Deller edits October 19, 2007
Harris edits October 22, 2007

Deller edits June 14, 2007; Goetz July 7, 2007

Chapter 7

Modeling the Probability of Manufacturing Activity in the Great Plains

John C. Leatherman and Terry L. Kastens

Department of Agricultural Economics
Kansas State University
331 Waters Hall
Manhattan, KS 66506
785-532-4492
jleather@agecon.ksu.edu

Introduction

Despite the fact that many rural regions have been buoyed by urban expansion, attraction for rural amenities, and high energy and commodity prices, many regions within rural America continue to struggle with population loss and economic decline. Persistent pockets of poverty in the South and Appalachia, natural resource dependence in many Western states, and continuing agricultural dependence in the Midwest have left many rural communities and regions without prospects for growth. This certainly is true in the Great Plains region of the United States where traditional economic sectors (agriculture, energy and manufacturing) are insufficient to sustain many rural communities. The dearth of alternative employment opportunities has led workers and their families to seek opportunities in larger population centers, leaving behind rural communities with stagnant or declining population and economic bases.

For those who remain, the desire for new economic opportunity is intense. New business recruitment is among the highest priority local economic development strategies for many communities. Despite the competitive and high-risk nature of industrial recruitment, it has a place in the toolbox of local economic development strategies. The challenge is one of making wise choices in targeting the expenditure of scarce local resources to market the community to prospective employers.

In this chapter we provide an overview of an industrial targeting system used to help local officials improve decision-making related to selection of targets for business recruitment. The Plains Economic Targeting System (PETS) consists of a series of econometric equations that match industry input and market requirements with community characteristics to generate a probability of new business location over a given time period. The original system matched location requirements for 78 industry sectors to local characteristics for 414 counties in six states (Leatherman, Howard and Kastens 2002). Further, the coefficients generated for a given county were transformed into marginal impacts, providing important information relating to local policies that can improve the probability of attracting a given industry.

While PETS provides insight into prospect probabilities, it does not offer any indication of the likely scale of activity (number of jobs), the quality of new employment, or any other important location factor not considered in the analysis. Additional information will be needed to determine both the location needs of specific sectors as well as the type of costs or benefits that would accrue to the community resulting from any specific activity.

Here, we focus on a subset of the system's output related to manufacturing activity included in the model. The system is offered as one among several methods outlined in this volume to not only help local officials better understand realistic development opportunities, but also to provide a better understanding of prospects for promoting inter-industry networks. The chapter proceeds with a brief discussion of business recruitment strategies. The factors influential to economic growth and the methods used to create PETS are then presented. Use of the system is illustrated by presenting the output for a single place, and by discussing regional and industry linkages. Finally, the implications for rural economic development strategies are addressed.

Industry Targeting Strategies

Targeted industry marketing has been used as an economic development strategy for decades (Sweet 1994; Deller and Goetz Chapter 2). Over time, it has evolved from a general community marketing approach to one that carefully selects targets based on industry growth prospects, potential benefits to the community, and the extent to which the community can provide the production inputs, market access and overall business climate conducive to a firm or an industry's success (McClenahen, 1996). Careful targeting is necessary given the cost of effective marketing, the high degree of competition between places, and the limited number of desirable growth opportunities.

The process of industry targeting typically begins by ranking industry sectors according to their relative attractiveness to the community (McKee 1994; Boyle 1994). Attractiveness criteria can include historic and projected growth patterns, size, profitability and other factors. Those industries ranking high in attractiveness are evaluated in terms of their location criteria, such as labor, energy or transportation needs. The community then performs a self evaluation to determine its competitive position in meeting those needs.

A variety of analytic techniques have been used in the target selection process. All are designed to help the community narrow the range of potential targets to a relative few likely and/or desirable prospects. Industry location quotients have long been used to determine which sectors are growing most rapidly. Analyzing backward and forward inter-industry linkages has been used to identify targets for import substitution (Hefner and Guimaraes 1995; Anderson and Johnston 1992; Deller Chapter 10 (other chapters in this book???). Recently, cluster analysis has been used to identify regional growth opportunities (Kim, Barkley and Henry 2000; Stough et al. 2000; Feser, Renski and Sweeney 2000). Other work has focused on spatial competition (Thill 1992; Bresnahan and Reiss 1991). To help project potential community impacts, various measures such as payroll per employee and employment per establishment have been devised (Whaley and LaCroix 1997). Finally, techniques such as the analytical hierarchy procedure also have been used to assist in determining community preferences for growth alternatives (Cox, Alwang and Johnson, 2000; Cox and Johnson Chapter 14).

Location models are among the tools available to assist in the process of evaluating community competitiveness for various industry sectors. These models match industry location requirements to community characteristics. Over the past two decades, considerable research has been conducted to identify the location requirements of different industry sectors (Kusmin, 1994). The factors identified in these location studies become the inputs into location models that can consider a wide variety of potential industry targets.

An earlier version of the industry targeting system used here was built in the mid-1980s (Goode and Hastings 1989). The Northeast Industrial Targeting (NIT) and Economic Development Database (EDD) System matched industry requirements with community characteristics for 69 aggregate manufacturing sectors for 730 nonmetropolitan communities in the northeastern United States. The PETS draws from Goode's modeling procedures, but incorporates a number of important modifications in adapting it to the Great Plains, exploiting its information potential, and updating it by acknowledging a wider variety of economic growth targets.

The probability-type model described here built upon Goode's original work and expanded sectoral consideration to encompass a wider variety of economic activity, including transportation, trade and service activities. Following on this effort, Davis Reum and Harris (2006 and Chapter 8) overcome some of the methodological challenges inherent in limited data availability by using a double hurdle procedure in constructing their model for Western-states' manufacturing activity (also see Gabe Chapter 6).

A Conceptual Model of Business Growth

Conceptually, it is assumed that for a given place, the probability of business growth is a function of key community attributes coupled with industry input and market requirements:

(1) business growth = f(community economic conditions, social climate, infrastructure, labor force, and market access)

Community Economic Characteristics

The literature on economic growth suggests a number of variables that might be considered in transforming the conceptual model in (1) into an empirical specification. Location factors can be categorized as including tax variables, government expenditure variables, labor market variables, education, market access, demographic characteristics, regional characteristics, industrial composition effects, and additional variables (Kusmin, 1994). A description of the variables selected for PETS is found in Table 1. The effects of any of the variables would be expected to differ depending on the sector modeled. For example, higher local expenditures for education might negatively impact manufacturing while having a positive impact on business services.

