly similar information.”

Farrell (1957) suggests that productive efficiency testing techniques are applicable and understandable to individuals in many different fields, i.e., economic statisticians, businessmen, and government officials. As intended, efficiency testing methods have been used in studies ranging from financial portfolio analyses (Sengupta, 1989; Sengupta, 2003; Wang, 2003) to agricultural production or productive efficiency (Shafiq and Rehman, 2000; Fletschner and Zepeda, 2002; Nin et al, 2003; Helfand and Levine, 2004) to efficiency of federal budget projections (Campbell and Ghysels, 1995).

A unique application of the approach described above is employed in the case of this analysis. The output resulting from this set of expenditure inputs is firm birth. In the past, DEA applied to the production efficiency of farms has employed a two-stage analysis, where in the first stage, technical and cost efficiency measures are calculated. Then the second stage consists of regressing the calculated measures of technical and cost efficiency on a set of characteristics specific to the farm or farmer (Rios and Shively, 2005). In the context of our study, the two stage analysis will be reversed. First, the expenditure inputs and control factor will be regressed on the firm birth output for the forty-eight contiguous states over a four year time horizon. Secondly, the inputs determined to positively and significantly influence firm birth will be employed in an efficiency test. These steps are switched in the context of this analysis to ensure that the expenditures included in the efficiency test truly are positive and significant influencers of firm birth within states.

Although no studies have been found within the literature in which an identical problem is tested, previous studies of like nature utilize regression methods to determine significant factors affecting firm birth (for example: Bartik, 1985; Goetz and Freshwater, 2001; Lee et al, 2004; Singh-Knights et al, 2006). However, we take the literature another step forward. After the significant inputs are determined through the regression analysis, the relative efficiency of each state in using the significant inputs to produce firm births is assessed through technical efficiency testing methods. This latter step provides insight as to where states stand in comparison to their peers in promoting firm births through these significant expenditures.

2.1 Measuring Significant Inputs

The fixed effects model for firm birth is as follows:

(1)

$$\text{Firm\_Birth}_{it} = \beta_0 + \delta_0 yr1_t + \delta_1 yr2_t + \delta_2 yr3_t + \theta_0 Control_{ki} + \beta_1 \text{Education}_{it} + \beta_2 \text{Health}_{it} + \beta_3 \text{Highways}_{it} + \beta_4 \text{Police}_{it} + \beta_5 \text{Natural\_Resources}_{it} + \beta_6 \text{Parks\_and\_Recreation}_{it} + a_i + u_{it}, t = 1,2,3,4$$

where the dependent variable Firm_Birth_{it} represents the number of firm births in state i during time period t, and the yr_t variables are dummy variables representing the years under consideration. The independent variable $Control_{\text{ki}}$ serves as a placeholder for the k$^{\text{th}}$ control for state *i*. The subscript "k" denotes the control variable under consideration, either the relative rurality index (Waldorf, 2006) or the number of incubators in state *i*. The x_{it} variables represent the independent expenditure variables employed by the model: Education_{it}, Health_{it}, Highways_{it}, Police_{it}, $\text{Natural\_Resources}_{it}$, and $\text{Parks\_and\_Recreation}_{it}$. These independent expenditure variables represent state government expenditures on a respective item in state i during time period t. The variable a_i captures all the unobserved, time-constant elements affecting Firm_Birth_{it}, and u_{it} denotes the idiosyncratic error.

We test two regression equations using the underlying ideas of Pollak and Wales (1991) to determine the more interesting control variable to include within the model. We have set below two "competing" hypotheses – each one regressing one of the two control variables. In Pollak and Wales' (1991) development of the likelihood dominance criterion, they develop two competing hypotheses as the base. Our competing hypotheses are as follows:

H1: $$\text{Firm\_Birth}_{it} = \beta_0 + \delta_0 yr1_t + \delta_1 yr2_t + \delta_2 yr3_t + \theta_0 Incubators_{\text{i}} + \beta_1 \text{Education}_{it} + \beta_2 \text{Health}_{it} + \beta_3 \text{Highways}_{it} + \beta_4 \text{Police}_{it} + \beta_5 \text{Natural\_Resources}_{it} + \beta_6 \text{Parks\_and\_Recreation}_{it} + a_i + u_{it}, t = 1,2,3,4$$

$$
\text{H2:} \quad \begin{aligned} &\text{Firm\_Birth}_{it} = \beta_0 + \delta_0 yr1_t + \delta_1 yr2_t + \delta_2 yr3_t + \theta_0 \, Relative\_Rurality_{\text{i}} + \beta_1 \text{Education}_{it} \\ &+ \beta_2 \text{Health}_{it} + \beta_3 \text{Highways}_{it} + \beta_4 \text{Police}_{it} + \beta_5 \text{Natural\_Resources}_{it} + \beta_6 \text{Parks\_and\_Recreation}_{it} \\ &+ a_i + u_{it}, \, t = 1,2,3,4 \end{aligned}
$$

Since the number of parameters is the same across both models, we know that the model with the highest r-squared value minimizes the squared errors; thus, in this instance we choose the best regression model (H1 or H2) on the basis of the highest r-squared value.

