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**Location Determinants of Food Manufacturing Investment: Are Non-metropolitan  
Counties Competitive?**

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# **Location Determinants of Food Manufacturing Investment: Are Non-metropolitan Counties Competitive?**

## **ABSTRACT**

Food manufacturing site selection is determined by infrastructure, agglomeration, product and input markets, labor markets, and fiscal attributes of local communities. This article examines how these factors influence location decisions across the rural-urban continuum in the lower forty-eight states of the U.S. Negative binomial regression and spatial clustering methods are used to forecast new food processor location patterns at the county level, 2000-2004. Remote rural areas are at a comparative disadvantage with respect to attracting food processors, but non-metropolitan counties with economic links to urban core areas may be attractive investment sites for footloose, supply, and demand-oriented food manufacturers.

**JEL Classification:** R1, R3

*Keywords:* firm location, food manufacturing, negative binomial regression, spatial clustering

## INTRODUCTION

The ability of rural areas to compete for manufacturing investment is unclear as the economy continues to evolve under forces of globalization and increased international competition. Competition from abroad and rapid adoption of new processing and production technologies has reduced the attractiveness of rural areas as potential locations for manufacturing (Barkley 1995). In the early 1970s, the movement of manufacturing out of core urban areas to low cost labor sites stimulated rural industrialization. But since the late 1990's rural areas have struggled as manufacturing investment flows back to urban areas that provide access to skilled labor, business services, and product and input markets.

Concentration of manufacturing investment in urban areas increased because of the heightened importance of a skilled workforce, supply-chain logistics, and emphasis on scale economies (Black and Lynch 2000; Amiti 1998). Rural areas have typically relied on a lower-cost, less educated workforce to attract manufacturing investment of firms seeking to minimize labor costs (McGranahan 1998; Schluter and Lee 2002). However, concomitant with the cost minimization logic of the new economy is wider access to deeper labor markets, encouraging manufacturers to seek low-wage workers abroad. To the extent that technological innovation and information technologies drive productivity growth, many rural places are now at a disadvantage with respect to attracting manufacturing investment due to low-skilled workforces and lack of business services.

Notwithstanding these challenges, recruiting food manufacturing remains a popular rural economic development strategy in the belief that rural areas offer an access advantage to firms processing agriculture commodities (Testa 1993; McNamara, Kriesel, and Rainey 1995). This philosophy is reinforced today with the promise of alternative fuel production from corn, soybeans, and other cellulosic materials. Some state and local governments

consider food manufacturing and other value-added agribusinesses as potential mechanisms to offset rural outmigration and unemployment because these activities are potential sources of off-farm work, and could increase farm income through backward linkages to local agricultural production (Capps, Fuller, and Nichols 1988; Benirschka and Binkley 1994; Henderson and McNamara 2000; Barkema, Drabenstott, and Stanley 1990). Expansion of the manufacturing sector in rural areas ended in the 1980s, but food processing still remains more rural-based than most U.S. manufacturing, suggesting that some non-metropolitan communities have a comparative advantage over urban areas in attracting food manufacturing investment (Schluter and Lee 2002).

This article examines the influence market factors, agglomeration, infrastructure, labor, and fiscal policy attributes on food manufacturing plant location decisions in the United States between 2000 and 2004 using negative binomial regression and spatial clustering methods. One policy-relevant question asked here is; which communities are more competitive with respect to attracting food manufacturing investment? To answer this question, an econometric model was developed to (1) measure the factors influencing the likelihood that a food manufacturing firm locates in a given county, and (2) to isolate clusters of counties more likely to attract food manufacturing investment. By identifying counties more likely to attract food manufacturing investment, and then comparing the attributes of those counties that drive the site selection decisions of potential investors, insight might be gained as to where local communities could focus limited resources if recruitment of food manufacturing establishments is pursued as a development strategy.

The next section highlights the conceptual model used to analyze food manufacturer site selection, and the data and empirical models used to estimate which factors are associated with the site selection decisions of food manufacturers. Regions where food

manufacturers with different cost structures are more likely to locate are identified using spatial clustering methods. Clusters are determined based on site selection probabilities estimated using negative binomial (NB) regressions, an approach frequently applied in firm location studies (Davis and Schluter 2005; Coughlin and Segrev 2000; Henderson and McNamara 2000). To our knowledge, this is the first analysis of food manufacturing clustering that uses probabilities generated by NB regression, conditional on firm cost structure. The regression analysis also allows for different location factor responses due to heterogeneity across spatial regimes. The approach taken is (i) theoretically consistent with firm profit-maximizing behavior, (ii) useful for identifying competitive counties across the rural-urban continuum, at the national level, (iii) adaptable to other types of location studies, and (iv) is easily implemented in wide array of software. The last section reports the results, and is followed by a concluding section highlighting implications for rural economic development.

