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Exploring Firm Location Beyond Simple Growth Models: A Double Hurdle Application

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Abstract. Firm location decisions are typically influenced by economic, demographic, environmental, and social factors. This research extends the current literature by investigating the factors thought to influence the total number of manufacturing firms within a given region. Given the large number of regions without any manufacturing firms, a double hurdle model is employed to account for excess zeros. The results suggest that there are certain industry input variables, such as population and education that make a region an attractive or unattractive location for a particular manufacturing firm.

1. Introduction

Firm location and operation is thought to be influenced by economic, demographic, environmental and social factors. For the most part, the ranking of these factors is unique to the firm's industry. Firms have a clear profit motive. All else held constant, firms seek out locations where costs are minimized leading to maximized profits. Therefore, firms might locate at the city center where transportation costs are minimized but rents are high. As firms locate further away from the city center, rents may decrease but increased transportation costs offset these gains. In the early 1900's, Alfred Weber (1929) identified several factors influencing the location of industries including: product weight and shipping distances, proximity to raw materials, and wages. Goode and Hastings (1989), as an extension to the work done by Weber and Losch (1954), investigated the importance of transportation and accessibility on the location of manufacturing plants in both metropolitan and non-metropolitan areas. They hypothesized that transportation services as well as agglomeration effects would play important and different roles for different types of manufacturing plants. They found that both the transportation and accessibility measures were important influences in location decisions but these impacts varied over manufacturing sector and metropolitan and non-metropolitan areas. Today these types of factors still drive location decisions, but these factors are not all-inclusive. Other aspects of a community including demographic variables, social climate and the community's infrastructure are also likely important.

It is critical for a community to understand the forces that drive development. If economic conditions, such as local wages or taxes, heavily influence business development then policymakers might entice more firms by creating policies that are business friendly. If social climate or the community's infrastructure is instead the more important influence then the strategy policymakers follow should be quite different. This may require a more indirect policy, allocating tax dollars to target population growth, better school systems, lower crime, etc. In the first instance, this might require a community to lower taxes and in the second instance, tax increases would be more appropriate. Therefore it is imperative that decision makers have relevant information about what drives firm location decisions.

This research investigates the importance of economic, demographic, and social factors on the frequency of manufacturing firms at the county level for the intermountain western states of the U.S. This study is based on manufacturing firms within the three digit North American Industrial Classification System (NAICS) for the year 1999. In addition to employing a simple Poisson count model, this research suggests that there may be two hurdles counties encounter

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when attempting to attract new firms to the region. Counties must provide a certain set of characteristics to entice firms to even consider the county a potential market. If the county does meet those standards firms still have the option of not locating in that region for various other reasons. There are potentially different factors that may affect these two decisions.

A separate count data model (Poisson model), single hurdle, and double hurdle model was estimated for each of the twenty-one manufacturing sectors using industry input, economic and social climate characteristics as explanatory variables. The results from this analysis suggest that in general industry input variables such as population and education drive the first decision, whether the county is even considered in the market of potential locations. Economic variables do not play a large role in the participation decision but rather they play a substantial role in the second decision (once the county is deemed a potential marketplace). These results imply that decision makers should target policies towards population growth and better school systems, which suggests a policy that might increase taxes.

We begin this paper with a brief review of the literature describing how previous studies have attempted to measure the influence of demographic and economic variables on firm location decisions. In Section III, we introduce the conceptual model followed by a discussion of the empirical specification, highlighting the advantages of using zero-adjusted model over the standard Poisson model. We then describe the data in Section V followed by the results in Section VI. We conclude this study with policy implications that can be drawn from this analysis and we address potential extensions to this area of work.

2. Literature Review

A number of studies have investigated the influences of socio-economic factors on firm location. A brief overview of a few of these studies can be found in Table 1. Each study takes a different approach; some look at the effect of statewide characteristics, others hypothesize that the unit of analysis should be smaller, i.e. a county, city, SMSA. This review is by no means inclusive of all studies exploring industry location decision but rather it attempts to highlight some of the key variables that should be included as well as some of the inconsistencies in the results with reference to some of these variables. As a result, there are still no clear policy implications from this line of research. Thus, local governments are unable to exactly determine the factors that entice a firm to locate in one region versus another.

Table 1. An overview of selected firm location studies

Authors	Year	Variables Studied	Conclusions (Affect on manufacturing activity)
Bartik	1985	State specific variables	Land area, unionization, corporate and property taxes were all significant factors
Guimaraes, Figueiredo, and Woodward	2004	Labor costs, Land costs, taxes, market size, localization and urbanization economies	Agglomeration[2]: positive influence Property taxes: negative influence Labor and land costs insignificant
Gabe and Bell	2004	Fiscal impacts (local taxes and government spending)	Low taxes are not helpful because they signal low public spending, unattractive to new firms
Holmes	1998	Right to work laws (state measures)	Large increase in manufacturing activity when crossing from an anti-business state to a pro-business state
Walker and Greenstreet	1990	Government incentives	Incentive offerings play a large role in location decisions

[2] Agglomeration was captured with two variables: urbanization economics and localization economies. Urbanization economies are externalities that are common to all firms, measured by the density of manufacturing and service firms in a county. Localization economies are externalities are benefit firms only in the same industry. This was measured by the number of establishments in the same two-digit SIC industry.

Bartik (1985) investigated how a branch plant's decision to locate is influenced by a state's socio-economic characteristics. He employed a multinomial logit model to determine the importance of state-specific variables in a manufacturing firm's state location decisions. As a result, land area, unionization, and corporate and property taxes were important factors in location decisions. The author found that no additional information was learned when he separately tested each of the manufacturing sectors as opposed to the method he used, all manufacturing plants aggregated together. While some taxes and regulations do vary within state lines, other economic and demographic variables may very greatly among regions in the state. These variations can not be captured in this analysis.

The inconsistencies in the results from previous work are especially prevalent when discussing the impact of fiscal policies on firm location, specifically local taxation. Newman and Sullivan (1988) provide a review of the effect of business taxes on industrial location. The authors focus primarily on the econometric specifications on previous studies but do not find evidence that taxes hinder location decisions. The studies are limited to only metropolitan areas so it is not possible to relate these results to non-metropolitan areas. Gabe and Bell (2004) find evidence that indicates businesses favor communities that spend high amounts on public goods and services, even if these expenditures are financed through local taxes. Walker and Greenstreet (1990) investigate the effect of government incentives and assistance on manufacturing. The authors look specifically at the following incentives: site-specific infrastructure, low-interest loans, training subsidies, and tax breaks, among others. They find that industrial incentives have the intended effect of attracting new manufacturing firms. In addition, the effective tax rate is a negative deterrent to locating in an area, which is inconsistent with Gabe and Bell's result.

Holmes (1998) found that the manufacturing's share of total employment increased by approximately one-third when crossing from an anti-business state to a pro-business state. The author used state right-to-work laws to measure how accommodating an environment was for manufacturing activity. A right-to-work law bans the union shop. This crude measurement of a pro-business environment might be too broad, particularly measured at the state level, to capture the location decisions of individual manufacturing firms.

Leatherman et al's (2002) industrial targeting system research most closely resembles the analysis in this study. They investigated the impact of community economic conditions, community social attributes, community infrastructure, and industry input/market conditions on the growth of manufacturing firms for counties in the Great Plains region. A binary logit model was employed where the dependent variable took on a value of one if there was a growth of firms, by industry, in a county, and zero otherwise. Variables such as population, poverty levels, and industry employment levels appeared to consistently be significant determinants of firm growth. Unfortunately, the model does not capture the magnitude of growth. Counties that grew by 200 firms would receive the same value as a county that grew by only one firm. Counties that lost firms would receive a zero value as well as counties where no firms existed at all. However, the results from this study provide the motivation required to complete an extended analysis of actual firm growth. For comparative purposes, this research will use similar variables within the context of a count model, allowing for the inclusion of the magnitude of total firms.

3. Background and Conceptual Model

3.1 Background

The intermountain western states could be considered a highly rural region in comparison to other regions of the country. Of the 282 counties in the intermountain region area, nearly 75 percent of them are considered non-metro by the Economic Research Service (ERS) by the USDA. Half of those counties are also not adjacent to a metro county, and approximately 25% are considered completely rural (population of 2,500 or less). Figure 1 provides a map of the Intermountain West Region and the varying levels of population by county.