2.2 Measuring Relative Efficiency of States in Using Significant Inputs

Within the second stage of the analysis, nonparametric efficiency testing is used to determine the relative technical output efficiency of states in fostering firm births (output) through the appropriation of expenditures (inputs). To determine the technical efficiency of the states within our sample over the four-year time horizon, we solve the following linear programming problem:

(4)
$$
\begin{aligned}
&\underset{\text{u},\lambda^1,\ldots,\lambda^K}{\text{Maximize}} \; u \\
&\text{Subject to}: \sum_{\text{t}=1}^{\text{T}} \sum_{k=1}^{\text{K}} u_k^t \lambda_k^t \geq u \\
&\sum_{k=1}^{\text{K}} x_{ki}^t \lambda_k^t \geq x_{ki}^T \\
&\sum_{k=1}^{K} \lambda_k^t = 1, \quad \lambda_k^t \geq 0
\end{aligned}
$$

where u is the maximum firm birth level per capita that appears to be technically feasible, u_k^t represents the firm births per capita of the k^{th} state in time period t, x_{ik}^t denotes the expenditures per capita on the i^{th} input used by the state whose efficiency is being tested in time period t, and λ_k^t is the weight assigned to the k^{th} state in time period t in forming a convex combination of the input vectors. The index of technical efficiency calculated via this approach is the ratio between the observed level of firm births per capita in the state being tested (u^0) and the optimal level of firm births per capita (u). Firm birth rates and expenditures are tested in per capita form to prevent both large and small outliers from distorting the results.

The basic assumption underlying technical efficiency testing is that all firms have access to the same technology. Other assumptions we make in order to conduct the analysis are free disposal of inputs and outputs and convexity of the set of inputs and outputs (Preckel, Akridge and Boland, 1997). Additional assumptions were also made to provide a more realistic analysis. Non-constant returns to scale are assumed. If constant returns to scale were assumed, the constraint that requires the λ_k^t's to sum to one would be relaxed. This would allow us to scale each observed input/output vector by any positive amount (Preckel et al, 1997). In short, non-constant returns to scale accounts for the limitations of state government budgets by restricting the technology set. The existence of a sequential production set is also assumed, since if state governments behave rationally, some form of dependence between state government expenditures across time should exist. To assume otherwise would suggest that states essentially "start over" each year and do not employ any prior knowledge in their decision-making processes (Nin et al, 2002).

The efficiency index calculated reveals the ratio between the observed level of firm births in each state and the optimal level of firm births for its respective expenditure levels. Results with an efficiency index equal to one indicate that the state is technically efficient in time period *t*; whereas, an efficiency index of less than one indicates the state is not technically efficient. The lower the reported value of the index, the less technically efficient the respective state. Technical inefficiency indicates that the state could theoretically have received more output for the amount of inputs used, i.e., more firm births given the allocation of expenditures, when evaluated relative to the other states.

3. Data

Firm birth data were obtained from the U.S. Census Bureau, Statistics of U.S. Businesses, while data associated with state government expenditures were obtained from the U.S. Census Bureau, State Government Finances Section. The average relative rurality of each state was obtained from the Index of Relative Rurality (IRR) developed by Waldorf (2006) for each county within the U.S. A state average for this Index of relative rurality was then calculated by averaging the individual indices of each county within the state. Singh-Knights, Smith, and Budumuru explored the significance of the number of incubators within a state as an indicator of infrastructure. The number of business incubators within each state was taken from a *BizVoice* article written by Monnier (2003).

This analysis considers panel data involving small firms births (firms with less than 500 employees) and state government expenditures of the forty-eight contiguous states from 1999-2002, yielding a total of 192 observations. The average index of relative rurality and number of incubators are assumed constant for each state over this four year period, since the relative rurality and number of incubators within states do not tend to fluctuate over such a small period of time.

Total small firm births was selected as the dependent variable and output. The six independent expenditure variables and inputs for the regression and nonparametric efficiency testing analyses were obtained from the literature and through intuition. Since education as a form of human capital has long been shown as a factor of firm birth and entrepreneurship (Evans and Leighton, 1990; Goetz and Freshwater, 2001; Armington and Acs, 2002; Lee et al, 2004), it is expected that expenditures in education would have an effect on firm birth.

The entrepreneurial climate differs greatly across states within the U.S. To account for some of this heterogeneity beyond state-specific expenditures, we incorporate a Relative Rurality Index developed by Waldorf (2006) in the model to account for the relative rurality of the state. This index incorporates the following measures to determine each county's degree of rurality: log population size, log population density, percentage of urban residents, and adjacency to metropolitan areas. The value of the index ranges from 0 to 1, with 0 indicating most urban and 1 indicating most rural. To assess each state's degrees of relative rurality, the average was taken of the index value for all counties within the state. By accounting for states' relative degrees of rurality, we indirectly capture differences among populations and possibly differences among states in terms of infrastructure. We would expect a higher relative rurality index, i.e. a relatively more rural state, to have a negative effect on firm birth. Conversely, we would expect a lower relative rurality index to positively affect firm births.