Bartik (1991, 1992) found that local tax rates generally had a negative effect on economic growth for communities, with the highest rates occurring in metropolitan areas. Overall, the effects of local taxes appear to depend on the mix of taxes, the use to which taxes are put, and the opportunity for inter-local (interstate) competition on the basis of taxes (Gabe and Bell 2004; Newman and Sullivan 1988; Kusmin 1994; Fox and Murray 1990). County industrial composition effects reflect potential linkages with input providers or markets, or the presence of agglomeration economies (Smith, Deaton and Kelch 1978; Wasylenko 1991; Carlton 1983; Bartik 1989; Fox and Murray 1990; Kusmin, Redman and Sears 1996). The value of housing in a community was also hypothesized to be an important community characteristic, reflecting land costs or a personal amenity important to business owners and managers. The state variable reflects the laws, policies, and institutions unique to each state as well as the influences of other factors not specified in this system (Holmes 1998; Bartik 1989; Schmenner, Huber and Cook 1987). Finally, the lagged growth variable reflects the presumption that industry performance in one time period has a carryover effect to the next period.

The lagged growth variable in many respects mirrors the efforts inherent in the clustering perspectives of prevalence today. The desirability of clustering is for purposes of fostering a regional network of economic activity that feeds into a regional momentum of economic activity. In this system, it is simply presumed that past economic performance helps propel current economic performance with no assertion of any causal genesis. Nonetheless, to the extent lagged growth performance is found to be predictive of future economic probabilities, at least indirect support is offer for the notion that such network/agglomeration economies are important to foster and capture.

Community Social Climate

Several indicators of a community's social climate were incorporated into the system. Local rates of poverty may have either positive or negative effects, presumably reflecting wage conditions in the labor market for individual sectors (Porterfield 1990; Killian and Parker 1991; Kusmin 1994). The age distribution (median age) may provide signals relating to the overall labor market (Wasylenko and McGuire 1985; Killian and Parker 1991). Finally, county per capita expenditures for public safety were assumed to reflect local needs and preferences for public goods and services (Gabe and Bell 2004; Bartik 1989), another indicator of social climate.

It might be noted that government tax and expenditure data discussed here elsewhere among the explanatory variables are likely to reflect certain countervailing effects in business location decisions. On balance in the literature, it is generally accepted that while taxes typically have a negative effect in business location decisions, the spending they support often has a positive impact. The challenge in a future modeling exercise will be to craft "net" measures where it makes sense to try to capture the net effect on balance of these types of investments.

Community Infrastructure

The quality and extent of a community's infrastructure is generally considered an important location variable. County per capita expenditures for highways (Kusmin 1994; Kusmin, Redman and Sears 1996), the presence of an interstate highway (dummy variable) (Carlino and Mills 1987; McHugh and Wilkinson 1988; Fox and Murray 1990) and the presence of a commercial airport (dummy) (Fox and Murray 1990; Porterfield 1990; Kusmin, Redman and Sears 1996) were seen as providing important signals related to public infrastructure.

Industry Input (Labor Force) and Market Requirements

Specific industries have both input and market access requirements that were seen as important location determinants. Input determinants included in this system related primarily to qualities of the local labor force. County per capita expenditures for education, educational attainment (percentage of population with greater than high school education) (Porterfield 1990; Bartik 1989; Killian and Parker 1991; Kusmin, Redman and Sears 1996), labor force participation rate, and average wage rates (Fox and Murray 1980; Kusmin, Redman and Sears 1996) were incorporated into the study. Similarly, market access is important to many types of business activities (Dorf and Emerson 1978; Kusmin 1994). Total population, proximity to a metropolitan area (Dorf and Emerson 1978; Mead 1982; McNamara, Kriesel and Deaton 1988) and population density (Schmenner, Huber and Cook 1987) were considered.[1]

It may worth noting at this point in the review of explanatory variables that our modeling system is very much intended to be a “practitioner’s tool” as opposed to a rigorous theoretically-driven modeling system. We included all factors where comparable data exists and for which previous research had shown was related to business location decisions. We then let the data “speak” to what’s actually important. Further, in our system, we permit all of the explanatory variables remain regardless of significance so long as we logically justify their inclusion at the start versus the alternative approach of retaining only the best fitting model for each industry. Admittedly, the approach is left to the modeler to select based on their belief structure about appropriate modeling techniques.

Aggregate Business Sectors Represented in the Economic Targeting System

PETS incorporates economic activity associated with 78 aggregate industries (or business

---

1. Goode (1986, 1989) demonstrated the efficacy of using more refined input and market access variables to explain sectoral growth. The refinements he developed represented a formidable data management task, and were not incorporated into the current version of this system.

sectors) viewed as having growth potential in rural areas, and includes manufacturing (38 industries); transportation, communication, and public utilities (5); wholesale trade (20); finance, insurance, and real estate (7); and business services (8). This inclusiveness recognizes the rural growth potential associated with a wider range of activities. Most other studies have been limited to manufacturing activity and, more recently, business services (Porterfield 1990). The industry sectors included represent an aggregation scheme intended to balance the need for specificity of industry identity and sufficient data to generate likely probabilities and reasonably reliable effects based on statistically significant coefficients.

The scheme began with county-level activity specified at a four-digit Standard Industrial Classification (SIC) level. The U.S. Census Bureau's *County Business Patterns* was used to count the number of positive business changes for each of the 414 study area counties between 1986 and 1994 (U.S. Department of Commerce 1986, 1994). Where the increased industry counts were insufficient, industries were aggregated within the same numeric range. For example, within the class 2000, there was sufficient activity to leave 2010, 2020, 2030 and 2040 disaggregated at a three-digit level, while all other sectors in the 2050 - 2999 range were aggregated to the 2000 not elsewhere classified (nec) SIC.

"Sufficient activity" was determined based on the perceived relevance of an industry sector to the Great Plains region. While Goode (1989) clustered manufacturing activity into sectors until 100 instances of increase in number of establishments were counted, the Great Plains region does not have nearly as much activity to allow such a threshold while retaining any useful specificity. Some sectors that represent important rural sectors were left disaggregated despite relatively small numbers of additional establishments. Increases in the number of establishments within sectors ranged from 11 to 283. Forty-one sectors had more than 100 additional establishments, 23 were between 50 and 100 additional establishments, and 14 were less than 50. The manufacturing sectors included in the discussion here are shown in Table 2.

Methods Used to Create the Economic Targeting System

To summarize the methods used to construct the PETS, 1980 county characteristics were used to explain economic growth occurring between 1986 and 1994. The parameter estimates from the 1980 model were inserted into a predictive equation containing 1990 county characteristics to generate probabilities of industry growth between 1995 and 2003. Finally, the coefficients from the second model were used to derive the marginal impacts associated with each of the independent variables.

The Great Plains generally encompasses an area extending northward from northern Texas to western Minnesota and west to eastern Montana (Rowley 1998). PETS includes 414 counties in North Dakota, South Dakota, Nebraska, Kansas, Oklahoma and the northern Texas panhandle region with a 1980 population of less than 75,000 each. Because the PETS is intended to project activity in rural counties, 16 counties with population greater than 75,000 were excluded. The study area is shown in Figure 1.