Although not as prevalent in the west as it is in the Midwest and the East, manufacturing has seen some growth in the western rural areas. Job growth in the rural west outpaced U.S. job growth in 1985-1995 by almost 60% (Beyers, 1999). Most of this growth was observed in the service industry, however manufacturing did see some gains, primarily in counties adjacent to metro areas. Manufacturing employment in the western non-metro areas grew by 14.6 percent while manufacturing employment in non-metro counties for the entire U.S. grew by only 12.3 percent. The nation as a whole (metro and non-metro) lost 5 percent in manufacturing employment while the west as a whole lost only 2 percent. Roth (2000) summarized the push for new manufacturing firms to locate in rural areas. He suggested that major advances in telecommunications allow firms to locate where they want to be, not where the traditional centers of finance dictate they have to be. In addition, rural manufacturing plants, like metro plants, are relying on new technology at an increasing rate to control virtually all phases of their productivity. This implies not only that rural manufacturing plants with the use of new technology can operate in more remote areas, but also that these plants must rely on more highly trained and skilled workers. More highly trained and skilled workers might not bode well for rural areas, but should be an indication to rural policy makers what might be needed to help attract new manufacturing firms.

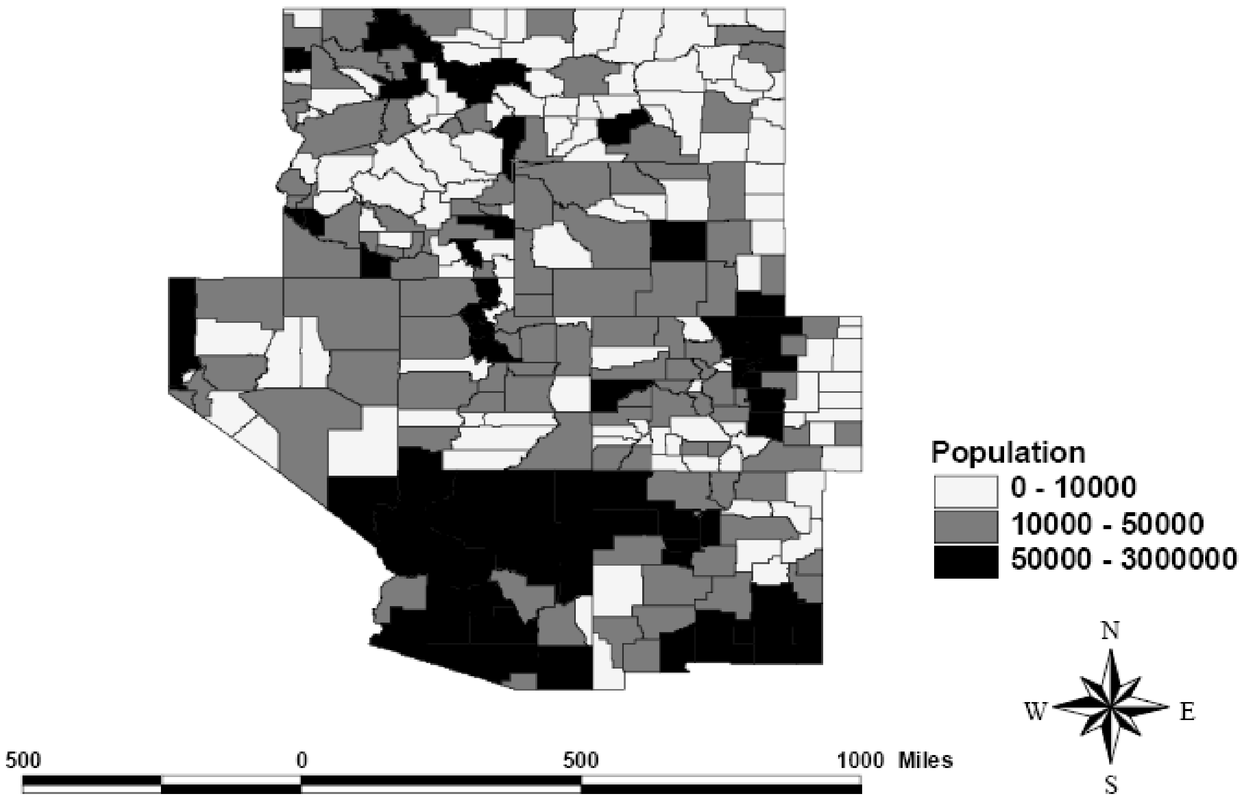

Figure 1. 1999 Population Totals for Intermountain States

3.2 Conceptual Model

The literature consistently explores a wide set of local characteristics that are hypothesized to be important determinants in a firm's location. Leatherman et al's (2002) study appears to be the most inclusive. Therefore, the model in this study will utilize most of the same variables, allowing for some comparison between the two studies.[3]

It is hypothesized that the number of firms located within a geographic region will be related to the current economic conditions, community social attributes, community infrastructure, and industry input and market conditions. The rationale behind including each of these set of characteristics and the expected influence of these characteristic on the number of firms is described below.

3.3 Current Economic Conditions

There are a number of factors that are hypothesized to be important for economic growth, for example, taxes, government expenditures, unemployment conditions, regional characteristics, etc. This analysis will look at the following economic conditions: per capita tax revenue, the percentage of the total em-

[3] The results will not be directly comparable. Leatherman et al. used a binary logit model for some manufacturing industries, whereas here a count model will be employed for all of the 3-digit manufacturing industries in NAICS system.

ployment in agriculture, manufacturing, services, and mining, as well as housing values within the area.

It is expected that per capita tax revenue will have a negative influence on the number of firms. This variable is assumed to capture both individual and corporate taxes. This hypothesis follows from Bartik's (1985) study where he found that high state taxes appeared to discourage new manufacturing plants. The four employment variables don't represent all of the employment in the county but it is expected that clusters of employment might represent both competition and agglomeration. Therefore the expected influence on the number of firms will vary depending on the type of manufacturing plant. High levels of agricultural and mining employment are expected to have a negative influence on manufacturing firms whereas the percent of employment in manufacturing is expected to have a positive influence on the number of firms due to the presence of agglomeration economies. Housing values are thought to be an important community characteristic because it represents the overall economic status of an area.

3.4 Community Social Climate

Two variables will be included in the analysis to represent the social climate of an area: poverty level and age.[4] The effect of a high level of poverty might not have a clearly defined effect on firm location. Areas with high levels of poverty could reveal that wages are low and thus a promising location for firms to enter and extract the benefits of inexpensive labor. On the other hand, this high level of poverty could signal poor economic conditions and therefore not a profitable location. Median age is expected to reflect the overall labor market. Older age individuals are not likely to be good candidates for manufacturing jobs, resulting in fewer firms.

3.5 Community Infrastructure

The importance of community infrastructure is measured by the presence of a highway and a commercial airport. The presence of an interstate highway and the presence of a commercial airport are both expected to be significant positive influences on the number of manufacturing firms. Both of these variables convey the level of accessibility from one region to another. This is clearly important for those industries that rely heavily on transportation facilities.

[4] Government expenditures are also expected to be influential in firm location. However the data available aggregated all expenditures into one category and thus was highly correlated with per capita taxes, resulting in a model that would not converge.

3.6 Industry Input and Market Requirements

Industry input factors included in this study are the percentage of the population with at least a high school degree, the labor force participation rate, population, population density, annual earnings, and metropolitan influence. The variable measuring the percentage of the population with at least a high school degree is expected to have a mixed effect. The more technical manufacturing firms would prefer highly trained workers as opposed to the less technical firms who would prefer individuals working for lower wages. Those individuals most likely would not be highly trained or educated. Large annual earnings are expected to have a negative influence on firm location because it signals expensive labor in the area. Population is expected to have a large positive influence on firm location. The minimum demand threshold literature suggests that the number of sustainable firms in an area is dictated by the population. While manufacturing firms aren't typically "local sellers" they do hire local workers as well potentially purchasing some of their inputs from local producers. Therefore population might proxy for available labor as well available resources. Finally, metropolitan influence is expected to have a strong positive effect on the frequency of firms because it suggests that a potentially strong market is in close proximity to the region.