Singh-Knights, Smith, and Budumuru (2006) hypothesize there are five elements, innovations, human capital, financial capital, state infrastructure, and entrepreneurial climate, that together determine the entrepreneurial output of states. Level of innovation is an important component in a state's entrepreneurial environment, and may account for some of the heterogeneity across states in firm birth. Within their innovation level indicators, Singh-Knights, Smith and Budumuru (2006) include the number of business incubators per state as a contributor of entrepreneurship output. However, their findings reveal that within their dataset, the effect of incubators on entrepreneurial output is negative. Due to this surprising result and the potential explanatory power of number of incubators as an indicator of the innovative environment within states, we test the number of incubators per state as a control variable within one of the "competing" regression models. We expect higher availability of business incubators to positively affect the number of firm births within a state.

The expenditure factors other than education expected to demonstrate a positive effect on small firm birth, but that do not appear in the literature are: healthcare, highways, police protection, natural resources, and parks and recreation expenditures. Healthcare expenditures serve as a proxy for indirectly providing a healthier, more productive workforce. Highway expenditures represent increased ease of mobility with improved road conditions. Police protection serves as an indicator for security of the state. The expenditures of funds on natural resources are believed to denote increased opportunity for new firms through greater environmental endowments. Expenditures on Parks and Recreation represent the ability to provide more leisure activities for workers; thus, providing a more pleasant place to live and work. In addition, parks and recreation expenditures may account for tourism or other business opportunities within the state.

These expenditures are not the only factors that exert an effect on firm birth. As mentioned previously, other factors obviously also play a role. Endogeneity issues likely exist within the regression model, since the included expenditures were selected endogenously. For example, suppose that increased police expenditures have a negative correlation with firm birth. It is doubtful that simply increasing police expenditures would lead fewer firms to locate in an area. This is indicative of a deeper underlying issue, such as a high crime rate. Short of a random experiment in which state governments "randomly" assign more police to areas in order to observe the result, or creating an instrumental variable to control for crime rate in a two-stage least squares context, this is the most appropriate analysis for the data. Despite this endogeneity issue, the model does explain a rather simple way in which state governments may indirectly promote firm birth and work towards further developing their state's economy.

4. Results and Discussion

4.1 Results from Regression Analysis

Results for both of the regression models were obtained through STATA 9 (2006), and are displayed in Tables 2 and 3. The results of the no fixed effects ordinary least squares regressions indicate that the regression equation including the relative rurality control produces better results, with an r-square value of 0.9459. Within the relative rurality control regression model education, highways, police, and natural resource expenditures and the relative rurality of states are significant at the 1% level. Healthcare expenditures are significant at the 5% level. Police protection expenditure and the relative rurality index yield negative effects on firm birth.

Within the incubator control model, signs and significance levels of the explanatory variables were maintained, and parks and recreation expenditures are positive significant at the 5% level. The number of incubators control variable was positive, as expected, but did not exhibit a significant effect.

The Breusch-Pagan test revealed the presence of heteroskedasticity within both of the competing regression models. To correct the standard errors for heteroskedasticity of unknown form, White's robust standard errors were used to conduct the regressions again. Four expenditure variables retained their significance across both models: education, highways, police expenditures, and natural resources, as did the relative rurality index in the relative rurality control model. Education, highways, police protection, and natural resources expenditures are significant at the 1% level. The coefficient for the relative rurality index maintained its negative, significant impact at the 1% level.

Since our study uses panel data, the fixed effects regression model is considered the most appropriate regression method. Fixed effects models can assist in accounting for unobserved heterogeneity, accounting in part for omitted variables (Wooldridge, 2003). Year dummies were created, and the six original independent inputs, along with the relative rurality control and year dummies, were again regressed on firm birth for each of the competing models. The independent variables retained their signs and respective levels of significance, and the regression model containing the relative rurality index control remained the best of the two models with an r-square value of 0.9489. Police protection had a negative effect on firm birth; thus, it will not be included in the efficiency testing analysis.

Although it was initially expected that expenditures for police protection would provide a safer, more secure state for residents and businesses, it appears this is not the case. State crime rankings calculated from six major crimes for the year 2000, were obtained from the Morgan Quitno Press (2000). Crime ranking of the state was then regressed against police expenditure. It was found that increased crime ranking explained a significant portion of higher police expenditures. With this in mind, it would then be expected that an increased crime rate, leading to increased spending in police protection, would in fact yield fewer firm births in a state. For this reason, police protection expenditures were excluded for the efficiency test portion of the analysis. The insight gained from this variable, however, is a valuable component of the regression analysis portion of the study.

4.2 Results of the Nonparametric Efficiency Test

Results for the nonparametric efficiency testing analysis were calculated using GAMS -- the Generalized Algebraic Modeling System (2006), and are reported in Tables 3 and 4. The most efficient states are those with an efficiency index at or near one. The results across the four years for the forty-eight contiguous states are found in Table 3. As can be seen in Table 3, both Wyoming and Colorado are at or very near efficiency in use of their expenditures across all four years. Some states, such as Utah and New Hampshire are efficient in the first year, but then suffer a drastic reduction in their efficiency indices the years thereafter.