The dependent variable for the PETS model was binary. Counts of the total number of establishments at the four-digit SIC level were taken for each of the 414 counties in the study area for the years 1986 and 1994. A county was given a score of 1 if the total number of businesses within an industry sector increased between the two time periods, and 0 if the number remained unchanged or declined. Industry sectors were then aggregated to the final 78 for each county. Thus, the dependent variable consisted of a zero/one score for the 78 industry sectors in each of the 414 PETS counties.

The independent variables described above consisted of 23 community characteristics for each county thought to be important to business location decisions. Explanatory variables were constructed from the 1980 and 1990 U.S. Census of Population and other sources. The proximity to metro area variable was based on the 1993 rural/urban continuum codes developed by the U.S. Department of Agriculture's (USDA) Economic Research Service (Butler and Beale 1994). The codes range from zero for major metro core counties to nine for the most remote rural counties. The variable was structured as a binary variable with counties coded one through five (zero-coded counties were excluded in the model) counted as a one, and counties coded six through nine counted as a zero. The 24th variable was the lagged business growth variable, counted as one if there was a positive change in the industry sector being modeled in the period 1977 to 1985 and zero otherwise.

The procedures used to generate predicted probabilities are generally based on those outlined in Goode (1989, 1993). While Goode used an ordinary least squares regression procedure, the PETS equations were estimated using a logistic regression procedure due to the binary (0/1) nature of the dependent variable. Each estimated equation was of the form:

$$\text{(2)} \qquad \text{Prob}(G_{i,k}^{86-94} = 1) = \frac{e^{\left(a_i + b_{i,1}C_1^{80} + b_{i,2}C_2^{80} + \ldots b_{i,23}C_{23}^{80} + b_{i,24}G_{i,k}^{77-85}\right)}}{\left\{1 + e^{\left(a_i + b_{i,1}C_1^{80} + b_{i,2}C_2^{80} + \ldots b_{i,23}C_{23}^{80} + b_{i,24}G_{i,k}^{77-85}\right)}\right\}} + \varepsilon_{i,k} \,,$$

where:

$G_{i,k}^{86-94} = 1$ if the number of businesses increased for industry *i* in county *k* over the period 1986 - 1994, 0 otherwise.

$C_{1,k}^{80} \ldots C_{23,k}^{80}$ are the values of 23 community characteristics in 1980 for counties 1 through *k*.

$G_{i,k}^{77-85}$ is the lagged dependent variable measuring industry growth over the period 1977 - 1985 for the *i*th industry in county *k*.

$a_i, b_{i,1}...B_{i,24}$ are the parameters to be estimated for equation (industry sector) *i*.
$\varepsilon_{i,k}$ is the model *i* error for county *k* (assumed logistically distributed).

Using maximum likelihood, equation 1 was independently estimated for each of *I*=78 industries

The resulting parameter estimates were then incorporated into a predictive equation of the same form as (2), along with 1990 values for the independent variables. While Goode set non-significant parameter estimates to zero and retained the significant parameter values to create an implicit weighting system, PETS retained all parameter estimates regardless of significance. Expected probabilities of an increase in the number of establishments during the next 8-year period, 1995 - 2003, were generated using:

$$(3) \qquad P_{i,k}^{95-03} = \frac{e^{\left(\hat{b}_0 + \hat{b}_{i,1}C_1^{90} + \hat{b}_{i,2}C_2^{90} + ... + \hat{b}_{i,23}C_{23}^{90} + \hat{b}_{i,24}G_{i,k}^{86-94}\right)}}{\left\{1 + e^{\left(\hat{b}_0 + \hat{b}_{i,1}C_1^{90} + \hat{b}_{i,2}C_2^{90} + ... + \hat{b}_{i,23}C_{23}^{90} + \hat{b}_{i,24}G_{i,k}^{86-94}\right)}\right\}},$$

where:

$P_{i,k}^{95-03}$ is the predicted probability of an increase in the number of industry *i* establishments in county *k* between 1995-2003.

$C_{i,k}^{90} + ... + C_{23,k}^{90}$ are the values of 23 community characteristics in 1990 for counties 1 through *k*.

$G_{i,k}^{86-94}$ is a lagged industry growth variable for the *i*th industry in county *k*.
$\hat{b}_0$ and $\hat{b}_1 - \hat{b}_{24}$ are the parameter estimates derived from the 1986 - 1994 model in equation 1.

To better understand the influence of each independent variable on expected growth, the coefficient estimates from (2) were used to derive marginal impacts. The marginal impact is defined as the expected change in probability of growth associated with a one-unit change in some explanatory variable. For a particular industry model, say industry *i*, the change in probability of growth for county *k* associated with a one-unit change in the *n*th variable, $B_{i,k,n}$, is calculated as (suppressing the 95-03 superscript):

(4a) $$B_{i,k,n} = \hat{b}_{i,n} * P_{i,k} * (1 - P_{i,k}),$$

where $\hat{b}_{i,n}$ is taken from the ith estimated equation in the group of equations described by (1) and $P_{i,k}$ is taken from (2).

To obtain a measure of the expected marginal impact of the nth variable on growth in the ith industry across all counties (a total of K counties, here 414), as might be needed to establish a more general understanding of the impact of the nth variable on growth for industry i, a simple average of the marginal impacts in (4a) is constructed:

(4b) $$B^{*}_{i,n} = 1/K * \sum_{k} B_{i,k,n}.$$

Similarly, to generalize across industries (a total of I industries, here 78) as well as counties, the following expected marginal impact of the nth variable is constructed:

(4c) $$B^{**}_{n} = 1/(I * K) * \sum_{i} \sum_{k} B_{i,k,n}.$$

Of course, other levels of generality can easily be obtained by appropriately constructing the average marginal impact.

Because the marginal impact as calculated in (4a) is only correct for a very small change in the independent variable, it is not appropriate to apply that expected change to the relatively large change associated with jumping from zero to one for a binary independent variable (e.g., building a commercial airport where none had existed). Thus, for a binary independent variable, the marginal impact associated with moving from zero to one was calculated as the difference in the predicted probability associated with the independent variable evaluated at one, less the predicted probability when it was evaluated at zero.

To evaluate the predictive utility of the system, two models were created based on an earlier version of PETS. The first counted the change in number of business establishments for each of the 78 sectors between 1977 and 1985 in the study region regressed on the 1980 independent variables. The second counted the change in the number of business establishments for each of the sectors between 1986 and 1994 regressed on the 1980 independent variables. The predictions generated by the two models were compared to the actual changes in the two periods. By a slight degree, the predictions for the future period, 1986-1994, were more accurate than the earlier period. This provided at least some evidence that current conditions could be used to predict future activity and that the change over at least this period was not so great as to suggest vast structural changes in economic relationships.

As indicated earlier, the importance of the lagged growth effect implies that whatever local or regional network/agglomeration effect that may in some measure have influenced industry performance in one time period helps to propel it into the next period. This is, in spirit, the same influence cluster approaches seek to capture in fostering a regional economic cluster.