4. Empirical Specification

Given the discrete, non-negative nature of the frequency of firms, a count model seems the most appropriate tool to use for this analysis. The Poisson regression model stipulates that each y_i is drawn from a Poisson distribution with parameter λ which can be parameterized to depend upon the regressors, x_i's. If the probability function for y_i is

$$\Pr ob(Y = y) = \frac{e^{-\lambda}\lambda^{y}}{y!} \text{ for } y = 0,1,2,... \qquad (1)$$

where Y_i is a potential integer outcome, then it is well known that $E(Y_i) = \lambda$ and $Var(Y_i) = \lambda$ as well. In this instance λ is parameterized to be $\lambda = \exp(x_i \beta)$. The exponential function is used to ensure non-negativity of the estimated number of firms.

The basic Poisson model accommodates zero entries. However, the nature of the data used for this study gives rise to a large number of counties with zero firms for many of the manufacturing sectors (see Table 2). Some have used the negative binomial distribution rather than the Poisson in an attempt to handle the excess zeros. However, the hurdle models do this in a manner which is perhaps more intuitive and allows the decision process to be decomposed into two choices (a) the choice of a firm to locate in a county at all and (b) the choice of the number of firms to locate in that county.

Table 2. Data Sources for Dependent and Independent Variables

Dependent Variable:	
Number of firms in county in 3-digit NAICS manufacturing sector	U.S. Census Bureau – County Business Patterns
Independent Variables:	
Per Capita Tax Revenue	U.S. Census Bureau – 1997 Census of Governments
Percent Employment in Agriculture	Bureau of Economic Analysis – Regional Economic Accounts
Percent Employment in Manufacturing	Bureau of Economic Analysis – Regional Economic Accounts
Percent Employment in Services	Bureau of Economic Analysis – Regional Economic Accounts
Percent Employment in Mining	Bureau of Economic Analysis – Regional Economic Accounts
Labor Force Participation Rate	U.S Census Bureau – 2000 Census
Average Home Value	U.S Census Bureau – 2000 Census
Percent of Population Below Poverty Level	U.S Census Bureau – 2000 Census
Percent Population with High School Degree	U.S Census Bureau – 2000 Census
Median Age of Population	U.S Census Bureau – 2000 Census
Average Annual Income	U.S Census Bureau – 2000 Census
Population	U.S Census Bureau – 2000 Census
Population Density	U.S Census Bureau – 2000 Census
Metro Influence	ERS 2003 Rural Urban Continuum Codes
Presence of Interstate Highway	Rand McNally Atlas
Presence of Commercial Airport	Rand McNally Atlas

The single-hurdle model accommodates many zero observations. It is capable of generating probabilities of counties with zero firms with a single mechanism. However, it can not tell us why this is so and thus, the possibility that the county is not a suitable market for firms can not be distinguished from a corner solution.

Let y_i denote the number of firms located in county i observed during a one year period. Define two vectors of variables, x and z, where x contains variables most likely bearing on the decision on how many firms, n, to locate within county i, and z is a vector of characteristics pertaining to the decision for a firm to locate at all during that year. The number of firms is equal to zero if the random variable $D_i \le 0$. While it is impossible to have negative firms, D_i merely represents whether there are unobserved impediments which preclude a firm from locating in a county during the year. Adopting the discrete specification, we have $\Pr ob(D_i = 0) = \omega$. ω can be parameterized as a logit, probit, or log-log. In this instance, $\omega = \exp(-\eta)$ where $\eta = \exp(z_i \alpha)$ and α is an unknown vector of parameters.

If the number of firms is positive, then $y_i = y_i^*$ with $E(y_i^*) = \lambda_i = \exp(x_i \beta)$. The single hurdle model then has a dichotomous probability mass function (PMF) of the form:

$$\Pr ob(D_i \le 0);\ \text{if } y_i = 0, \qquad (2)$$
$$\text{PMF}(y_i \mid y_i > 0) \Pr ob(D_i > 0);\ \text{if } y_i > 0.$$

This implies that $\Pr ob(y_i > 0) = 1 - \exp(-\omega)$. The likelihood function in the case of the single hurdle model with Poisson PMF specification is

$$\ell = \frac{\prod_{y=o} \exp(-\omega_i) \prod_{y>0} (1 - \exp(-\omega_i)) \lambda_i^y}{[(\exp(\lambda_i) - 1) y_i !]} \qquad (3)$$

The double hurdle model can be developed to allow for two ways of generating zero observations.

This model splits the decision into one part which determines the participation decision and the other part that determines the number of firms. This second stage allows for firms who consider a region a potential marketplace but we still observe zero firms. Now the probability of a zero observation is

$$\Pr ob(y_i^* \leq 0) + \Pr ob(y_i^* > 0) \Pr ob(D_i \leq 0). \qquad (4)$$

There will be zero firms observed if the county is not a suitable market or if the county is a suitable market but an additional hurdle ($D \leq 0$) prevents firms from entering into the county. The PMF of a positive observation reflects that there are a positive number of firms entering and the additional hurdle does not limit firms from entering. It is of the form:

$$\Pr ob(y_i^* > 0) PMF(y_i^* \mid y_i^* > 0) \Pr ob(D_i^* > 0). \qquad (5)$$

The Poisson likelihood in this case becomes

$$\prod_{y=0} [\exp(-\lambda_i) + (1-\exp(-\lambda_i))\exp(-\omega_i)] \prod_{y>0} (1-\exp(-\omega_i))\exp(-\lambda_i)\lambda_i^{y_i}[y_i!]^{-1} \qquad (6)$$

under the assumption that $y_i = y_i^*$ if $y_i^* > 0$ and $D_i > 0$. In this case, the truncated expectation of y is $E(y_i \mid y_i > 0) = \dfrac{\lambda_i}{1-\exp(-\lambda_i)}$ and the unconditional expectation of y is $E(y_i) = \lambda_i(1-\exp(-\omega_i))$.

The advantages of the double hurdle model over the single hurdle and poisson models are clear. The double hurdle model can provide estimates of three different probabilities of participation in the market. The model can predict the probability of non-participation, $\exp(-\omega_i)$, the probability of a corner solution, $(1-\exp(-\omega_i))\exp(-\lambda_i)$, and the probability of a county acquiring one or more firms, $(1-\exp(-\omega_i))(1-\exp(-\lambda_i))$.

5. Data

The data that were used for this study are combined from several sources. The study includes information on 232 counties within the eight intermountain western states: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah and Wyoming. The dependent variable in this study is the total number of firms located in a county, repeated for each of the twenty-one three-digit manufacturing sectors classified by the NAICS system (311 through 339).[5] Table 2 lists the dependent and explanatory variables that will be used in the analysis as well as the source of the data. Table 3 provides a description of the dependent variables used in this study. In most instances the variance is substantially larger than the mean suggesting that there is overdispersion in the data. However, this is largely attributed to the number of zero counts and thus is well-suited for a zero-altered Poisson model.

The set of county characteristics used as explanatory variables were gathered from several sources. Table 4 provides descriptive statistics for the independent variables. The last three variables in the table require a bit more discussion. The presence of an interstate highway and commercial airport variables are dummy variables that take on a value of unity if they exist and zero otherwise.[6] The metro influence variable is also a dummy variable. If a county has a rural urban continuum code of five or less (counties with population greater than 20,000) then the variable enters the model with a value of one and zero otherwise. In addition, fixed effects were included to control for state specific effects not measurable in the data.

6. Results

The full set of results is located in the appendix. Table A1 details all of the parameter estimates for the Poisson model for each of the 21 manufacturing industries. Tables A2 and A3 provide the results from the single hurdle model and double hurdle models respectively.[7] Table 5 provides a summary of the frequency of significant variables that influenced the number of firms locating within a region. For example, in the Poisson model, for thirteen of the twenty-one manufacturing sectors, higher tax revenues would be a negative deterrent for firm location. For the most part the sign and the significance of the coefficients estimated from the Poisson model are consistent with a priori expectations. The results from the Poisson model suggest that firm location is mostly determined by economic conditions, community infrastructure, and industry inputs.

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[5] Not all numbers are utilized in the system.

[6] As determined by the ERS.

[7] The single hurdle models for the following manufacturing sectors did not converge: textiles, paper manufacturing, petroleum and coal manufacturing and primary metal manufacturing. The double hurdle models for the following manufacturing sectors failed to converge: apparel, paper manufacturing, petroleum and coal manufacturing, primary metal manufacturing and fabricated metal manufacturing.