States ranked in order of average efficiency 1999-2002 can be seen in Table 4. Those states that are most efficient have efficiency indices at or near one. Those considered most inefficient have efficiency indices near or below 0.50. Wyoming, Colorado, New York, Montana, and Florida are the five most efficient states in terms of average efficiency indices, while Iowa, Pennsylvania, Mississippi, Kentucky, and West Virginia are the five leave efficient states, exhibiting an efficiency index of less than 0.60 in all four years.

Such rankings provide states with the ability to better understand where they stand in comparison to their counterparts. For example, consider the rankings of Colorado and Louisiana in 2002, first and thirty-ninth respectively. Their population levels are very similar. Colorado has a population level of 4,498,000, while Louisiana has a population level of 4,477,000. As can be seen below in Figure 2, their firm birth rates are separated by 6,250 firm births in that year, and their efficiency indices are very different, with Colorado exhibiting efficiency and West Virginia ranking in the ten least inefficient states for that year. Figure 3 displays the 2002 target input expenditures for Colorado and Louisiana. Although the firm birth rate in Louisiana is much lower than that of Colorado, the total target expenditures in education, highways, and natural resources are very similar for the two states. This comparison would indicate that Colorado is receiving more “bang for its buck” in terms of expenditures generating firm births.

In assessing the efficiency of states in using the expenditure inputs to receive firm birth outputs, it was discovered that some states are consistently more efficient than others across time and some states are consistently more inefficient than other states across time. The efficiency test results can be further analyzed as above to give indication as to where individual states stand in comparison to their peers.

5. Conclusions and Future Research

The natural questions to ask in response to this analysis are what can states actually do to promote firm birth, and how can this analysis help them? We attempt to answer these questions by two means (1) with the results of this study and (2) by providing a unique method of analysis, which is both accessible and useful. Results indicate that state governments’ expenditures on education, highways, and natural resources positively affect the birth of small firms, while higher relative rurality decreases the number of firm births. Essentially these results suggest, not surprisingly, that a more educated population, better transportation infrastructure, and protection of natural resources indirectly fosters firm birth within states. In addition, as expected relatively more urban areas facilitate more firm births.

Although the regression model including the relative rurality index proved to be the better of the two models, some interesting conclusions can be drawn from the results of the regression model including the number of incubators within the state. Unlike Singh-Knights, Smith, and Budumuru (2006), we found that the number of incubators within a state has a positive but not significant effect on firm births. Within their study, the result for the number of business incubators runs contrary to prediction with a negative and significant value in both explaining rate of new firm start-ups and the number of Inc. 500 firms. It is intuitive that the number of incubators within a state would have a positive effect on the number of firm births; however, they may affect small firm births more than the firms under consideration in the Singh-Knights, Smith, and Budumuru study. Further consideration of this variable appears warranted, given the differing results across studies.

The efficiency test analysis provides deeper insight into the results of our analysis by allowing us to rank states in order of their efficiency in using the productive expenditures to promote firm birth. One may expect that larger states with higher budgets would be able to do more to foster firm births; however, this is not always the case. Several smaller states in terms of population, such as Wyoming, Colorado and Montana, are among the most efficient in terms of utilizing their expenditures to promote firm births. Although the three target expenditures under analysis certainly do not encompass everything needed for state governments to indirectly promote firm births, the results do provide benchmarks for state policy makers as they look to other states for models of efficiency. As mentioned previously, states of all sizes inhabit the most efficient list, and most states can likely find a similarly populated state to look to in terms of efficient expenditures.

One of the major contributions of this study is the methodology. We describe a method through which state governments can test other factors relevant to them outside the realms of firm birth. State and local governments likely have access to more specific expenditure data, which they can apply to matters of direct importance to them. For example, Colorado may want to investigate if it is more efficient in attracting big business than its bordering states. This methodology provides states with the ability to benchmark their efficiency in utilizing relevant growth factors relative to neighboring and peer states.

There are several elements that could potentially add interesting results to this model. An important component that may be added to the model is corporate tax rates across states. Since business location decisions are at times driven by tax rates, this is an element for which future studies will likely want to account (Bartik, 1985). The difficulty in considering corporate tax rates lies in the characteristic that some states operate under a tiered corporate tax rate system, making a cross-comparison of states difficult. Perhaps in the future, this difficulty can be overcome, and an important element in the firm birth decision can be included in the regression and possibly efficiency testing analyses.

In addition future research could further delve into efficiency by industry to determine whether expenditures affect firm births differently, depending on industry categories. This would help us to understand if particular industries, such as agriculture or manufacturing, are affected more than others by state government expenditures. Although state government expenditures tend to remain at fairly stable levels across years, it would also strengthen the analysis to lag the expenditure variables by one or more years in order to give them time to pose an effect on firm births.

This study serves as an important step in helping states to understand both the factors influencing firm birth and their relative efficiency in using such factors. Applying efficiency testing to rank states in terms of significant input use to receive an output or outputs, can be expanded to items other than firm birth. For example, this approach can assist governments at any level in determining the relative efficiency of their budget allocations in obtaining a desired output, i.e. number of constituents obtaining a post-secondary degree, number of constituents receiving government assistance, etc. This method could also be extended for use by small business development entities to determine their relative efficiency in promoting the success of small firms, with the number of firms surviving past some threshold as the output. As our study demonstrates, this is an extremely useful tool, which can provide tangible and understandable results to both practitioners and academics in many fields.