## **CONCEPTUAL BACKGROUND**

Research suggests that manufacturing location choices are increasingly influenced by access to product and input markets, business services, and manufacturing agglomeration. The integration of information technology into all aspects of firm operations, coupled with intensified capitalization, also suggests that firms will continue to become more concentrated in agglomeration economies (Barkley 1995). Food manufacturing location studies frequently find that proximity to markets, infrastructure, and labor characteristics are key location determinants (Lopez and Henderson 1989; Leistritz 1992; Vesecky and Lins 1995). Goetz (1997), and Henderson and McNamara (2000) examined food processor site selection and concluded that plant investments were influenced by the same factors that affected general

manufacturing plant investment decisions; access to product and input markets, agglomeration economies, and infrastructure. But Henderson and McNamara (2000) found that supply-oriented food manufacturer investment was positively related with access to agricultural inputs.

Food manufacturing plants have been classified as ‘demand-oriented’, ‘supply-oriented’, or ‘footloose’ on the basis of their cost structure (table 1) (Connor and Schiek 1997; Henderson and McNamara 1997, 2000). Demand-oriented firms are characterized by a total cost structure dominated by distribution costs. These firms typically produce fragile or perishable goods, such as chips, ice-cream, and baked goods; or bulky items such as beverages or packaged liquids. Demand-oriented firms prefer to locate near product markets to minimize distribution costs. Supply-oriented firms have a total cost structure dominated by the purchase of a single input commodity. These firms tend to locate near inputs to minimize procurement costs. Examples of supply-oriented firms include meat packers, grain milling, ethanol and biodiesel production, and plant oil processing. Footloose firms have a cost structure not dominated by either demand or supply factors. Examples include firms that produce mixed nuts, confectionaries, chocolates, or salsa. These processors prefer to locate in areas with access to transportation, business services, and capital.

Firm location choice has been analyzed as a two-stage decision process (Schmenner, Huber, and Cook 1987; McNamara, Kriesel and Deaton 1988; Kriesel and McNamara 1991; Woodward 1992; Bartik 1985; Henderson and McNamara 1997; Lambert, McNamara, and Garrett 2006a). Firms are hypothesized to evaluate potential sites on the basis of regional, state, local, and site-specific attributes. In the first stage, firms select a region based on broad company objectives such as product market penetration, access to raw materials, increasing market share, or other criteria in the firms’ objective function. The Economic Research

Service (ERS) farm resource regions are used to control for unobserved factors associated with the first-stage location decision of firms; Heartland, Northern Crescent, Northern Great Plains, Prairie Gateway, Eastern Uplands, Southern Seaboard, Fruitful Rim, Basin and Range, and the Mississippi Portal (ERS 2000). The regions are characterized by the dominant agricultural commodities produced in the area, along with soil, climatic, and farm demographic attributes.

In the second stage, firms seek a minimum cost site in the selected region for their investment. The second stage of the location decision is represented as  $Z_j = g(\mathbf{M}_j, \mathbf{A}_j, \mathbf{L}_j, \mathbf{I}_j, \mathbf{F}_j)$ , where  $Z_j$  is the site choice in location  $j$ , and  $\mathbf{M}$ ,  $\mathbf{A}$ ,  $\mathbf{L}$ ,  $\mathbf{I}$ ,  $\mathbf{F}$  are vectors of community attributes representing input and product markets, agglomeration factors, labor attributes, infrastructure, fiscal characteristics, and social capital that influence firm costs, respectively.

## DATA AND VARIABLE DESCRIPTION

New food manufacturer investments over the 2000-2004 periods were measured by counting the number of new food manufacturing establishments ( $E$ ) following Davis and Schluter's (2005) methodology. The positive cumulative change in the number of firms over the sample period ( $N_j$ ) in a given county  $j$  was used to measure firm location activity,  $N_j = \sum_t N_{j,t}$ , where  $N_{j,t} = E_{j,t} - E_{j,t-1}$  if  $E_{j,t} > E_{j,t-1}$ , 0 otherwise. County Business Pattern data was used to measure firm location events ( $N = 3,062$  counties). This measure of gross firm entry may underestimate the actual number because it is not possible to identify exiting firms. But because the measure is explicitly defined over time and space, it is unlikely that occurrences of simultaneous entries and exits are encountered (i.e. 'churning' effects) (Davis and Schluter 2005). Food processors were classified as demand-oriented, supply-oriented, or footloose



according to the industry's cost structure based on Connor and Schiek's (1997) typology (table 1).