Outlook for a Single County

The Plains Economic Targeting System is intended to assist officials at the local level identify the most likely prospects for new economic development. Use of the system is illustrated by the case of Smith County, Kansas, a remote rural county (5,947 population) on the Nebraska border in north central Kansas.

Selected industry growth probabilities for Smith County manufacturing are shown in Table 3. The rank shows where among the 78 total sectors considered each of the manufacturing activities falls. The probabilities reflect the relative likelihood there will be an increase in the number of establishments within an identified industry sector between 1995 and 2003. In the case of Smith County, the overall probability of new manufacturing activity was fairly low. The system predicted there was only about a 30 percent chance that a new manufacturing establishment of the highest-ranked manufacturer would appear between 1995 and 2003. The best manufacturing prospects include stone, clay and glass products; industrial machinery and equipment; and printing and publishing.

If Smith County officials wanted to know how to improve their probability for a given prospect, or were otherwise interested in a strategy of adding to or diversifying the existing economic base, they might be interested in examining the marginal impacts associated with specific sectors. For illustration, the marginal impacts of four of the highest-probability manufacturing sectors are shown in Table 4, together with Smith County's 1990 independent variable values. The state marginal impacts generally indicate that Smith County compares somewhat unfavorably to counties in other states for these manufacturing activities. Local officials also can determine that their county's small population size may hinder their efforts. They may want to think about strategies to mitigate the generally strong negative effects associated with local poverty. It also appears that their heavy dependence on agricultural employment would not especially hurt their chances for attracting several of these activities. Taken together, the information related to marginal impacts may help local officials develop strategies about points of emphasis for marketing or programs to mitigate the negative conditions that may exist.

An additional potential application of PETS could be to inform local business retention and expansion (BR&E) programs. To the extent we observe sectors with high probabilities of additional activity, we would presume that which currently exists has expansion possibilities. Further, to the extent we find these activities have characteristics deemed desirable for local development purposes (e.g. Cox and Johnson Chapter 14), these sectors also may become the foci for cluster development efforts.

Building Networks of Economic Activity

Additional insights derived from the PETS system can be obtained by considering the relationships of manufacturing activity. Porter emphasizes the notion of building networks of interrelated activities in pursuit of economic clusters. We consider the probabilities generated by PETS for all counties and all industries. First, we consider the geographic proximity of industry sectors by the relative probabilities. The probabilities for a sampling of manufacturing sectors for all study counties are mapped in Figure 1. Overall, the probabilities range from zero to 100 percent. Mapping the probabilities allows a visual analysis of the spatial aggregation of county prospects for this activity. In general, the probability of new activity of this type occurring follows the population distribution found in the states considered. Further, the spatial proximities observed make intuitive sense considering transportation routes, sectoral employment patterns, and commodity production patterns known to exist in states included. In contrast to the Porter notion that state policies for the most part are irrelevant, we note fairly distinct patterns of both heightened and lower probability levels that coincide with state boundaries.

Taking the inter-industry relationships one step further, the correlation coefficients between each of the manufacturing sectors and each of the other 78 industries in the model is provided in Figure 2. This a-spatial view suggests both the potential spin-off effects of industry location, and the necessary production input “infrastructure” likely to be needed by an activity.

Here, without regard to any specific geographic locale, we observe what activities tend to be found together. Looking at it from the two sides, it would help to suggest that if a given activity were present, what other activities might want to be in close proximity to it (might follow it). We might then suggest that a desirable target industry is one that tends to be connected to a lot of other activities. Conversely, it might suggest that in order to be successful in attracting a given target, what might be the other industries that may need to be present.

Given the relatively large number of observations (counties) included in the model, a correlation was significant at a relatively low level, about 0.11. To gain insight, we group them by the strength of their association in Figure 2. Reading down a column, the density of the shading observed shows the extent to which the manufacturing activity is likely to attract other economic activities. Reading across the rows and noting the shading density shows what other economic sectors are likely needed within reasonable geographic proximity if a locality would hope to attract a prospect.

Among those manufacturing activities likely to attract a larger number of associated activities, commercial printing, chemical and allied products, rubber and miscellaneous products, and fabricated metals tend to be strongly associated with a large number of other activities. Conversely, those sectors with fairly weak linkages to other activities include several food products and multiple agriculture-related manufacturers. Considering the services and other inputs generally required by manufacturers, business services and transportation services are among those most strongly associated. Thus, if networks are the key to economic competitiveness, our correlation matrix suggests the activities are likely to foster dense networks in the region.

Conclusion

In this chapter we presented and discussed an industry targeting system for the Great Plains region. The system calculates the probability of new industry establishments at the county level for 78 business sectors. In addition to an overall probability, the system estimates the marginal impacts associated with a number of community and regional characteristics generally thought important to business growth. Further, the system incorporates information associated with a wider variety of economic sectors possessing growth potential in rural communities beyond manufacturing. The system will be of direct benefit to local officials eager for new economic opportunity in a generally lagging region of the country.

Among the important attributes of the system is its capacity to consider the marginal impacts associated with a variety of community characteristics that influence growth prospects. This opens the door to a broader discussion of local development strategies regarding what might be done to improve prospects by investing in education, reducing the impacts of local poverty, or focusing on the quality of housing stock.

Even among the variables for which it appears there is little a community can do, local policy strategies may exist. For example, if an industry is sensitive to the labor force participation rate, this may suggest a need to focus on helping a prospective employer recruit needed labor. In this way, the system provides rich possibilities for education beyond the simple notion of Asmokestack chasing,@ while at the same time answering important questions asked in virtually every rural community.

The system is not a self-sufficient decision-making system, nor would it be the only information needed to select industry targets. Additional information needed prior to selecting a target include its potential positive and negative impacts to the community, its growth prospects, the extent to which state and local policies are supportive of the activity, its place within a regional economic system, the degree to which spatial competition may exist, and the community’s preference for development alternatives (see other chapters in this volume). Effective local action still depends on an intimate understanding of the industries that are the focus of local efforts. There is potential to append these types of information to the probabilities and marginal impacts generated with this type of targeting system.

The Plains Economic Targeting System holds potential as a useful tool to improve the practice of local economic development and a powerful educational Ahook@ to open discussion about rural community goals and strategies to achieve local development. For those concerned about broader regional economic prospects, the system provides insight into the factors that influence economic growth and the relationships inherent in economic activity.

References

Anderson, D., and S.A. Johnston. AA Linkage Approach to Industrial Location.@ *Growth and Change.* 23(Summer 1992):321-34.

Bartik, T.J. ASmall Business Start-Ups in the United States: Estimates of the Effects of the Characteristics of States.@ *S. Econ. J.* 55(April 1989):1004-18.

______. *Who Benefits from State and Local Economic Development Policies?* Kalamazoo: W.E. Upjohn Institute for Employment Research, 1991.