Table 3 A Description of the Dependent Variables

Industry	Average # firms	Variance # firms	# Counties with 0 firms	Maximum # firms
Food manufacturing (311)	5.89	191.36	54	142
Beverage and Tobacco manufacturing (312)	0.74	3.02	160	14
Textile Mills (313)	0.38	1.93	193	15
Textile Product Mills (314)	1.46	24.94	150	59
Apparel Manufacturing (315)	1.6	25.77	155	53
Leather and Allied Product Manufacturing (316)	0.51	1.84	178	11
Wood Product Manufacturing (321)	4.23	100.96	80	120
Paper Manufacturing (322)	0.63	8.1	190	36
Printing and Related Products (323)	9.55	139.21	88	469
Petroleum and Coal Products Manufacturing (324)	0.37	1.53	193	13
Chemical Manufacturing (325)	2.78	102.9	122	127
Plastics and Rubber Manufacturing (326)	3.39	192.46	156	172
Nonmetallic Mineral Products Manufacturing (327)	4.48	150.27	66	144
Primary Metal Manufacturing (331)	1.13	16.92	168	48
Fabricated Metal Products Manufacturing (332)	12.09	2181.97	67	618
Machinery Manufacturing (333)	4.66	316.34	108	230
Computer and Electronic Manufacturing (334)	4.92	483.47	144	262
Electrical Equipment, Appliance and Component Manufacturing (335)	1.31	28.66	169	68
Transportation Equipment Manufacturing (336)	2.6	142.62	136	172
Furniture and Related Products Manufacturing (337)	5.67	374.43	98	245
Miscellaneous Manufacturing (339)	9.73	1016.61	99	326

The single hurdle and the double hurdle models suggest that taxes are no longer of great importance for determining the number of firms.[8] Manufacturing and service employment positively influence the number of firms. Age has the expected negative effect for several of the manufacturing sectors. After including variables that might characterize a hurdle for firm location, it appears that community infrastructure and industry input characteristics play an important role in firm location.

Table 6 provides a summary of the variables that were hypothesized to influence zero firm entries. The single hurdle is unable to distinguish a lack of market participation from market participation but still observing a zero response. Three variables consistently appeared to affect zero entry in the single hurdle model: population, manufacturing employment, and the percentage of the population with at least a high school education. These variables all had the expected effect. As population increases, the area is more appealing for firms, thus this decreases the probability of zero entry. Areas with high levels of manufacturing employment provide a solid base of employees for future manufacturing firms therefore firms are less likely not to enter. The same holds true for education.

The double hurdle model is capable of distinguishing between zero market participation and those

[8] Tax variables such as property taxes, corporate income taxes, franchise taxes and inventory taxes were also tested in the specification but were never significant. While this result may seem counterintuitive, Barkley (1996) found that low local taxes may not provide a locational advantage. Low tax rates might translate into low-quality public services. Manufacturing firms seek skilled labor and thus high quality schooling (often found in regions with a higher tax base) in the area signals the potential for a well-qualified labor pool.

Table 4 Descriptive Statistics for Independent Variables

Variables	Mean	Standard Deviation	Minimum	Maximum
Per Capita Tax Revenue ($)	352.65	322.21	36.32	3220.67
Percent Employment in Agriculture	0.7	10.4	0	52.6
Percent Employment in Manufacturing	5.8	5.5	0	34.4
Percent Employment in Services	24.5	9.5	1.9	85.4
Percent Employment in Mining	3.6	8.9	0	82.7
Labor Force Participation Rate (%)	59.2	7.9	30.1	83.6
Average Home Value ($1,000s)	113.39	101.86	36.5	1269
Percent Population Below Poverty Level	10.4	4.9	1	33.5
Percent Population with at least High School Degree	83.3	6.7	63.6	97
Median Age of Population (years)	36.4	5.1	20.7	48.9
Average Annual Income ($100's)	229.86	48.96	156.84	514.73
Population (1,000's)	71.28	244.04	0.55	3072.15
Population Density (population/sq mileage county)	39.69	126.1	0.4	1218.4
Presence of Interstate Highway	0.49	0.5	0	1
Presence of Commercial Airport	0.32	0.47	0	1
Metro Influence	0.33	0.47	0	1

Table 5 A summary of the results[9]

Variables	Poisson	Single Hurdle	Double Hurdle
Tax Revenue	13/21 Negative Effect	2/17 Negative Effect	2/17 Negative Effect
Agricultural Employment	15/21 Negative Effect	7/17 Negative Effect	5/17 Negative Effect
Manufacturing Employment	14/21 Positive Effect	15/17 Positive Effect	13/17 Positive Effect
Service Employment	3/21 Positive Effect	7/17 Positive Effect	10/17 Positive Effect
Age	9/21 Negative Effect	7/17 Negative Effect[10]	8/17 Negative Effect
Airport	10/21 Positive Effect	8/17 Positive Effect	8/17 Positive Effect
Population	18/21 Positive Effect	14/17 Positive Effect	14/17 Positive Effect
Population Density	21/21 Positive Effect	14/17 Positive Effect	17/17 Positive Effect
Metro Influence	15/21 Positive Effect	11/17 Positive Effect	11/17 Positive Effect

[9] Of the 21 manufacturing sectors, the single hurdle and double hurdle models converged for 17 of them. See the full set of results in the appendix for complete details.
[10] For the wood industry, median age had a positive effect on the frequency of firms.

Table 6 A summary of the results for the hurdle variables

Hurdle Variable	Single Hurdle	Double Hurdle
Population	***16/17***	***16/17***
	Negative Effect	Negative Effect
Manufacturing	***6/17***	***1/6***
	Negative Effect	Positive Effect
Education	***14/17***	***7/11***
	Negative Effect	3 Negative(beverage, printing, plastics)
		4 Positive (computers, nonmetallic, machinery)
Metro		***3/4***
		2 Positive (Electrical, Textiles)
		1 Negative (Food)
Service		***7/9***
		Positive Effect
Highway		***1/2***
		Negative Effect

firms who choose to be part of the market but still do not locate in the region. After estimating several different combinations of variables that were hypothesized to be significant hurdles, the results in Table 6 provide a summary of those variables that were used in the final analysis.[11] It appears that population, as expected from central place theory, is the most influential hurdle. In all but one instance, the larger the population the less likely zero firms would locate in the county. The sign and significance of the remainder of the variables was specific to the manufacturing industry. For example, education was a negative deterrent to entry for the computer, non-metallic, fabricated metals and machinery industries but a positive inducement for the beverage, printing, and plastics industry.

An appealing aspect of the double hurdle model is that it is possible to calculate the probability that a region will have any firms. Furthermore, it is possible to decompose that probability into two parts. The third column of Table 7 provides an estimate of the proportion of counties that do not pass the first hurdle. The proportion of counties with zero firms because the county is considered a non-participant is equal to ω. This was calculated as discussed in section IV for $\omega = \exp(-\exp(z_i\alpha))$ where z is the vector of specified hurdle variables. For example, 5.75 percent of the counties will have zero beverage firms as explained by the level of service employment, population, and the percentage of the population with a high school degree. The fourth column provides the proportion of counties with zero firms even after the county passed the first hurdle. This was calculated by substituting the parameter estimates back into the equation: $\exp(-\lambda)$ where $\lambda = \exp(x_i\beta)$. Continuing the example above, the results suggest that 63.22 percent of the counties will have zero beverage firms because of the levels of the x variables. The sum of ω and $\exp(-\lambda)$ should be approximately equal to the percentage of counties with zero firms which in this instance is equal to 69.96 percent. This is approximately equal to 68.97 percent, the estimated percentage of firms with zero beverage firms.

In most instances, there is additional information gained by using the double hurdle model over the single hurdle model. In all but six of the manufacturing sectors, the log likelihood is greater for the double hurdle models over the single hurdle model. In all instances when the models converged, both hurdle models were superior to using the simple Poisson count model. It would be advantageous to verify if a hybrid model, which is a combination of the single and double hurdle model, would be the best method. In addition, a negative binomial double hurdle model might work even better because of the apparent overdispersion, not explained by the excess number of zeros, for several of the manufacturing sectors.

[11] The final set of variables was determined by selecting the model with largest log likelihood.