We rely on a variety of data sources to measure the relationships between location determinants and new food manufacturing growth between 2000 and 2004. To avoid potential simultaneity problems, location determinants measured in 2000 (or prior to 2000) are used in the regression analyses.

#### *Agglomeration economies (A)*

Agglomeration is the accumulation of business activity in and around a specific geographic area. Agglomeration economies are typically characterized by agglomeration due to urbanization or localization economies. Localization economies are associated with geographic specialization in specific activities, and urbanization economies are associated with size (i.e. population) or economic diversity (Viladecans-Marsal 2004). Agglomeration economies are formed when firms cluster together in a region (Barkley 1995). One by-product of agglomeration economies are information, own-industry, supply-side, and demand-side spillover effects between firms (Cohen and Paul 2005). Other effects include reduced transportation costs of inter-firm trade, increased firm diversity, and product differentiation (Fujita, Krugman, and Venables 2001; Henderson 1994). Businesses agglomerate to access external services at lower costs, to gain access to a base of workers with specialized skills, and to reduce costs of infrastructure provision (Richardson 1973). The concentration of activity in a particular area typically leads to a larger labor pool with skills needed by that industry (Rainey and McNamara 1999). Agglomeration economies also represent the cost savings gained by firms locating in communities with a relatively large concentration of other firms (Kriesel and McNamara 1991; McNamara, Kriesel, and Rainey

1995; Henry and Drabenstott 1996). Agglomeration factors are hypothesized to have a positive influence on the location of all types of food processing plants at state and county levels.

The 2000 number of food manufacturing establishments divided by the total number of business establishments in a county was used to measure the effects of localization economies on the site selection decision (MFGS). The effects of urbanization economies on the location decision were measured using the percent of the workforce employed by the manufacturing sector in 2000 (MEMPL) (table 2).

#### *Product and input market determinants (M)*

Firms enter product markets to distribute final goods with the goal of minimizing distribution costs (Connor and Schiek 1997). Product markets are also the source of final demand (Henderson and McNamara 2000). Goetz (1997) found that access to product markets had a positive influence on food manufacturing site location. Closeness to product markets is more important for demand-oriented food processing firms because most of the total production costs of these firms are associated with distribution of final products (Capps, Fuller, and Nichols 1988). Market potential captures effective demand relative to the supply of competing manufactured goods. Larger potential markets can be served by taking advantage of lower transportation costs, thereby increasing competitiveness. It is hypothesized that product markets will be positively related with all types of food manufacturers, but that this relationship will be more important for demand-oriented processors. The 2000 county population (POP) and per capita income (PCI) were used to measure the effects of product markets on the site selection decision. It is expected that population and per capita income will be positively associated with the site selection decision

of all firms, but that demand-oriented and footloose firms will place more weight on these factors than supply-oriented firms. The total state population was also included in the regression models to further differentiate local market effects from those of broader, regional markets. For example, a county with a relatively large population in Montana is unlikely to be just as competitive as another county with a similar population in New Jersey.

Food processors enter input markets to minimize input procurement costs, but also prefer locations that reduce transportation costs associated with the production of bulky, watery, perishable, or immovable resources (Connor 1987; Capps, Fuller, and Nichols 1988). Higher-values crops (i.e. fruits and vegetables) will tend to be produced near urban centers, while lower-valued crops (i.e. grains) will tend to be produced in non-core regions. The distance in road miles to the nearest metropolitan county (ROADDIST) was used to measure the effects of transport costs and access to product markets on the location decision. It is hypothesized that transport costs as measured by this measure will be more important for footloose and demand-oriented food processors (expected sign is negative). On balance, transport costs to metropolitan areas may not be as an important a consideration in the location calculus of supply-oriented processors because these firms typically locate operations near raw materials.

The relative importance of access to inputs also differs by food processor type. Access to raw material inputs is more important for supply-oriented plants because their cost structure is dominated by costs associated with input acquisition. Henderson and McNamara (1997, 2000) found that access to input markets influenced food manufacturing location choice at the county level. In their study, the sum of cash receipts for crops and livestock per county area measured access to agricultural inputs. It is hypothesized that counties endowed with agricultural raw materials will be more likely to attract all types of food processing

plants, but that this relationship will be more important for supply-oriented processors. The 2000 sum of crop and livestock receipts per county acres (AGRI) and the percent of land in agriculture (%FRMLND) were used to measure agricultural input market effects on the site selection decision.