______. AThe Effects of State and Local Taxes on Economic Development: A Review of Recent Research.@ *Econ. Develop. Quart.* 6(February 1992):102-10.

Boyle, M.R. AEconomic Development Targeting in the Nineties.@ *Econ. Develop. Rev.* 12 (Spring 1994):13-22.

Bresnahan, T.F., and P.C. Reiss. AEntry and Competition in Concentrated Markets.@ *J. Polit. Econ.* 99(October 1991):977-1009.

Butler, M.A., and C.L. Beale. *Rural-Urban Continuum Codes for Metro and Nonmetro Counties*. Washington DC: U.S. Department of Agriculture, ERS Staff Report No. 9425, 1994.

Carlino, G.A., and E.S. Mills. AThe Determinants of County Growth.@ *J. Reg. Sci.* 27 (February 1987):39-54.

Carlton, D.W. AThe Location and Employment Choices of New Firms: An Econometric Model with Discrete and Continuous Endogenous Variables.@ *Rev. Econ. and Statist.* 65(August 1983):440-49.

Cox, A.M., J. Alwang, and T.G. Johnson. ALocal Preferences for Economic Development Outcomes: Analytical Hierarchy Procedure.@ *Growth and Change*. 31(Summer 2000):341-66.

Davis Reum, A., and T.R. Harris. "Exploring Firm Location Beyond Simple Growth Models: A Double Hurdle Application." *J. Reg. Analysis & Policy*. 36(Spring, 2006):45-67.

Dorf, R.J., and M.J. Emerson. ADeterminants of Manufacturing Plant Location for Nonmetropolitan Communities in the West North Central Region of the U.S.@ *J. Reg. Sci.* 18(February 1978):109-20.

Feser, E.J., H. Renski, and S.H. Sweeney. ALabor Pools or Value Added Chains as the Basis for the Geographic Clustering of Businesses.@ Paper presented at the Southern Regional Science Association annual meeting, Miami Beach, FL, 13-15 April 2000.

Fox, W.F., and M.N. Murray. ALocal Public Policies and Interregional Business Development.@ *S. Econ. J.* 57(October 1990):413-27.

Gabe, T.M. and K.P. Bell. "Tradeoffs between Local Taxes and Government Spending as Determinants of Business Location." *J. Reg. Sci*. 44(February, 2004):21-41.

Goode, F.M. AThe Efficacy of More Refined Demand Variables in Industrial Location Models: Note.@ *Growth and Change*, 17(Winter 1986):66-75.

______. ARural Industrial Location versus Rural Industrial Growth.@ *Ann. Reg. Sci.* 23(February 1989):59-69.

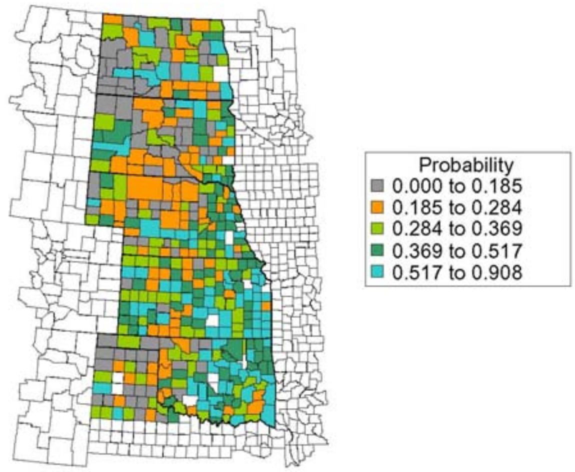
______. AThe Role of Interindustry Linkages in an Industrial Targeting Model.@ *Microcomputer-Based Input-Output Modeling: Applications to Economic Development*. D.M. Otto and T.G. Johnson, eds., pp 131-56. Boulder: Westview Press, 1993.

Goode, F.M., and S.E. Hastings. AAn Evaluation of the Predictive Ability of the Northeast Industrial Targeting (NIT) and Economic Development Database (EDD) System.@ Unpublished, The Pennsylvania State University, 1989.

Hefner, F.L., and P.P. Guimaraes. ABackward and Forward Linkages in Manufacturing Location Decisions Reconsidered.@ *Rev. Reg. Studies.* 24(Winter 1995):229-44.
Holmes, T.J. "The Effects of State Policies on the Location of Manufacturing: Evidence from State Borders." *J. Pol. Econ*. 106(41, 1998): 667-705.
Killian, M.S., and T. Parker. 1991. AEducation and Local Employment Growth in a Changing Economy.@ *Education and Rural Economic Development: Strategies for the 1990's*. Washington DC: U.S. Department of Agriculture. ERS Staff Report No. AGES 9153, 1991.
Kim, Y., D.L. Barkley, and M.S. Henry. AIndustry Characteristics Linked to Establishment Concentrations in Nonmetropolitan Areas.@ *J. Reg. Sci.* 40(May 2000):231-59.
Kusmin, L.D. *Factors Associated with the Growth of Local and Regional Economies: A Review of Selected Empirical Literature*. Washington DC: U.S. Department of Agriculture. ERS Staff Report No. AGES 9405, 1994.
Kusmin, L.D., Redman, J.M., and D.W. Sears. *Factors Associated with Rural Economic Growth: Lessons from the 1980's*. Washington DC: U.S. Department of Agriculture, ERS Technical Bulletin 1850, 1996.
Leatherman, J. C., Howard, D.J., and T.L. Kastens. "Improved Prospects for Rural Development: An Industrial Targeting System for the Great Plains." *Rev. Agr. Econ*. 12(Spring 2002):59-77.
McClenahen, J.S. ASelective Pursuit.@ *Industry Week.* 245(October 6, 1996):35-38.
McHugh, R.J., and J.T. Wilkinson. AThe Determinants of Country Growth.@ *J. Reg. Sci.* 28(May 1988):271-73.
McKee, D. ATarget Industry Marketing: Strategy and Techniques.@ *Econ. Develop. Rev.* 12 (Spring 1994):4-12.
McNamara, K.T., W.P. Kriesel, and B.J. Deaton. AManufacturing Location: The Impact of Human Capital Stocks and Flows.@ *Rev. Reg. Studies* 18(Summer 1988):42-48.
Mead, A.C. AA Simultaneous Equations Model of Migration and Economic Change in Nonmetropolitan Areas.@ *J. Reg. Sci.* 22 (November 1982):513-27.
Newman, R.J. and D.H. Sullivan. "Econometric Analysis of Business Tax Impacts on Industrial Location: What Do We Know and How Do We Know It?" *J. Urb. Econ*. 23(1988):215-34.
Porterfield, S.L. AProducer Services: A Viable Option for Rural Economic Development?@ Paper presented at the Southern Regional Science Association annual meeting, Washington DC, March, 1990.
Rowley, T.D. ASustaining the Great Plains.@ *Rural Develop. Perspect.* 13(February 1998):2-6.
Schmenner, R.W., J.C. Huber, and R.L. Cook. A Geographic Differences and the Location of New Manufacturing Facilities.@ *J. Urban Econ.* 21(January 1987):83-104.
Smith, E.D., B.J. Deaton, and D.R. Kelch. ALocation Determinants of Manufacturing Activity in Rural Areas.@ *S. J. Agr. Econ.* 10(Juy. 1978):23-32.
Stough, R.R., R. Kulkarni, J. Riggle, and M. Trice. ASome New Cluster Analytic Methods and Advising State Technology Policy.@ Paper presented at the Southern Regional Science Association annual meeting, Miami Beach FL, 13-15 April 2000.
Sweet, D.C. ATargeting Software as a Tool for Today=s Economic Development Professional.@ *Econ. Develop. Rev.*12(Spring 1994):65-68.
Thill, J-C. ASpatial Competition and Market Interdependence.@ *Papers in Reg. Sci.* 71(July