Table 7 Expected probabilities of counties with zero firm counts, by manufacturing sector

Manufacturing Sectors	**Hurdle Variables Included**	**Probability of Zero Firms "Out of market"**	**Probability of Zero Firms "Corner Solution"**
Beverage	Service Employment, Population, Education	0.05749	0.6322
Leather	Service Employment, Population, Education	0.2250	0.5383
Printing	Service Employment, Population, Education	0.1123	0.2908
Chemicals	Service Employment, Population, Education	0.3299	0.2162
Plastics	Service Employment, Population, Education	0.4413	0.2418
Computers	Service Employment, Population, Education	0.1594	0.4850
Textile Products	Manufacturing Employ Population, Education	0.4584	0.1856
Non-Metallics	Manufacturing Employ Population, Education	0.1419	0.177
Machinery	Manufacturing Employ Population, Education	0.1475	0.3074
Miscellaneous	Manufacturing Employ Population, Education	0.3122	0.1312
Fabricated Metals	Manufacturing Employ Population, Education	0.1419	0.1771
Food	Service Employment, Population, Metro	0.0856	0.1529
Transportation	Service Employment, Population, Metro	0.4167	0.1745
Textile	Service Employment, Population, Metro	0.1937	0.6469
Electrical	Manufacturing Employ, Population, Metro	0.2333	0.5057
Wood	Highway, Population, Metro	0.18775	0.1565
Furniture	Highway, Population, Education	0.2735	0.1443

7. Conclusions

Local, state, and federal government officials are appointed to identify economic trends or potential opportunities to better promote a sustainable or viable community. The results from this analysis suggest that it isn't necessarily economic conditions, such as tax revenues or average earnings that attract firms to an area. While these factors can be easiest to manage by government officials, it appears that it is possible that a community's infrastructure and industry input characteristics make more of a difference between being an attractive or an unattractive area for firm location. Thus the policy implications are more complex. As opposed to controlling fiscal policy, government officials should instead try to target improvements in education and local infrastructure while maintaining a strong population.

Future work could enrich the results provided in this study. As opposed to using actual counts of firms within each region, instead it would be superior to look at the influence of these community variables on changes in the counts of firms. In addition, it is likely that a firm's decision to locate in an area is not independent of the locational decisions of other firms. Harris and Shonkwiler (1997) applied this concept by analyzing the interdependencies of retail business location decisions. They found that the interdependencies were important and should not be ignored.

The influence of metropolitan areas was included in the analysis, however this variable can not fully capture the importance of spatial relationships. It is possible that non-metro counties that are adjacent to metro counties suffer from spatial competition from the neighboring metro county. For instance, an interesting question might investigate if high levels of population in one area draw away potential demand in a less populous neighboring region.

While the study area consists of many rural areas, we could extend the analysis by separating the sample into rural and urban areas and exploring the importance of the same economic and community characteristics. It would be expected that the influence of these variables would not be the same for the two types of counties. The results from this extension could also be used by policymakers to entice firms to locate in their community.

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Table A1. Poisson Results[12]

Variables	Food	Beverage	Textiles	Textile Products	Apparel	Leather
Constant	**4.8219**	1.1482	9.637	-0.1396	0.4697	**-20.811**
	(2.292)	(0.268)	(1.450)	(-0.224)	(0.102)	**(-4.074)**
Arizona	-0.0554	0.6687	0.4453	-0.2772	0.8419	**0.9535**
	(-0.116)	(1.147)	(0.619)	(-0.395)	(1.170)	**(1.833)**
Colorado	0.0834	0.6018	-0.3889	0.5841	0.3170	-0.579
	(0.349)	(1.251)	(-0.718)	(1.325)	(0.519)	(-1.317)
Idaho	-0.2025	-0.2830	-1.069	-0.1545	-0.5589	-0.4095
	(-0.723)	(-0.508)	(-1.397)	(-0.331)	(-0.831)	(-0.701)
Montana	0.3627	0.4081	-0.3119	0.1987	0.2859	-0.6361
	(1.445)	(0.979)	(-0.415)	(0.412)	(0.536)	(-1.459)
Nevada	0.3472	0.5532	-1.716	0.673	0.7640	0.6467
	(0.881)	(0.918)	(-1.413)	(1.305)	(1.092)	(0.840)
New Mexico	0.0828	0.2159	0.1588	-0.4577	0.2382	0.3229
	(0.276)	(0.438)	(0.266)	(-0.924)	(0.368)	(0.647)
Utah	**-0.5167**	-0.8159	**-2.031**	-0.1786	-0.4006	-0.8649
	(-1.656)	(-1.319)	**(-2.468)**	(-0.376)	(-0.555)	(-1.408)
Tax Revenues	-0.0007	-0.0005	**-0.00195**	**-0.0012**	-0.0004	**-0.0024**
	(-1.543)	(-0.991)	**(-2.075)**	**(-2.098)**	(-0.806)	**(-3.137)**
Agricultural	-0.0202	**-0.1417**	**-0.11448**	**-0.1215**	**-0.0754**	-0.0175
Employment	(-1.353)	**(-4.008)**	**(-2.226)**	**(-4.015)**	**(-2.609)**	(-0.455)
Manufacturing	**0.0314**	0.0365	0.0346	**0.0515**	0.0227	**0.0745**
Employment	**(2.558)**	(1.471)	(1.138)	**(2.994)**	(1.167)	**(2.784)**
Service Em-	0.0181	0.0079	0.0311	0.0229	0.0209	0.0303
ployment	(1.499)	(0.579)	(0.955)	(1.443)	(1.221)	(1.362)
Mining Em-	**-0.0591**	-0.0259	-0.0178	-0.0708	**-0.094**	0.0128
ployment	**(-2.999)**	(-1.182)	(-0.417)	(-1.641)	**(-2.797)**	(0.482)
Housing Values	-0.0011	0.0006	0.0003	0.0003	0.0012	0.0001
	(-1.311)	(-0.512)	(0.305)	(0.382)	(1.438)	(0.117)
Family Poverty	**-0.0496**	-0.0447	**-0.1597**	0.0085	-0.0311	**0.1200**
	(-2.009)	(-0.897)	**(-2.008)**	(0.384)	(-0.597)	**(2.040)**
Median Age	**-0.0657**	-0.0384	-0.0621	**-0.0343**	**-0.0830**	0.0457
	(-4.095)	(-1.315)	(-1.219)	**(-1.684)**	**(-2.636)**	(1.117)
Highway	-0.1076	0.1132	-0.4293	**-0.4513**	0.0970	0.0093
	(-0.939)	(0.437)	(-1.199)	**(-2.379)**	(0.424)	(0.046)
Airport	**0.3914**	**0.6277**	0.2178	**0.5089**	0.3116	**0.8174**
	(3.057)	**(2.428)**	(0.738)	**(2.867)**	(1.441)	**(2.599)**
Population	**0.0006**	0.00031	0.00014	**0.0009**	**0.0005**	**0.0012**
	(3.475)	(1.162)	(0.319)	**(4.700)**	**(2.129)**	**(3.674)**
Population Den-	**0.0015**	**0.0008**	**0.0034**	**0.0013**	**0.0014**	**0.0018**
sity	**(7.424)**	**(1.809)**	**(4.949)**	**(4.879)**	**(3.968)**	**(4.048)**
Metro Influence	**0.7157**	0.4183	0.5893	0.4248	0.3653	0.1881
	(4.577)	(1.342)	(1.296)	(1.635)	(1.143)	(0.492)
Household	-0.0188	-0.0073	-0.0449	-0.0043	0.0146	**0.1634**
Education	(-0.956)	(-0.201)	(-0.971)	(-0.221)	(0.378)	**(3.834)**
Labor Force	0.0065	0.0146	-0.0307	0.0208	0.0009	0.0538
	(0.478)	(0.576)	(-0.922)	(1.084)	(0.042)	(1.459)
Average Earn-	-0.0002	-0.0016	-0.0064	-0.0005	0.0024	-0.0049
ings	(-0.131)	(-0.413)	(-1.277)	(-0.195)	(0.918)	(-1.198)
Log Likelihood	*-551.725*	*-180.765*	*-105.84*	*-217.280*	*-249.47*	*-147.678*

[12] T-statistics are in parentheses below estimates. Estimates in bold are significant at $\alpha = 0.10$.