#### *Labor quality and availability (L)*

Manufacturing productivity depends on labor availability. A deep labor pool requires less recruiting and provides a more diversified work force. A diversified work force increases the likelihood of acquiring workers with the necessary skill sets to fill positions at all levels of production. Plants in locations with small quantities of labor face more turnover and recruitment problems. It is hypothesized that a positive relationship exists between food processor location decisions and labor availability. This is expected to be true of all types of food manufacturing establishments. The 2000 county unemployment rate was used to proxy the available labor pool (UNEM) (table 2).

More diverse populations may also be an indication of available labor. Ethnic diversity is associated with faster rates of economic growth, and employment mismatches may also be less likely in more diverse communities (Rupasingha, Goetz, and Freshwater 2002). The effect of social diversity (SOCIODIV) on food manufacturer site selection was measured using Alesina and La Ferrara's (2004) ethnolinguistic fractionalization measure:  $SOCIODIV = 1 - \sum_k s_k^2$ , where  $s_k$  is the 2000 share of population classified as White, Hispanic, Black, Asian or Native American. This measure is expected to be positively related with food location announcements.

Manufacturing productivity is also influenced by labor quality (McNamara, Kriesel, and Deaton 1988). Higher quality workers are generally more productive, and increased

productivity leads to higher output at the same or lower costs, thus increasing plant profits. In lieu of increasing demand for a wide array of labor skill sets, it is hypothesized that high-quality labor will be positively associated with food manufacturing site selection. The 2000 percent of individuals over the age of twenty-five with a high school diploma in each county was used to measure labor quality effects on the firm location decision (HS00) (table 2).

Labor costs directly influence production costs and plant profits. Places with lower labor costs have lower operating costs, increasing the attractiveness of the area for manufacturing (Schmenner, Huber, and Cook 1987; Smith, Deaton, and Kelch 1978; McNamara, Kriesel, and Deaton 1988). It is hypothesized that labor costs will be negatively correlated with manufacturing location for all food processors. The 2000 annual manufacturing wage per worker in each county was used to measure labor cost effects (MWAGE) (table 2).

Results of previous research are mixed with respect to the effect of worker unionization on firm site selection. Counties where relatively more of the workforce belongs to unions may be less attractive to firms (Bartik 1995; Woodward 1992). But Friedman, Gerlowski, and Silberman (1992) found a positive association between plant site selection and unionization. Union strength in states with right-to-work laws may be weaker because workers in states with right-to-work laws may be less willing to join unions (Davis and Schluter 2005). The 1999 percent of workers belonging to a union (UNION) is expected to have a negative impact on firm site selection. States with right-to-work laws were indicated with a dummy variable (RTW). Contrary to the above logic, Schluter and Davis (2005) found that right-to-work laws had a negative impact on food processor site selection. But after further investigating this counterintuitive result, they hypothesized that unions may be viewed as productivity-enhancing when they are weakly organized (i.e. in right-to-work

states), but perceived as barriers to profit-maximization in states without right-to-work laws. To test this hypothesis, they included an interaction effect between these variables. Based on their findings, an interaction term between the percent of unionized workers and states with right-to-work legislation is included in the model (RTWXUN). The hypothesized relation between the interaction effect and firm site selection is positive.

#### *Infrastructure determinants (I)*

Infrastructure consists of the physical or natural components of an economy that support the community needs and business activities by creating access to regional, national, and international markets. Infrastructure includes land availability, transportation networks, access to navigable waterways, recreational areas, and learning institutions. These factors are hypothesized to increase the attractiveness of a site and the probability of a food manufacturer locating in a given county. Smith, Deaton, and Kelch (1978), Woodward (1992), and Rainey and McNamara (1999) looked at infrastructure effects at the county level, all finding that it was a significant and positive determinant of plant location choice. Bartik (1985, 1989), Glickman and Woodward (1988), and Coughlin, Terza, and Arromdee (1991) found infrastructure effects on manufacturing location at the state level to be significant and positive. Henderson and McNamara (2000) found infrastructure to be a positive and significant factor affecting food processor plant location at the county level. County adjacency to a major river or a Great Lake (RIVER) were used to measure the influence of physical and natural transport infrastructure on the location decision of food manufacturers (table 1). Location studies typically include county access to interstates. Interstates were not included here because of collinearity issues. Every metropolitan county has access to an

interstate, and the variable ROADDIST also measures the effects of transport infrastructure on the firm location decision.