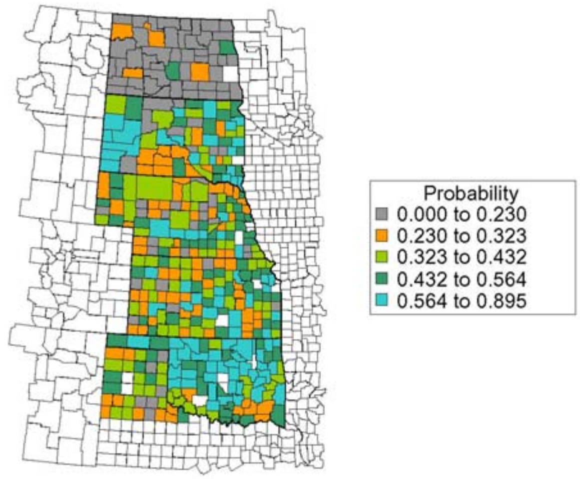
1992):259-75.
U.S. Department of Commerce. *County Business Patterns* (CD-ROM). Washington DC: U.S. Department of Commerce, Bureau of the Census, 1986, 1994.
Wasylenko, M. ΑEmpirical Evidence of Inrerregional Business Location Decisions and the Role of Financial Incentives in Economic Development.@ *Industry Location and Public Policy*. H.W. Herzog, and A.M. Schlottmann, eds., pp. 13-30. Knoxville: University of Tennessee Press, 1991.
Wasylenko, M., and T. McGuire. ΑJobs and Taxes: The Effect of Business Climate on States= Employment Growth Rates.@ *Nat. Tax J.* 38(December 1985):497-511.
Whaley, J.W., and S.S. LaCroix. ΑAdvanced Targeting Simplified.@ *Econ. Develop. Rev.* 15(Fall 1997):11-19.

Figure 1A. PETS Region and Probabilities for Food and Kindred Products (SIC 2000) Location, 1995-2003



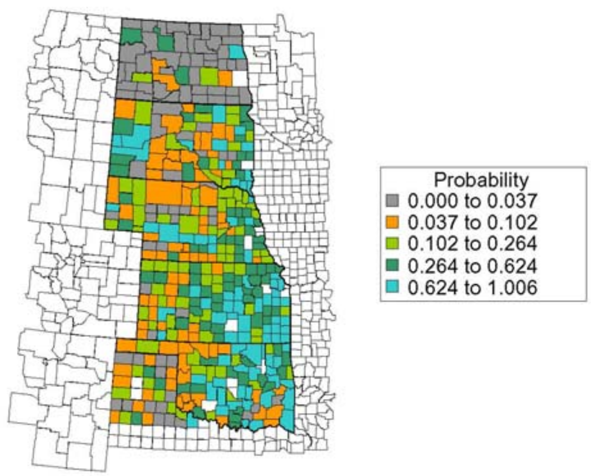
Counties shaded white within the study region were excluded from the analysis.

Figure1B. PETS Region and Probabilities for Printing and Publishing (SIC 2700) Location, 1995-2003



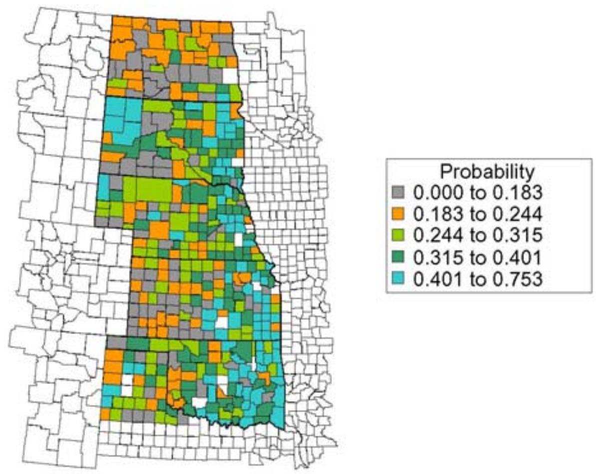
Counties shaded white within the study region were excluded from the analysis.

Figure 1C. PETS Region and Probabilities for Rubber and Misc. Plastics Products (SIC 3000), 1995-2003