References

Armington, C. and Z.J. Acs, 2002, 'The Determinants of Regional Variation in New Firm Formation', *Regional Studies*, 36(1), 33-45.

Baumol, W., 2002, *The Free-Market Innovation Machine: Analyzing the Growth Miracle of Capitalism*, Princeton: Princeton University Press.

Bartik, T.J., 1985, 'Business Location Decisions in the United States: Estimates of the Effects of Unionization, Taxes, and Other Characteristics of States', *Journal of Business & Economic Statistics*, 3 (1), 14-22.

Birch, D.L., 1981, 'Who Creates Jobs?', *The Public Interest*, 65(Fall), 3-14.

Birley, S., 1986, 'The Role of New Firms: Births, Deaths and Job Generation', *Strategic Management Journal*, 7(4), 361-376.

Bradshaw, T. K. and E. J. Blakely, 1999, 'What are 'Third-Wave' State Economic Development Efforts? From Incentives to Industrial Policy', *Economic Development Quarterly*, 13(3), 229-244.

Campbell, B. and E. Ghysels, 1995, 'Federal Budget Projections: A Nonparametric Assessment of Bias and Efficiency', *The Review of Economics and Statistics*, 77(1), 17-32.

Charnes, A., W. Cooper, and E. Rhodes, 1978, 'Measuring the Efficiency of Decision Making Units', *European Journal of Operation Research*, 2(6), 429-444.

Davidsson, P., L. Lindmark, and C. Olofsson, 1994, 'New Firm Formation and Regional Development in Sweden', *Regional Studies*, 28(4), 395-410.

Daniels, M., 2005, Governor Mitch Daniels' State of the State Address.

Evans, D.S. and L.S. Leighton, 1990, 'Small Business Formation by Unemployed and Employed Workers', *Small Business Economics*, 2(4), 319-330.

Färe, R., S. Grosskopf and C. A. K. Lovell, 1985, *The Measurement of Efficiency of Production*, Boston: Kluwer-Nijhoff Publishing.

Farrell, M.J., 1957, 'The Measurement of Productive Efficiency', *Journal of the Royal Statistical Society* 120(3), 253-290.

Fletschner, D.K. and L. Zepeda, 2002, 'Efficiency of Small Landholders in Eastern Paraguay', *Journal of Agricultural and Resource Economics*, 27(2), 554-572.

Generalized Algebraic Modeling System (GAMS), 2006, Version 2.5, GAMS Development Corporation, Washington D.C.

Goetz, S.J. and D. Freshwater, 2001, 'State-Level Determinants of Entrepreneurship and a Preliminary Measure of Entrepreneurial Climate', *Economic Development Quarterly* 15(1), 58-71.

Helfand, S.M. and E.S. Levine, 2004, 'Farm Size and the Determinants of Productive Efficiency in the Brazilian Center-West', *Agricultural Economics*, 31(2-3), 241-249.

Isserman, A.M., 1994, 'State economic development policy and practice in the United States: A survey article', *International Regional Science Review*, 16(1-2), 49-100.

Kirchkoff, B. and B. Phillips, 1988, 'The Effect of Firm Formation and Growth on Job Creation in the U.S', *Journal of Business Venturing*, 3(4), 261-272.

Lee, S.Y., R. Florida, and Z.J. Acs, 2004, 'Creativity and Entrepreneurship: A Regional Analysis of New Firm Formation', *Regional Studies*, 38(2004), 879-891.

Luger, M. and J. Koo, 2005, 'Defining and Tracking Business Start-ups', *Small Business Economics*, 24(1), 17-28.

Mata, J., 1996, 'Small Firm Births and Macroeconomic Fluctuations', *Review of Industrial Organization*, 11(2), 173-182.

Monnier, C., 2003, 'Q&A: Indiana's Business Incubators', *BizVoice*, 6(5), 56.

Morgan Quitno Press, 2000, 'Results of the 2000 Most Dangerous and Safest State Awards', http://www.morganquitno.com/dangsaf00.htm.

Nin, A., C. Arndt, and P.V. Preckel, 2003, 'Is Agricultural Productivity in Developing Countries Really Shrinking? New Evidence Using a Modified Nonparametric Approach', *Journal of Development Economics*, 71(2), 395-415.

Preckel, P.V., J.T. Akridge, and M.A. Boland, 1991, 'Efficiency Measures for Retail Fertilizer Dealers', *Agribusiness*, 13(5), 457-559.

Reynolds, P., 1994, 'Autonomous Firm Dynamics and Economic Growth in the United States', *Regional Studies*, 28(4), 429-442.

Reynolds, P. and W.R. Maki, 1990, *Business Volatility and Economic Growth*. Project Report prepared for the U.S. Small Business Administration.

Rios, A.R. and G.E. Shively, 2005, 'Farm Size and Nonparametric Efficiency Measurements for Coffee Farms in Vietnam', Selected Paper, American Agricultural Economics Association Annual Meeting.

Schumpeter, J., 1934, *The Theory of Economic Development*. Cambridge: Harvard University Press.