Land availability is also part of infrastructure. Firms locate where there is land available for current projects and possible future expansions (Henderson and McNamara 1997), but compete for sites where land prices are relatively lower (Bartik 1985). The probability of a food processor locating operations in a given area depends on the number of potential sites. The larger the county, the better its chance of having a higher profit site (Bartik 1985, 1989; Woodward 1992). It is hypothesized that land availability will have a positive influence on the site selection decision. County size (LAND) was used to measure the effects of land availability on the site location decision.

As technology adoption and innovation continue to co-evolve in manufacturing, more educated workers and the capacity to re-equip workers with new skill sets are usually required to remain competitive (McGranahan 1998). Educational institutions and availability of training centers provide workers with opportunities to improve their skill sets and abilities. Plants looking for a better educated workforce favor locations with access to educational institutions or training facilities (Smith, Deaton and Kelch 1978; Henderson and McNamara 1997). The presence of a business school or junior college in a county in 2000 was used to proxy the potential for skill development and labor quality (EDUC). It is hypothesized that the presence of these learning facilities will be positively associated with food processing plant location for all types of processors.

#### *Fiscal determinants (F)*

Fiscal policy includes the expenditure patterns and tax policies of counties and states. Fiscal policy influences plant site selection by collecting taxes to finance public services

(Henderson and McNamara 1997). Higher state spending can be a benefit, but states with high corporate taxes are less attractive sites for manufacturers (Goetz 1997). Fiscal policy expenditures directed to worker training, school systems, educational facilities, public services, and infrastructure development can decrease the costs of production and increase the prospect of plant profitability (Bartik 1989; Kriesel and McNamara 1991; Smith, Deaton, and Kelch 1978).

Bartik (1985, 1989) measured fiscal policy effects on firm site selection decisions at the state level and found them to be negative and significant. Kriesel and McNamara (1991), and Rainey and McNamara (1999) found fiscal policy factors to be significant and negative at the county level. Henderson and McNamara (1997, 2000) used county per capita taxes divided by total county expenditures per capita to measure the effects of fiscal policy on firm location decisions. In their 1997 study, tax effort had positive and significant effects. But in their 2000 study, fiscal policy was found to have a negative effect on plant location choice. County-level per capita property taxes divided by total county expenditures per capita in 2000 were used to measure fiscal effects on the site location decision in this study (FISC) (table 2). It is expected that this variable will be negatively correlated with food processor location choice.

## **EMPIRICAL MODEL AND ESTIMATION**

The influence of local factors on food manufacturer site selection was measured using negative binomial-II (NB) regression (Cameron and Trivedi 2005). Firm location events are discrete nonnegative counts. And, in the context of firm location theory, NB regression is compatible with the random utility (profit-maximization) framework under special circumstances (Guimarães, Figueiredo, and Woodward 2003, 2004; Davis and Schluter 2005;



Chong 2006). Guimarães, Figueiredo, and Woodward (2004) show how the conditional logit model with random effects reduces to a negative binomial specification when (1) site-selection outcomes are modeled as discrete-choice events, and (2) a single cross section and single economic sector (or sub-sector) are considered. Davis and Schluter (2005) applied this relationship in their study of firm entry in the food manufacturing sector between 1991 and 1997. The same conditions apply in this study. Three models estimated the site selection factors associated for footloose, demand-, and supply-oriented food manufacturers. The NB regressions were estimated with maximum likelihood (ML), and standard errors were estimated using MacKinnon and White's (1985) jackknifed heteroskedastic-consistent covariance (HC-3) matrix. The HC-3 estimator is robust to unspecified forms of heteroskedasticity. Significant differences between location determinants in different regimes were determined using t tests for each food manufacturing type.

#### *Spatial dependence, spatial heterogeneity, and spatial clustering*

Previous manufacturing location studies have detected significant spatial lag (Lambert, McNamara, and Garrett 2006a) or spatial dependence in residuals of discrete choice firm site-selection models (Lambert, McNamara, and Garrett 2006b). Estimates are inconsistent and biased when neighboring values of the dependent variable in location  $j$  predict the value observed in location  $i$  due to endogeneity. When spatial dependence is detected in residuals, estimates are consistent, but inefficient. Spatial Lagrange Multiplier (SLM) tests were used to test for spatial lag or error dependence (Anselin 1988). Pearson's  $\chi^2$  residuals were used in the tests. To accommodate overdispersion due to the count model, the projection matrix used in the spatial lag tests was normalized using the NB variance function. Specifically, the general linear specification of the negative binomial projection matrix was used:

$\mathbf{W}^{1/2} \mathbf{X} (\mathbf{X}' \mathbf{W} \mathbf{X})^{-1} \mathbf{X}' \mathbf{W}^{1/2}$ , where  $w_{ii} = \mu_i (1 + \mu_i \alpha)^{-1}$ ,  $\mu_i$  the mean function evaluated at maximum likelihood estimates, and  $\alpha$  the negative binomial dispersion parameter.