Table A1. Poisson Results (continued)

Variables	Wood Product	Paper	Printing	Petroleum	Chemical	Plastics
Constant	-0.9039	**-7.9552**	0.4551	6.7866	2.4715	1.0463
	(-0.374)	**(-1.645)**	(0.183)	(1.188)	(0.913)	(0.2664)
Arizona	-0.1635	0.45944	**0.8729**	-0.9242	0.4658	**1.937**
	(-0.526)	(0.408)	**(1.667)**	(-0.776)	(1.110)	**(2.382)**
Colorado	0.2348	1.57294	**0.7186**	0.0415	-0.0995	**1.553**
	(0.979)	(1.624)	**(2.681)**	(0.055)	(-0.335)	**(2.420)**
Idaho	0.2733	0.79762	0.0961	**-1.8528**	**-0.6271**	0.4964
	(1.023)	(0.779)	(0.303)	**(-2.549)**	**(-1.825)**	(0.699)
Montana	0.3334	0.59698	0.2456	-0.2982	0.2279	0.8231
	(1.270)	(0.593)	(0.760)	(-0.460)	(0.805)	(1.300)
Nevada	0.2954	**3.51467**	**1.1465**	-0.6120	**0.6699**	**2.517**
	(0.768)	**(3.171)**	**(2.872)**	(-0.658)	**(1.765)**	**(3.603)**
New Mexico	-0.4391	0.45826	0.5407	-0.2777	-0.1023	0.6055
	(-1.240)	(0.425)	(1.536)	(-0.435)	(-0.271)	(0.8195)
Utah	-0.4110	0.7827	**-0.7727**	-1.1849	-0.6058	0.1909
	(-1.432)	(0.819)	**(-1.918)**	(-1.682)	(-1.623)	(0.278)
Tax Revenues	**-0.0016**	**-0.00302**	-0.0006	**-0.0013**	-0.0003	-0.0007
	(-3.707)	**(-2.457)**	(-1.217)	**(-2.027)**	(-0.072)	(-1.162)
Agricultural	**-0.0823**	-0.11336	**-0.1068**	**-0.2826**	**-0.0527**	**-0.1264**
Employment	**(-4.527)**	(-1.559)	**(-3.821)**	**(-3.074)**	**(-1.845)**	**(-2.843)**
Manufacturing	**0.0558**	0.02863	**0.0391**	-0.0276	**0.0417**	**0.072**
Employment	**(3.838)**	(1.294)	**(2.508)**	(-0.859)	**(2.729)**	**(4.210)**
Service Em-	0.0116	-0.05156	0.0143	0.012	0.0134	0.0038
ployment	(0.838)	(-1.243)	(0.852)	(-0.254)	(0.922)	(0.182)
Mining Em-	-0.0345	**-0.14416**	**-0.0698**	-0.0378	-0.0117	**-0.0938**
ployment	(-1.599)	**(-1.979)**	**(-3.081)**	(-1.261)	(-0.862)	**(-2.222)**
Housing Val-	-0.0001	-0.00037	-0.0001	**-0.0299**	-0.009	-0.004
ues	(-0.249)	(-0.351)	(-0.142)	**(-3.155)**	(-0.882)	(-0.437)
Family Pov-	0.0335	**0.13004**	-0.0235	-0.1091	**-0.0696**	-0.0198
erty	(1.111)	**(1.713)**	(-0.807)	(-1.587)	**(-1.991)**	(-0.419)
Median Age	0.0216	0.07318	**-0.0559**	-0.0522	**-0.0766**	**-0.0733**
	(1.062)	(1.274)	**(-3.025)**	(-1.054)	**(-3.347)**	**(-2.228)**
Highway	-0.036	0.35771	0.0462	0.0760	-0.0012	-0.1289
	(-0.240)	(0.905)	(0.314)	(0.198)	(-0.027)	(-0.516)
Airport	0.2146	0.27282	**0.5065**	-0.5944	0.149	0.2487
	(1.225)	(1.023)	**(3.227)**	(-1.439)	(0.871)	(1.213)
Population	**0.0009**	**0.00115**	**0.0008**	**0.0007**	**0.0007**	**0.0005**
	(6.881)	**(4.675)**	**(5.187)**	**(2.422)**	**(4.107)**	**(2.777)**
Population	**0.0014**	**0.00249**	**0.0019**	**0.0016**	**0.0015**	**0.0019**
Density	**(5.366)**	**(6.376)**	**(6.029)**	**(2.629)**	**(6.672)**	**(6.363)**
Metro Influ-	**0.3924**	**1.88139**	**0.5824**	**1.117**	**1.073**	**4.5265**
ence	**(1.899)**	**(3.388)**	**(3.077)**	**(2.246)**	**(4.647)**	**(4.226)**
Household	0.0145	0.00315	0.0305	-0.017	0.0135	0.0048
Education	(0.825)	(0.104)	(1.234)	(-0.316)	(0.565)	(0.143)
Labor Force	0.0064	0.05129	-0.0057	0.02812	-0.0245	0.0058
	(0.400)	(1.292)	(-0.362)	(0.623)	(-1.339)	(0.262)
Average Earn-	-0.0028	-0.0023	0.0006	0.0004	0.0029	-0.0017
ings	(-1.469)	(-0.795)	(0.399)	(0.1118)	(1.512)	(-0.844)
Log Likelihood	*-518.19*	*-104.645*	*-544.048*	*-101.289*	*-306.15*	*-295.993*

Table A1. Poisson Results (continued)

Variables	**Nonmetallics**	**Primary Metal**	**Fabricated Metal**	**Machinery**	**Computer**	**Electrical**
Constant	-1.51332	-2.21184	-0.33544	0.51549	-3.1274	-7.79763
	(-0.618)	(-0.490)	(-0.119)	(0.174)	(-0.741)	(-0.27)
Arizona	**0.89977**	0.9107	0.68701	0.47589	**1.36242**	**2.02208**
	(2.097)	(1.450)	(1.052)	(0.751)	**(2.391)**	**(1.913)**
Colorado	**0.62445**	0.2782	0.45626	0.29891	**1.03375**	**1.36486**
	(3.041)	(0.504)	(1.299)	(0.931)	**(2.598)**	**(2.542)**
Idaho	-0.07027	0.58757	-0.1431	-0.18691	-0.40424	0.55179
	(-0.294)	(0.974)	(-0.345)	(-0.522)	(-0.850)	(0.167)
Montana	0.23625	0.5938	-0.09824	-0.36353	-0.06434	0.47329
	(1.017)	(1.221)	(-0.265)	(-1.044)	(-0.135)	(0.674)
Nevada	**1.00234**	0.3787	**0.83086**	0.58274	**1.53713**	**2.16497**
	(2.719)	(0.566)	**(1.724)**	(1.140)	**(2.930)**	**(2.775)**
New Mexico	**0.81395**	0.6386	0.16761	-0.51426	0.53505	**1.19049**
	(2.982)	(1.097)	(0.364)	(-1.082)	(1.153)	**(1.862)**
Utah	0.00113	0.7949	-0.26214	**-1.01156**	**-1.24317**	-0.58214
	(0.0190)	(1.469)	(-0.602)	**(-2.494)**	**(-2.274)**	(-0.369)
Tax Revenues	-0.00039	**-0.00156**	**-0.00108**	**-0.00098**	**-0.00121**	-0.00127
	(-0.932)	**(-2.003)**	**(-2.027)**	**(-1.782)**	**(-2.042)**	(-0.893)
Agricultural	-0.02741	-0.05697	**-0.05544**	**-0.04794**	**-0.1236**	-0.10387
Employment	(-1.608)	(-1.225)	**(-2.361)**	**(-1.954)**	**(-1.944)**	(-0.851)
Manufacturing	**0.02928**	0.0149	**0.04422**	**0.06185**	**0.1032**	0.07301
Employment	**(1.847)**	(0.807)	**(3.234)**	**(3.858)**	**(5.673)**	(1.085)
Service Em-	0.01474	**0.05199**	0.01525	0.01736	**0.0321**	0.02809
ployment	(1.154)	**(2.111)**	(0.829)	(0.983)	**(1.730)**	(0.232)
Mining Em-	-0.01642	-0.02122	-0.02219	-0.02187	-0.04468	-0.00012
ployment	(-1.377)	(-0.590)	(-1.237)	(-1.067)	(-1.114)	(-0.0007)
Housing Val-	-0.00006	-0.00078	-0.00189	-0.00166	0.00086	0.00014
ues	(-0.077)	(-0.695)	(-1.313)	(-1.293)	(1.001)	(0.060)
Family Pov-	-0.02201	-0.05444	-0.01471	-0.02917	-0.00623	0.04584
erty	(-0.800)	(-0.917)	(-0.440)	(-0.762)	(-0.129)	(0.149)
Median Age	-0.02366	-0.00264	-0.01639	**-0.04612**	**-0.1062**	-0.04151
	(-1.271)	(-0.062)	(-0.764)	**(-1.936)**	**(-3.229)**	(-0.307)
Highway	0.22516	0.36853	-0.00717	-0.09686	**-0.44704**	0.00866
	(1.269)	(1.278)	(-0.048)	(-0.525)	**(-2.110)**	(0.001)
Airport	**0.39633**	0.35641	0.23229	0.13103	**0.76904**	0.35222
	(2.634)	(1.250)	(1.554)	(0.821)	**(4.078)**	(0.478)
Population	**0.00084**	**0.00066**	**0.00082**	**0.00076**	**0.00095**	0.00094
	(5.118)	**(2.403)**	**(5.008)**	**(4.343)**	**(4.010)**	(1.037)
Population	**0.00094**	**0.0012**	**0.00168**	**0.00199**	**0.00242**	**0.00254**
Density	**(4.271)**	**(3.477)**	**(6.867)**	**(6.552)**	**(6.122)**	**(1.988)**
Metro Influ-	**0.63135**	**1.28675**	**1.11795**	**1.11127**	**1.08459**	1.09822
ence	**(3.378)**	**(3.076)**	**(5.905)**	**(4.565)**	**(3.523)**	(1.305)
Household	0.03744	0.0142	0.01709	0.01033	**0.08062**	0.06779
Education	(1.554)	(0.415)	(0.597)	(0.409)	**(2.440)**	(0.617)
Labor Force	-0.01703	-0.0308	0.00834	0.01292	-0.02141	0.02483
	(-1.094)	(-0.977)	(0.467)	(0.694)	(-1.100)	(0.302)
Average Earn-	0.00085	0.00213	0.00051	-0.0006	-0.00126	**-0.00548**
ings	(0.286)	(0.934)	(0.288)	(-0.241)	(-0.514)	**(-2.369)**
Log Likelihood	*-496.17*	*-193.488*	*-751.232*	*-430.157*	*-308.877*	*-170.761*