Sengupta, J.K, 1989, ‘Nonparametric Tests of Efficiency of Portfolio Investment’, *Journal of Economics*, 50(1), 1-15.

Sengupta, J.K., 2003, ‘Efficiency Tests for Mutual Fund Portfolios’, *Applied Financial Economics*, 13(12), 869-876.

Shafi, M. and T. Rehman, , ‘The Extent of Resource Use Inefficiencies in Cotton Production in Pakistan’s Punjab: An Application of Data Envelopment Analysis’, *Agricultural Economics*, 22(3), 321-330.

Singh-Knights, D., D.K. Smith, and Y. Budumuru, 2006, ‘Determinants of Entrepreneurship and Small Business Activity: A Two-Stage Regression Analysis’, Selected Paper, American Agricultural Economics Association Annual Meeting.

Stata Version 9, 2006, StataCorp, College Station, TX.

Waldorf, B.S., 2006, ‘What is Rural and What is Urban in Indiana?’, PCRD Working Paper, January 2006.

Wang, K.Q., 2002, ‘Nonparametric tests of conditional mean-variance efficiency of a benchmark portfolio’, *Journal of Empirical Finance*, 9(2), 133-170.

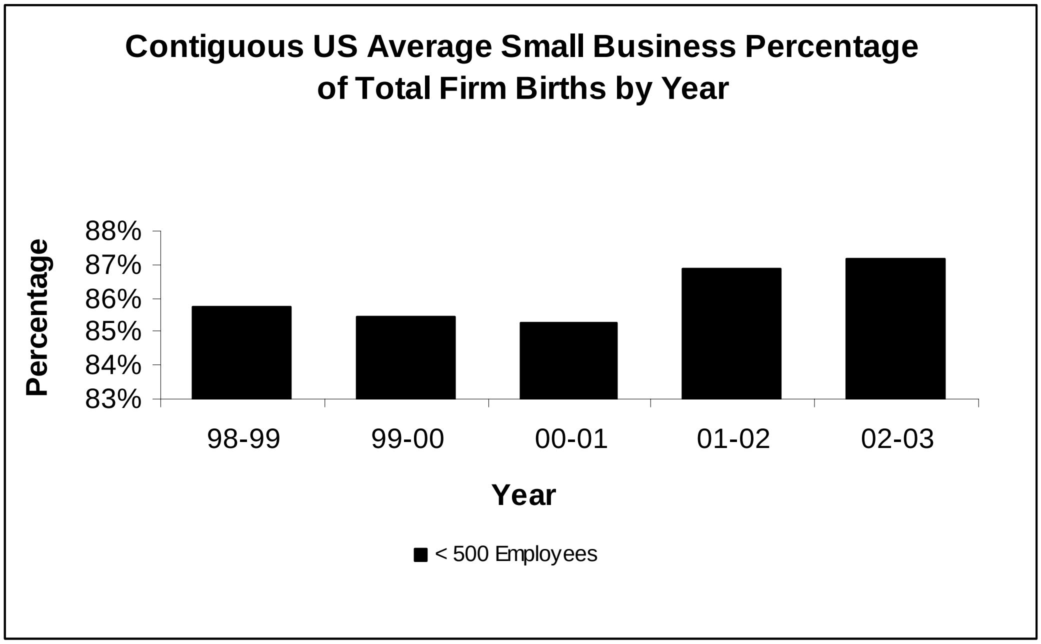
Wooldridge, J.M., 2002, *Introductory Econometrics: A Modern Approach*, 2nd Edition, Mason, OH: South Western College Publishing.

U.S. Census Bureau, State Government Finances, http://www.census.gov/govs/www/state.html.

U.S. Census Bureau, *Statistics of US Businesses*, http://www.census.gov/csd/susb/susbdyn.htm.

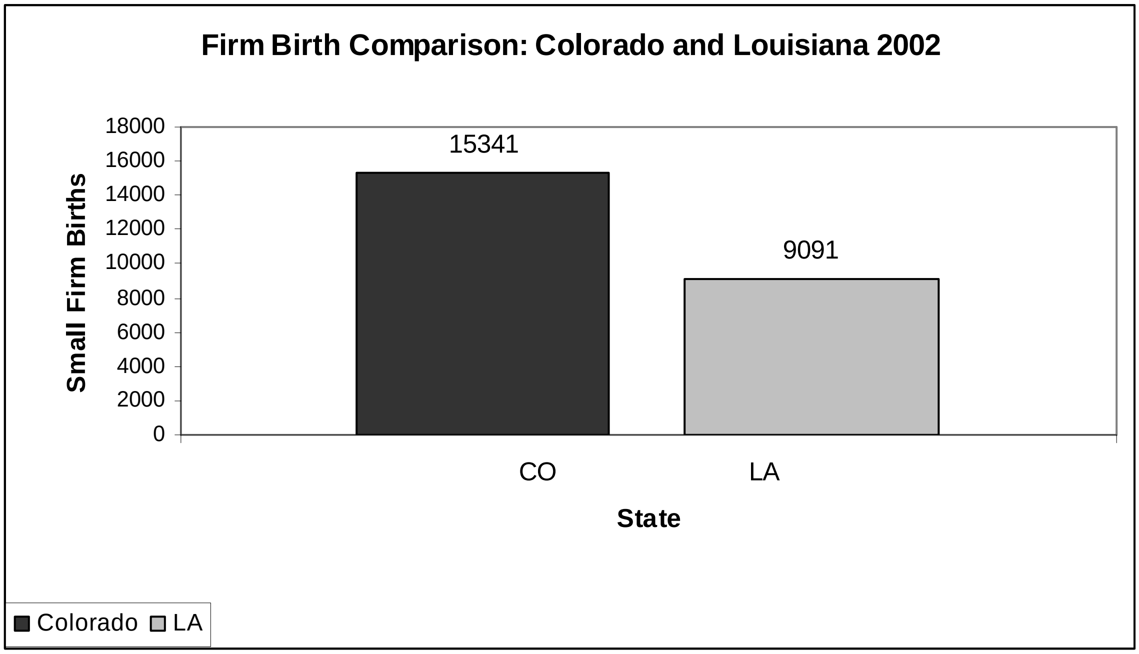
U.S. Census Bureau, *State and County Quickfacts*, http://quickfacts.census.gov/qfd/.