The spatial weighing matrix used in the SLM tests was a row-standardized, first-order contiguity matrix. The weights attributed to counties surrounding county  $j$  were based on the length of the border between county  $i$  and  $j$  relative to the perimeter of county  $j$ . Row-standardization naturally follows this neighborhood configuration.

The assumption that the relationship between location determinants and firm site selection holds over an entire geographical region may not be tenable. Heterogeneity may exist as different slopes or intercepts across the urban-rural continuum. To test this hypothesis, slopes and intercepts were allowed to vary according to the classification of ‘metropolitan’, ‘micropolitan’, and ‘non-core’ (or completely rural) counties (ERS 2003). These categories are based on commuting patterns, population density, and proximity of counties to densely populated, economic ‘urban core’ counties. Although this classification scheme is somewhat arbitrary, it retains some information about inter-county dependencies, wider regional linkages, and the remoteness (or ‘rurality’) of counties. A likelihood ratio test was used to test the null hypothesis that the slope and intercept coefficients of the location determinants were similar in metropolitan, micropolitan, and rural regimes.

Firm high-probability location clusters were estimated using local Moran’s I statistics (LISA, Anselin 1995) to determine if the pattern of predicted location probabilities form agglomeration clusters, or broader, interconnected regions that exhibit greater likelihood of attracting food manufacturing investment relative to other regions (Lambert, McNamara, and Garrett 2006a). Location probabilities for footloose, demand-, supply-oriented, and all firms were calculated as  $\Pr(y_i \geq 1) = 1 - \Pr(y_i = 0) = 1 - (1 + \alpha \mu_i)^{-1/\alpha}$ , where  $\alpha$  is the estimated NB dispersion parameter, and  $\mu_i$  the exponentiated linear predictor at location  $i$ .

## RESULTS AND DISCUSSION

The null hypothesis of no spatial error or lag independence between new food manufacturing growth could not be rejected at the 5% level in any of the models (respectively, Lagrange multiplier [LM] tests for spatial error:  $LM = 0.00004$ ,  $0.48$ , and  $3.01$  for demand, supply, and footloose models, with one degree of freedom), or spatial lag (respectively,  $LM = 0.000001$ ,  $0.13$ , and  $0.06$  for demand, supply, and footloose models, with one degree of freedom). Demand- and supply-oriented, and footloose models were subsequently estimated using ML. If spatial lag or error dependence had been detected, candidate estimation methods of the NB model include conditional autoregressive models for error processes (Schabenberger and Pierce 2002; Rasmussen 2004), or a Bayesian resampling approach (Griffith 2005).

The null hypothesis that the intercepts and slopes of the metro, micro, and rural regimes were not different was rejected at the 1% level (Likelihood ratio test =  $274$ ,  $226$ , and  $185$  for the demand, supply, and footloose models, with 56 degrees of freedom in each model). These results suggest that the effects of location determinants on the site selection decision of food manufacturers are heterogeneous across the geographic area, and that a global interpretation of mean effects may miss important variations in the data set. To attend to the heterogeneity across the spatial regimes, slope and intercept shifters delineating metropolitan, micropolitan, and non-core (rural) counties were retained in each model.

In general, the location models performed quite well (table 3). About 75% of the variation in the data was explained in the demand-oriented location model. The footloose and supply-oriented models explained 64% and 50% of the data, respectively. There is considerable variation between spatial regimes with respect to the significance of the location determinants, conditional on the food manufacturing type. Discussion of the results focuses

on the elasticities of the variables determined significant at the 10% level or lower. The focus of the discussion is on the percent change in the probability of attracting at least one food manufacturer type, given a percent change in a variable. Therefore, elasticities for the  $k$ th

variable,  $j$ th county are calculated as 
$$e_{jk} = \frac{\partial \Pr(y_j \geq 1)}{\partial x_{jk}} \frac{x_{jk}}{y_j} = \left( [1 + \alpha \mu_i]^{-(1+\alpha)/\alpha} \right) \beta_k x_{jk}.$$

#### *Product and input market determinants*

Product markets, as measured by county population and per capita income, are important with respect to attracting all kinds of food manufacturers across the urban-rural continuum (table 4). However, more populated states appear to be less attractive places for supply-oriented food processors. The effect of county-level population appears to be strongest in the non-core, rural counties. Given a 10% change in population, the probability of attracting all food manufacturer types to rural areas increases by about 2.7% (table 4). A similar relationship was determined for non-metropolitan counties adjacent to urban core counties for supply-oriented and footloose food manufacturers. Counties with higher per capita income are more competitive. The magnitude of the association increases, moving away from urban core counties to more rural areas for demand-oriented and footloose firms. In rural counties, given a 10% increase in per capita income, the probability of attracting at least one demand-oriented or footloose food processor increases by about 6%.