Table A1. Poisson Results (continued)

Variables	Transportation	Furniture	Miscellaneous
Constant	4.4729	2.32459	-2.08475
	(1.451)	(0.804)	(-0.679)
Arizona	-0.04556	**1.1057**	**0.79174**
	(-0.054)	**(2.446)**	**(1.808)**
Colorado	-0.19308	**0.70887**	**0.59207**
	(-0.402)	**(2.447)**	**(1.867)**
Idaho	**-0.8925**	0.42323	0.13423
	(-1.656)	(1.331)	(0.334)
Montana	-0.39928	0.46432	0.33917
	(-0.739)	(1.558)	(0.988)
Nevada	0.1392	**1.14204**	**1.21974**
	(-0.399)	**(2.800)**	**(2.889)**
New Mexico	-0.90464	**0.90312**	**0.85079**
	(-1.286)	**(2.613)**	**(2.092)**
Utah	**-0.80683**	0.13331	-0.33615
	(-1.6451)	(0.384)	(-0.762)
Tax Revenues	**-0.00132**	**-0.00099**	**-0.001**
	(-2.286)	**(-2.138)**	**(-1.811)**
Agricultural Employment	**-0.11078**	**-0.11133**	**-0.09446**
	(-3.673)	**(-4.803)**	**(-2.831)**
Manufacturing Employment	**0.05083**	**0.04267**	**0.04345**
	(3.663)	**(3.400)**	**(2.698)**
Service Employment	0.00392	0.018	**0.02876**
	(0.231)	(1.285)	**(1.920)**
Mining Employment	**-0.10425**	**-0.0658**	**-0.0876**
	(-2.929)	**(-2.819)**	**(-3.482)**
Housing Values	-0.00092	-0.00004	-0.00004
	(-0.923)	(-0.051)	(-0.046)
Family Poverty	-0.05202	**-0.05903**	-0.01414
	(-1.140)	**(-1.754)**	(-0.403)
Median Age	0.00104	**-0.0478**	-0.03096
	(0.030)	**(-2.432)**	(-1.201)
Highway	-0.14795	-0.04996	0.17492
	(-0.849)	(-0.352)	(0.974)
Airport	**0.3351**	**0.53179**	**0.55498**
	(1.750)	**(3.762)**	**(3.918)**
Population	**0.0005**	**0.00068**	**0.00079**
	(2.538)	**(3.928)**	**(4.311)**
Population Density	**0.00136**	**0.00136**	**0.00185**
	(4.412)	**(5.861)**	**(6.127)**
Metro Influence	**0.97691**	**0.32622**	**0.73188**
	(3.646)	**(1.907)**	**(3.321)**
Household Education	**-0.05732**	0.00474	**0.04942**
	(-2.292)	(0.189)	**(1.883)**
Labor Force	0.03326	0.01034	-0.01238
	(1.478)	(0.632)	(-0.690)
Average Earnings	-0.00112	-0.00286	-0.00015
	(-0.609)	(-1.588)	(-0.074)
Log Likelihood	*-286.867*	*-449.718*	*-597.716*

Table A2. Single Hurdle Results[13]

Variables	Food	Beverage	Textile Products	Apparel	Leather	Wood Product
Constant	+	-			-	
Arizona					+	
Colorado		+				
Idaho				-		
Montana						
Nevada	+				+	
New Mexico						
Utah						
Tax Revenues						-
Agricultural Employment						-
Manufacturing Employment	+		+	+	+	+
Service Employment	+	+		+		
Mining Employment	-					
Housing Values	-					
Family Poverty	-				+	
Median Age	-					+
Highway			-			-
Airport	+		+	+		
Population	+	+	+	+	+	+
Population Density	+		+		+	+
Metro Influence	+	+				+
Household Education	-				+	
Labor Force						
Average Earnings		-			-	-
Single Hurdle Variables						
Constant	**4.108**	**1.588**	**5.0092**	**5.1263**	**4.954**	**0.3673**
	(2.731)	**(6.224)**	**(3.435)**	**(3.482)**	**(3.578)**	**(2.476)**
Manufacturing Employment	**-0.0637**	**-0.0187**	-0.02229	0.0066	-0.0079	**-0.3760**
	(-2.777)	**(-1.887)**	(-1.198)	(0.340)	(-0.791)	**(-1.876)**
Population	**-0.0467**	**-0.0086**	**-0.01992**	**-0.1231**	**-0.0078**	**-0.0335**
	(-3.025)	**(-2.862)**	**(-4.714)**	**(-5.459)**	**(-3.315)**	**(-4.565)**
Household Education	**-0.0458**	**-0.5223**	**-0.04536**	**-0.0467**	**-0.0427**	0.4271
	(-2.554)	**(-2.294)**	**(-2.664)**	**(-2.727)**	**(-2.573)**	(1.385)
Log Likelihood	*-516.66*	*-177.811*	*-215.537*	*-210.349*	*-145.37*	*-495.76*

[13] T-statistics are in parentheses below estimates. Estimates in bold are significant at $\alpha = 0.10$.

Table A2. Single Hurdle Results (continued)

Variables	**Printing**	**Chemical**	**Plastics**	**Non-metallics**	**Fabricated Metal**	**Machinery**
Constant		+				
Arizona	+		+	+		
Colorado	+			+		
Idaho						
Montana		+				
Nevada			+	+		
New Mexico				+		
Utah						
Tax Revenues				+		
Agricultural Employment	-				-	-
Manufacturing Employment	+	+	+		+	+
Service Employment						
Mining Employment	-			-	-	
Housing Values					-	
Family Poverty		-				
Median Age	-		-			-
Highway						
Airport	+					
Population	+	+		+	+	+
Population Density	+	+	+	+	+	+
Metro Influence	+	+		+	+	+
Household Education				+		
Labor Force		-		-		
Average Earnings			-			
Single Hurdle Variables						
Constant	**5.1508**	**3.9021**	**4.7824**	-0.0800	1.4986	**3.9254**
	(3.392)	**(2.621)**	**(2.818)**	(-0.138)	(0.911)	**(3.064)**
Manufacturing Employment	0.00406	-0.0025	0.0208	0.0006	**-0.0481**	**-0.0519**
	(0.382)	(-0.211)	(1.625)	(0.857)	**(-1.899)**	**(-2.764)**
Population	**-0.0737**	**-0.0483**	**-0.041**	-0.0542	**-0.052**	**-0.0284**
	(-3.581)	**(-5.478)**	**(-5.78)**	(-4.337)	**(-2.863)**	**(-3.953)**
Household Education	**-0.0524**	**-0.0325**	**-0.0431**	0.0038	-0.0116	**-0.03655**
	(-2.700)	**(-1.788)**	**(-2.109)**	(0.529)	(-0.586)	**(-2.432)**
Log Likelihood	*-498.99*	*-284.11*	*-254.25*	*-441.04*	*-688.88*	*-400.883*