Figure 1. Contiguous US average small business percentage of total firm births by year



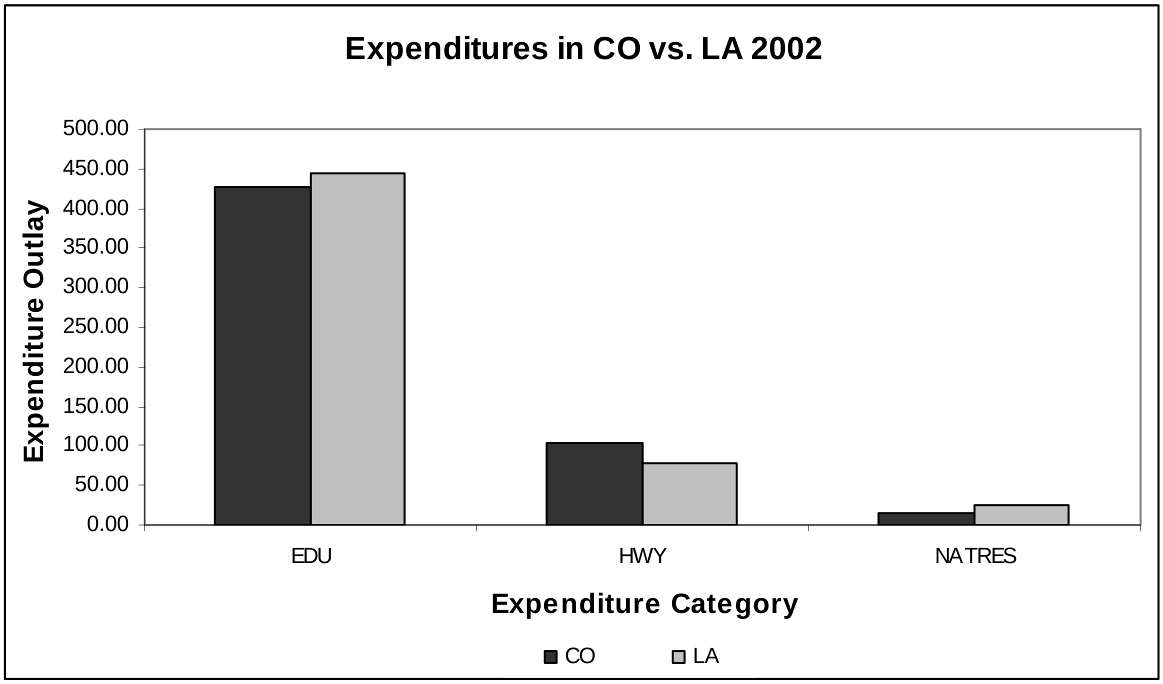
Source: US Census

Figure 2. Firm birth comparison for Colorado and Louisiana 2002



Source: US Census

Figure 3. Target expenditure comparison for Colorado and Louisiana 2002



Source: US Census

Table 1. Five year average of percentage of firm births represented by each firm size category

Firm size: number of employees	**1-4**	**5-9**	**10-19**	**20-99**	**100-499**	**500+**
Percentage of total firms births	60%	11%	5%	5%	4%	14%

Table 2. Linear regression results for the birth of small firms

	Time Fixed Effects Including Incubators	**Time Fixed Effects Including Relative Rurality Index**
Constant	-1358.366 (-2.82)**	2116.574 (1.64)
Education	0.000677 (3.29)**	0.000730 (3.87)**
Health	0.001378 (1.39)	0.001326 (1.39)
Highways	0.004137 (5.48)**	0.004210 (5.74)**
Police	-0.000981 (-2.81)**	-0.011304 (-3.54)**
Natural Resouces	0.007294 2.43)**	0.007521 (2.53)**
Parks and Recreation	0.007792 (1.58)	0.005007 (0.96)
Relative Rurality Index		-5952.84 (-2.76)**
Incubators	47.67568 (0.57)	
R-Squared	0.9473	0.9489

* Indicates significance at the 5% level
** Indicates significance at the 1% level