Access to input markets appears to be most important for footloose firms across all county types, but the strength of the association is stronger for rural counties. The results are mixed with respect to input endowments. With respect to supply-oriented food processors and per acre agricultural rents, non-metropolitan counties located near urban core counties appear to have a comparative advantage over their rural counterparts. However, rural

counties with relatively more farmland appear to also be attractive for supply-oriented food processors. Given a 10% increase in the amount of farmland, the probability of attracting at least one supply-oriented food processor to a remote area increases by about 3%.

#### *Agglomeration determinants*

Agglomeration due to urbanization economies appears to be important for rural counties with respect to attracting supply-oriented food processors (table 4). A 10% increase in the percent employed in the manufacturing sector was associated with a 1.2% increase in the probability of attracting supply-oriented firms in remote, non-metropolitan areas. In metropolitan counties, the relationship was about one-half the magnitude observed in rural counties.

Agglomeration due to localization economies was important with respect to attracting supply-oriented food processor to micropolitan and rural, non-core counties. Given a 10% increase in the proportion of food manufactures of all business establishments in the county, the likelihood of attracting an additional food manufacturer increased by about 1.2% in micropolitan and rural counties. Localization economies in rural areas appear to be important determinants for footloose food processors, as well.

#### *Infrastructure determinants*

Non-metropolitan counties with relatively larger populations are competitive with respect to attracting demand oriented food manufactures, but larger metropolitan counties appear to have a competitive advantage over other counties with respect to attracting supply-oriented food processors (table 4). Remoteness (as measured by road miles to the nearest metropolitan county) appears to be an important factor with respect to rural county

competitiveness, and attracting demand-oriented and footloose food manufactures. Given a 10% increase in distance away from the urban core, rural counties were about 2% less likely to attract at least one food processor. Access to rivers or adjacency to one of the Great Lakes appears to have no effect on the likelihood of attracting food manufacturing investment.

The presence of a business school or junior college is important with respect to attracting supply-oriented food processors in metropolitan counties, and footloose food manufacturers in metropolitan and rural counties, with a stronger effect in metropolitan counties. On balance, the likelihood of attracting a supply-oriented food processor increased by about 1% in metropolitan counties.

#### *Labor determinants*

Labor availability, as measured by the unemployment rate, is an important consideration for demand- and supply-oriented firms locating in metropolitan counties, and for footloose firms locating in micropolitan counties. Given a 10% increase in available labor, the probability of attracting a supply-oriented(footloose) food processor increased by about 1.3% in urban-core(micropolitan) counties (table 4).

Labor quality was also important for supply-oriented and footloose food manufacturers locating in metropolitan and micropolitan counties, with the association increasing moving from metro- to micropolitan counties (table 4). A 10% increase in the percent of individuals having a high school diploma was associated with an 8-10% increase in the likelihood of attracting supply-oriented or footloose food manufacturers. The relationship between labor quality and attraction of supply-oriented food manufactures was negative in relatively remote non-metropolitan counties, which is consistent with previous

location studies (Lambert, McNamara, and Garrett 2006a). The result suggests that worker skill level may not be as great a concern for supply-oriented food processors considering rural sites. In some food processing operations (for example, poultry, catfish, animal rendering, or meat packing industries), highly skilled workers may not be too important with respect to slaughter and processing.

Micropolitan and rural counties where manufacturing wages were relatively high were at a competitive disadvantage with respect to attracting demand-oriented firms, which is consistent with results of previous location studies (Schmenner, Huber, and Cook 1987; Smith, Deaton, and Kelch 1978) (table 4). But the effect was opposite for demand-oriented firms locating in metropolitan counties. One possible explanation might be that – holding other factors constant – a better workforce may be associated with relatively higher wages. And, on balance, higher wages may also be expected in more densely populated urban centers.

The results were mixed with respect to the importance of a diverse population or potential workforce on the location decision. Metropolitan and remote rural counties with more diverse populations were more likely to attract supply-oriented firms. Demand-oriented food processors were more likely to locate in metropolitan counties with diverse populations, but the effect was negative with respect to demand-oriented firms locating in micropolitan counties. Apparently, micropolitan counties with more homogenous populations are more attractive to demand-oriented food manufacturers.