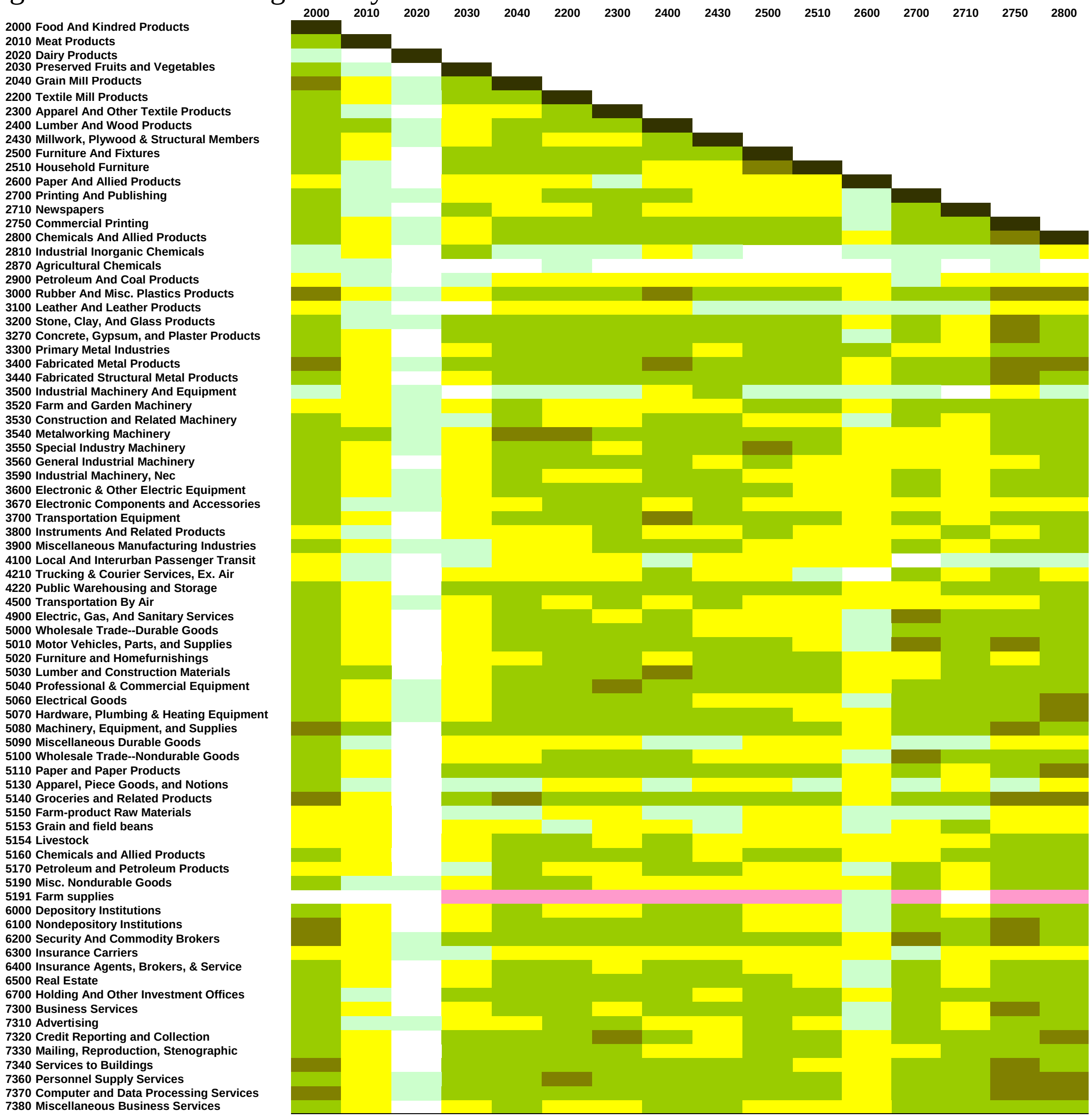
Counties shaded white within the study region were excluded from the analysis.

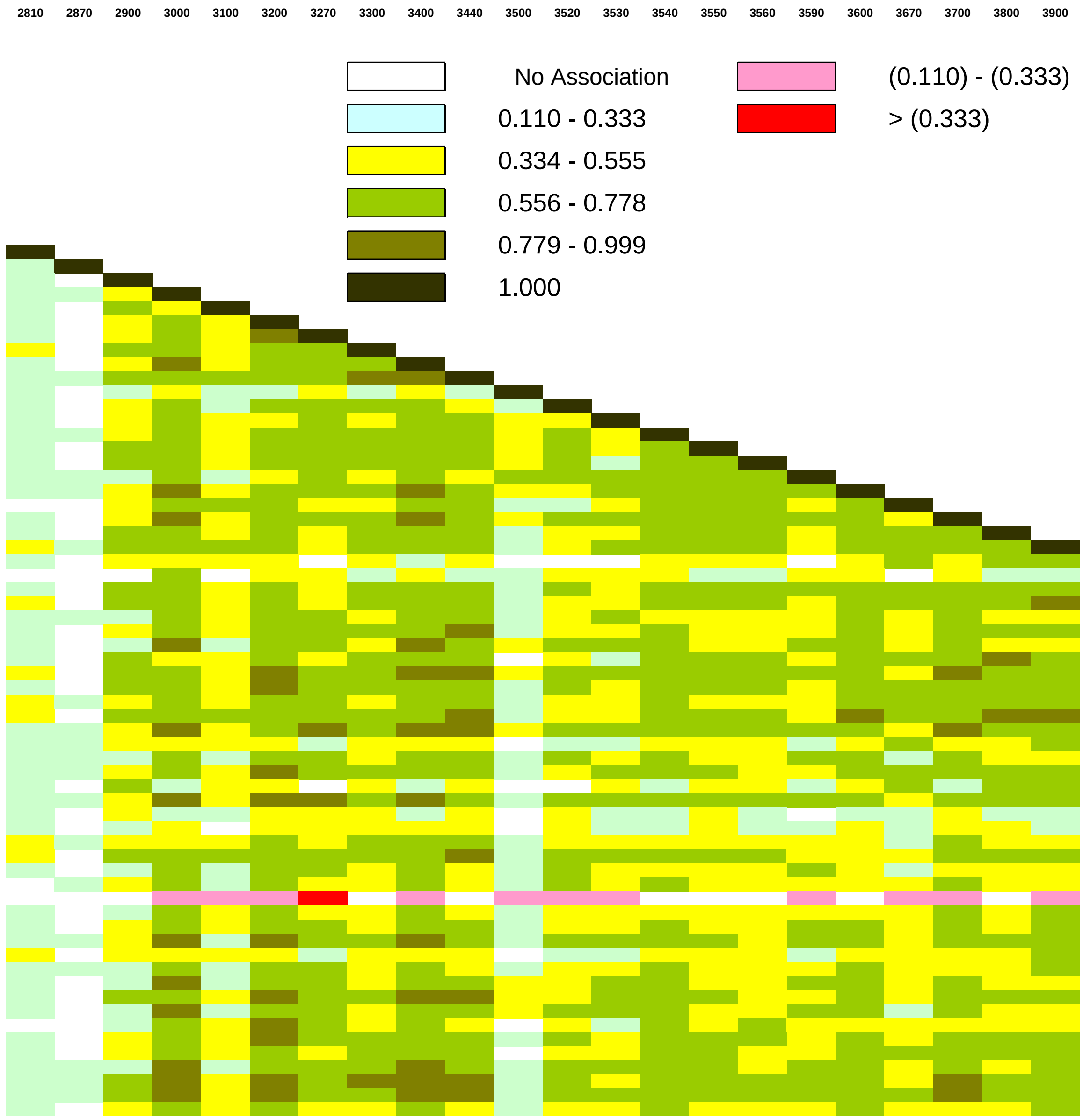
Figure 1D. PETS Region and Probabilities for Industrial Machinery and Equipment (SIC 3500), 1995-2003



Counties shaded white within the study region were excluded from the analysis.

Figure 2. Manufacturing activity correlations with 78 PETS industries





2810 2870 2900 3000 3100 3200 3270 3300 3400 3440 3500 3520 3530 3540 3550 3560 3590 3600 3670 3700 3800 3900
No Association
0.110 - 0.333
0.334 - 0.555
0.556 - 0.778
0.779 - 0.999
1.000
(0.110) - (0.333)
> (0.333)

Comment: this figure is really neat, but may be difficult to reproduce in legible manner. Can it be spread over two pages?