Table 3. Nonparametric efficiency test results for forty-eight contiguous states 1999-2002

State	**Year**				
	1999	2000	2001	2002	Average
Alabama	0.662	0.589	0.556	0.605	0.603
Arizona	0.877	0.796	0.771	0.772	0.804
Arkansas	0.652	0.646	0.614	0.661	0.643
California	0.802	0.767	0.768	0.770	0.777
Colorado	1.000	0.984	0.978	1.000	0.991
Connecticut	0.769	0.710	0.670	0.641	0.698
Delaware	0.878	0.875	0.810	0.780	0.836
Florida	1.000	0.925	0.930	1.000	0.964
Georgia	0.834	0.771	0.757	0.788	0.788
Idaho	0.869	0.833	0.860	0.899	0.865
Illinois	0.794	0.754	0.629	0.667	0.711
Indiana	0.630	0.567	0.572	0.637	0.602
Iowa	0.570	0.558	0.544	0.608	0.570
Kansas	0.654	0.657	0.670	0.716	0.674
Kentucky	0.546	0.510	0.505	0.539	0.525
Louisiana	0.594	0.557	0.590	0.632	0.593
Maine	0.897	0.830	0.777	0.840	0.836
Maryland	0.670	0.638	0.618	0.656	0.646
Massachusetts	0.899	0.828	0.713	0.720	0.790
Michigan	0.600	0.567	0.548	0.602	0.579
Minnesota	0.680	0.657	0.679	0.722	0.685
Mississippi	0.576	0.507	0.518	0.568	0.542
Missouri	0.706	0.679	0.609	0.737	0.683
Montana	0.946	0.958	0.964	1.000	0.967
Nebraska	0.816	0.639	0.677	0.721	0.713
Nevada	1.000	0.889	0.863	0.914	0.917
New Hampshire	1.000	0.778	0.828	0.844	0.863
New Jersey	0.955	0.896	0.760	0.760	0.843
New Mexico	0.654	0.624	0.627	0.663	0.642
New York	1.000	0.986	0.960	1.000	0.987
North Carolina	0.710	0.636	0.661	0.681	0.672
North Dakota	0.606	0.612	0.637	0.677	0.633
Ohio	0.598	0.549	0.566	0.599	0.578
Oklahoma	0.923	0.627	0.642	0.685	0.719
Oregon	1.000	0.806	0.855	0.885	0.887
Pennsylvania	0.577	0.527	0.513	0.565	0.546
Rhode Island	0.754	0.735	0.672	0.726	0.722
South Carolina	0.742	0.630	0.623	0.670	0.666
South Dakota	0.888	0.816	0.838	0.921	0.866
Tennessee	0.700	0.616	0.609	0.672	0.649
Texas	0.822	0.707	0.728	0.774	0.758
Utah	1.000	0.758	0.812	0.868	0.860
Vermont	0.928	0.827	0.765	0.763	0.821
Virginia	0.816	0.791	0.743	0.862	0.803
Washington	0.832	0.810	0.793	0.807	0.811
West Virginia	0.513	0.487	0.490	0.520	0.503
Wisconsin	0.576	0.553	0.551	0.617	0.574
Wyoming	0.997	0.967	1.000	1.000	0.991
Average	0.782	0.717	0.705	0.745	0.737
Standard Deviation	0.15396	0.139675	0.136588	0.132721	0.136525
Minimum	0.513	0.487	0.490	0.520	0.503

Table 4. States ranked by average efficiency index 1999-2002 in ascending order

Rank	State	Average
1	Wyoming	0.991
2	Colorado	0.991
3	New York	0.987
4	Montana	0.967
5	Florida	0.964
6	Nevada	0.917
7	Oregon	0.887
8	South Dakota	0.866
9	Idaho	0.865
10	New Hampshire	0.863
11	Utah	0.860
12	New Jersey	0.843
13	Maine	0.836
14	Delaware	0.836
15	Vermont	0.821
16	Washington	0.811
17	Arizona	0.804
18	Virginia	0.803
19	Massachusetts	0.790
20	Georgia	0.788
21	California	0.777
22	Texas	0.758
23	Rhode Island	0.722
24	Oklahoma	0.719
25	Nebraska	0.713
26	Illinois	0.711
27	Connecticut	0.698
28	Minnesota	0.685
29	Missouri	0.683
30	Kansas	0.674
31	North Carolina	0.672
32	South Carolina	0.666
33	Tennessee	0.649
34	Maryland	0.646
35	Arkansas	0.643
36	New Mexico	0.642
37	North Dakota	0.633
38	Alabama	0.603
39	Indiana	0.602
40	Louisiana	0.593
41	Michigan	0.579
42	Ohio	0.578
43	Wisconsin	0.574
44	Iowa	0.570
45	Pennsylvania	0.546
46	Mississippi	0.542
47	Kentucky	0.525
48	West Virginia	0.503

Table 4. Target expenditure dollars per firm birth for Colorado and Louisiana (2002)

Year	State	FB	EDU	HWY	NATRES	Total
2002	CO	15341	427.15	104.71	14.24	546.10
2002	LA	9091	445.49	77.56	24.51	547.57
		1.69	0.96	1.35	0.58	0.9973