Table A2. Single Hurdle Results (continued)

Variables	**Computer**	**Electrical**	**Transportation**	**Furniture**	**Miscellaneous**
Constant					
Arizona	+	+		+	+
Colorado	+	+		+	+
Idaho			-		
Montana				+	
Nevada	+			+	
New Mexico	+			+	+
Utah	-		-		
Tax Revenues			-		
Agricultural Employment	-		-	-	
Manufacturing Employment	+	+	+	+	+
Service Employment	+	+	+		+
Mining Employment				-	-
Housing Values	+				
Family Poverty				-	
Median Age	-			-	-
Highway					
Airport	+	+		+	+
Population	+			+	+
Population Density	+	+	+	+	+
Metro Influence		+		+	+
Household Education	+		-		+
Labor Force	-		+		
Average Earnings		-			
Single Hurdle Variables					
Constant	**5.799**	**1.5371**	**1.2766**	**5.0233**	**5.1619**
	(3.933)	**(9.640)**	**(6.280)**	**(3.262)**	**(3.163)**
Manufacturing Employment	0.00348	-0.0078	-0.0241	0.1542	**-0.0469**
	(0.109)	(-0.511)	(-1.083)	(0.716)	**(-2.188)**
Population	**-0.0623**	**-0.0190**	**-0.0307**	**-0.0687**	**-0.0662**
	(-7.071)	**(-3.852)**	**(-3.561)**	**(-4.147)**	**(-4.839)**
Household Education	**-0.0479**	-0.1944	-0.0175	**-0.0489**	**-0.047**
	(-2.837)	(-0.628)	(-0.599)	**(-2.624)**	**(-2.521)**
Log Likelihood	*-267.60*	*-167.58*	*-260.903*	*-420.103*	*-523.501*

Table A3. Double Hurdle Results[14]

Variables	**Beverage**	**Leather**	**Printing**	**Chemicals**	**Plastics**	**Computers**
Constant		-				
Arizona			+		+	+
Colorado	+	-	+		+	+
Idaho						
Montana		-				
Nevada				+	+	+
New Mexico						
Utah			-		-	-
Tax Revenues		-				
Agricultural Employment	-		-		-	-
Manufacturing Employment	+	+	+		+	+
Service Employment	+	+	+		+	+
Mining Employment		+	-			
Housing Values		+			+	+
Family Poverty	-	+		-		
Median Age	-		-	-	-	-
Highway						
Airport		+	+			+
Population		+	+	+		+
Population Density	+	+	+	+	+	+
Metro Influence			+	+		+
Household Education		+				+
Labor Force				-		-
Average Earnings		-			-	
Double Hurdle Variables						
Constant	**8.7504**	4.4042	**10.8329**	-0.1309	3.3186	**-17.2377**
	(-1.711)	(0.837)	**(3.195)**	(-0.037)	(-1.590)	**(-2.263)**
Service Employment	**0.2375**	**0.3686**	**0.1863**	-0.0144	**0.0774**	**0.1126**
	(1.740)	**(1.933)**	**(2.768)**	(-0.735)	**(2.700)**	**(2.833)**
Population	**-0.2749**	**-0.2828**	**-0.1016**	**-0.0533**	**-0.0297**	**-0.04377**
	(-1.753)	**(-2.182)**	**(-3.352)**	**(-2.610)**	**(-4.047)**	**(-3.463)**
Household Education	**-0.0029**	-0.1285	**-0.1892**	0.01104	**-.0545**	**0.1908**
	(-2.0813	(-1.609)	**(-3.415)**	(0.249)	**(-2.201)**	**(2.264)**
Log Likelihood	*-168.103*	*-135.37*	*-495.139*	*-293.292*	*-249.28*	*-282.186*

[14] T-statistics are in parentheses below estimates. Estimates in bold are significant at $\alpha = 0.10$.

Table A3. Double Hurdle Results (continued)

Variables	**Textile Product**	**Non-metallics**	**Machinery**	**Miscellaneous**	**Fabricated Metals**
Constant					
Arizona		+		+	+
Colorado		+		+	+
Idaho					
Montana					
Nevada		+		+	+
New Mexico		+		+	+
Utah			-		
Tax Revenues					
Agricultural Employment					
Manufacturing Employment	**+**		**+**	+	
Service Employment		+		+	+
Mining Employment				**-**	
Housing Values					
Family Poverty				-	
Median Age			**-**	**-**	
Highway	-				
Airport	**+**			+	
Population	**+**	**+**	**+**	**+**	**+**
Population Density	**+**	**+**	**+**	**+**	**+**
Metro Influence	**+**	**+**	+	+	+
Household Education		+		+	+
Labor Force				-	
Average Earnings					
Double Hurdle Variables					
Constant	3.424	**-7.1319**	**-26.6389**	2.5031	**-7.1319**
	(1.550)	**(-1.727)**	**(-3.912)**	(1.276)	**(-1.727)**
Manufacturing Employment	-0.0324	0.00156	**0.14244**	-0.032	0.00156
	(-0.747)	(0.015)	**(3.194)**	(-1.081)	(0.015)
Population	**-0.1821**	**-0.0367**	**-0.1521**	**-0.04841**	**-0.0367**
	(-3.095)	**(-1.756)**	**(-3.662)**	**(-2.423)**	**(-1.757)**
Household Education	-0.0122	**0.07862**	**0.3074**	-0.0241	**0.0786**
	(-0.331)	**(1.693)**	**(3.923)**	(-1.067)	**(1.693)**
Log Likelihood	*-197.12*	*-453.175*	*-405.4995*	*-528.078*	*-453.176*

Table A3. Double Hurdle Results (continued)

Variables	**Food**	**Transportation**	**Textile**		**Electrical**
Constant	+				-
Arizona			-		+
Colorado			-		+
Idaho		-	-		
Montana					
Nevada			-		+
New Mexico		-	-		
Utah		-	-		
Tax Revenues					
Agricultural Employment		-			
Manufacturing Employment	+	+			+
Service Employment	+		+		+
Mining Employment	-		+		
Housing Values	+		+		
Family Poverty	-				
Median Age	-				
Highway					
Airport	+				+
Population	+	+			+
Population Density	+	+	+		+
Metro Influence	+	+	+		+
Household Education	-	-			
Labor Force		+			
Average Earnings			-		-
Double Hurdle Variables					
Constant	4.9991	**1.0282**	**-7.147**	Constant	-0.6280
	(1.585)	**(2.848)**	**(-1.824)**		(-0.670)
Service Employment	**0.1646**	-0.01263	**0.21805**	Manufacturing	0.0823
	(2.393)	(-0.449)	**(1.942)**		(1.438)
Population	**-0.1637**	**-0.0732**	-0.0417	Population	**-0.0557**
	(-4.014)	**(-3.582)**	(-1.555)		**(-3.436)**
Metro Influence	**-0.1065**	0.4887	**4.332**	Metro Influence	**2.0853**
	(-2.075)	(1.0655)	**(2.506)**		**(3.149)**
Log Likelihood	*-507.26*	*-264.75*	*-93.055*	*Log Likelihood*	*-159.93*

Table A3. Double Hurdle Results (continued)

Variables	**Wood**		**Furniture**
Constant			
Arizona			+
Colorado			+
Idaho			+
Montana			
Nevada			+
New Mexico			+
Utah			
Tax Revenues	-		
Agricultural Employment	-		-
Manufacturing Employment	+		+
Service Employment			+
Mining Employment			-
Housing Values			
Family Poverty			-
Median Age			
Highway	-		
Airport			+
Population	+		+
Population Density	+		+
Metro Influence	+		+
Household Education			
Labor Force			
Average Earnings	-		
Double Hurdle Variables			
Constant	-0.17422	Constant	3.9277
	(-0.717)		(1.146)
Highway	**-1.1312**	Highway	0.2088
	(-1.852)		(0.416)
Population	**-0.0268**	Population	**-0.2611**
	(-2.695)		**(-3.268)**
Metro Influence	0.9283	High School	-0.0258
	(1.599)		(-0.674)
Log Likelihood	*-485.741*		*-414.801*