Table 1. Variables incorporated into the Plains Economic Targeting System

Dependent variable

Business growth (1 if positive growth in the number of establishments for a given sector between 1986 and 1994, 0 otherwise)

Independent variables

Community economic conditions

Per capita total local government (county) tax revenues

Percentage of county employment in agriculture

Percentage of county employment in manufacturing

Percentage of county employment in services

Median value of housing ($/house)

Lagged industry growth (1 if growth in 1977-84 (1985-94 in predictive models) for a given sector, 0 otherwise)

Five state variables (1 if the county is in that state, 0 otherwise; Kansas as the excluded category)

Community social attributes

Percentage of families below poverty level

Local per capita expenditures for public safety

Median age of county residents

Community infrastructure

Local per capita expenditures for highways

Presence of an interstate highway (1 if present, 0 otherwise)

Presence of a commercial airport (1 if present, 0 otherwise)

Industry input/market conditions

Total county population

County population density (persons per square mile)

Metro influence (1 if Beale Code 1-5, 0 if Beale Code 6-9, all counties over 75,000 population excluded)

Percentage of age ∃25 population with more than a high school education

Local per capita expenditures for education

County labor force participation rate (% of total population included in the labor force)

County average earnings per job (%)

Table 2. Manufacturing sectors represented in the PETS system

Industry sector	Standard Industrial Class
Nondurable goods manufacturing	
Food and Kindred Products	2000
Meat Products	2010
Dairy Products	2020
Preserved Fruits and Vegetables	2030
Grain Mill Products	2040
Textile Mill Products	2200
Apparel and Other Textile Products	2300
Lumber and Wood Products	2400
Millwork, Plywood and Structural Members	2430
Furniture and Fixtures	2500
Household Furniture	2510
Paper and Allied Products	2600
Printing and Publishing	2700
Newspapers	2710
Commercial Printing	2750
Chemicals and Allied Products	2800
Industrial Inorganic Chemicals	2810
Agricultural Chemicals	2870
Petroleum and Coal Products	2900
Durable goods manufacturing	
Rubber and Misc. Plastics Products	3000
Leather and Leather Products	3100
Stone, Clay, and Glass Products	3200
Concrete, Gypsum, and Plaster Products	3270
Primary Metal Industries	3300
Fabricated Metal Products	3400
Fabricated Structural Metal Products	3440
Industrial Machinery and Equipment	3500
Farm and Garden Machinery	3520
Construction and Related Machinery	3530
Metalworking Machinery	3540
Special Industry Machinery	3550
General Industrial Machinery	3560
Industrial Machinery, Nec	3590
Electronic and Other Electric Equipment	3600
Electronic Components and Accessories	3670
Transportation Equipment	3700
Instruments and Related Products	3800
Miscellaneous Manufacturing Industries	3900

Table 3. Manufacturing prospect industries for Smith County, KS, 1995-2003

Rank order	Probability of growth	Industry SIC code	Industry sector description
13	0.323	3200	Stone, Clay and Glass Products
16	0.280	3500	Industrial Machinery and Equipment
17	0.273	2700	Printing and Publishing
23	0.208	2710	Newspapers
24	0.206	2510	Household Furniture
25	0.200	3400	Fabricated Metal Products
26	0.199	3590	Industrial Machinery, Nec
27	0.194	2000	Food and Kindred Products
31	0.156	2040	Grain Mill Products
32	0.148	3000	Rubber and Misc. Plastics Products
34	0.139	3270	Concrete, Gypsum and Plaster Products
35	0.128	3700	Transportation Equipment
36	0.114	2500	Furniture and Fixtures
39	0.108	2400	Lumber and Wood Products
41	0.093	2750	Commercial Printing
42	0.092	3900	Misc. Manufacturing Industries
43	0.086	2300	Apparel and Other Textile Products
48	0.066	2430	Millwork, Plywood & Structural Members
49	0.063	2010	Meat Products
52	0.048	3800	Instruments and Related Products
53	0.048	2600	Paper and Allied Products
54	0.037	3600	Electronic and Other Electric Equipment
56	0.036	2030	Preserved Fruits and Vegetables
57	0.034	2800	Chemicals and Allied Products
61	0.025	3440	Fabricated Structural Metal Products
62	0.022	3540	Metalworking Machinery
63	0.021	3300	Primary Metal Industries
64	0.020	3550	Special Industry Machinery
65	0.013	2200	Textile Mill Products
69	0.006	3670	Electronic Components and Accessories
70	0.006	2900	Petroleum and Coal Products
74	0.003	3560	General Industrial Machinery
75	0.002	2870	Agricultural Chemicals
76	0.002	3100	Leather and Leather Products
77	0.000	2810	Industrial Inorganic Chemicals
78	0.000	2020	Dairy Products

Table 4. Marginal effects in decimal form and significant growth variables for highest-probability manufacturing industries for Smith County, KS, 1995-2003

Independent variable	1990 Smith County value	SIC 3200: Stone, Clay and Glass Products	SIC 3500: Industrial Machinery and Equipment	SIC 2700: Printing and Publishing	SIC 2510: Household Furniture
North Dakota	0	-0.41121	-0.29888	0.34437	0.14333
South Dakota	0	0.18713	0.19354	0.33229	0.02555
Nebraska	0	-0.00293	0.11334	0.36688	0.00599
Oklahoma	0	0.09918	0.01385	0.50104	-0.06188
Texas	0	0.09599	0.11135	-1.22910	-1.11399
Metro effect	0	-0.13309	-0.04685	-0.15742	0.09051
Interstate	0	0.02270	0.00831	0.07718	0.03107
Airport	0	-0.01274	-0.03623	0.06709	-0.03697
Population (per 1,000)	5,947	0.00535	0.00768	0.00399	0.01141
Population density (per square mile)	6.6	-0.00026	0.00226	0.00232	0.00165
Families below poverty (%)	13.0	-0.02056	-0.01655	-0.04510	-0.02905
Total per cap. local govt. revenue ($)	$542	-0.00024	-0.00038	0.00016	-0.00016
Local per cap. expend. highways ($)	$202	0.00004	-0.00044	-0.00121	-0.00085
Local per cap. expend. education ($)	$519	0.00011	0.00000	0.00016	0.00028
Local per cap. expend. public safety ($)	$28	0.00011	0.00165	0.00012	0.00039
Population with some college (%)	66.3	-0.00288	-0.00127	-0.00759	-0.01040
Median age in county	42.9	-0.00129	-0.00099	-0.02312	0.00003
Average county wage ($)	$8.68	-0.00339	0.00603	0.04667	-0.00839
Labor force participation rate (%)	53.4%	0.00725	0.00746	0.00465	0.00754
Housing value (per house)	$18,300	-0.00219	-0.00139	-0.00087	-0.00996
Agricultural employment (%)	30.7%	0.00101	-0.00062	0.01105	0.00457
Manufacturing employment (%)	5.9%	-0.00245	-0.00254	0.00755	0.00813
Service employment (%)	25.7%	0.00806	-0.00159	-0.02062	0.00163