Rural counties located in states where workforces were relatively more unionized were at a competitive disadvantage with respect to attracting demand-oriented food processors. Given a 10% increase in worker unionization, the probability associated with attracting demand-oriented firms decreased by 2.5%. Unionization also had a negative

impact on the probability of supply-oriented(footloose) firms locating in micropolitan(metropolitan) counties (table 4). Davis and Schluter (2005) found that counties in states with right-to-work laws were less likely to attract food manufacturing investment. They also found that by including an interaction term between unionization and right-to-work, better sense of this counterintuitive finding could be made. A positive interaction effect of unionization and right-to-work laws suggests that unions are potentially productivity-enhancing, but only when they are weakly organized. On the other hand, in states without right-to-work laws, unions may be perceived as impediments to profit-maximization goals. The same results were obtained here, but the strength and importance of the relationships appear to be conditional on the firm type, and the spatial regime. The productivity-enhancing effect was observed in all spatial regimes considering supply-oriented firms, and the effect strengthened moving from the urban-core to more remote places. For footloose firms, the positive union/right-to-work interaction effect was only evident in metropolitan and rural counties. For demand-oriented firms, the interaction effect was not important with respect to site selection.

#### *Fiscal determinant*

Fiscal policy, as measured by per capita property taxes divided by total county expenditures per capita, had a negative effect on the probability of metropolitan counties attracting supply-oriented food manufacturers. In all other cases, fiscal policy does not appear to be an important location determinant because firms may negotiate long term abatements on capital taxes with county governments.

#### *Distribution of location clusters*



Local Indices of Spatial Association were estimated to directly compare the local attributes of counties comprising high-probability clusters with counties not associated with location clusters (figure 1). In all cases, the global Moran's I test was significant at the 1% level and greater than 0.35, indicating a pattern of positive spatial correlation. Low-probability clusters are more frequent across the Northern Great Plains for demand-oriented firms. The low probability pattern across this region is broken up looking at footloose and supply-oriented cluster patterns, which seems to be consistent with input-oriented location objectives. The concentration of high-probability clusters is greatest for demand-oriented firms in the North Eastern states, although there are also significant clustering effects for supply-oriented and footloose firms in this densely populated region of the United States. There is some evidence of positive clustering in the upper Corn Belt region for footloose and supply-oriented food manufacturers. The strong positive probability clustering in Colorado may be due to the location of meat packing or animal rendering operation, and the significant clustering for supply-oriented firms in Louisiana may be due to New Orleans as the gateway to the Mississippi.

Matching estimated high-probability clusters to corresponding counties across an urban-rural continuum produced similar results for footloose, demand-, and supply-oriented firms (figure 2). Most of the high-probability clusters were located in densely populated urban centers. Clusters members associated with all firm types decreased moving outward from the urban core towards non-metropolitan counties. This decreasing trend continues across the range of micropolitan county types, but increases in small micropolitan counties adjacent to metropolitan areas. For non-metropolitan counties in general, the results are clear with respect to population and place. Non-metropolitan counties adjacent to the urban core are more competitive than other non-metropolitan counties with respect to attracting

food manufacturing investment. Non-metropolitan counties with relatively smaller populations appear to be competitive with metropolitan counties when they are located next to urban core areas.

## **CONCLUSIONS**

Local community attributes influence location choices of food manufacturers. Population, a measure of agglomeration due to urbanization economies and product markets, labor quality, and transportation infrastructure are key location determinants for food manufacturing.

Returns on investment may be high for non-metropolitan counties planning to recruit food manufacturers if (i) they are economically linked to metropolitan counties as evidenced by predictable commuting patterns, (ii) they have access to transport infrastructure, (iii) they have a potentially higher-quality workforce, and (iv) they target supply-oriented or footloose firms. Very remote non-metropolitan counties do not appear to be competitive with respect to attracting food manufacturers. All food processor types tend to select plant locations in or around urban areas, or in non-metropolitan counties that provide access to product or input markets, or agglomeration economies. Supply-oriented firms might select non-metropolitan sites that provide access to agricultural inputs, but they might also choose to locate in areas where the workforce is less skilled.

Counties with access to agglomeration economies, product markets, transportation networks, and agricultural resources are better-positioned to use food manufacturing recruitment as an economic development strategy. Non-metropolitan counties not endowed with these factors might consider alternative development strategies. The prospects of attracting manufacturing investment depend on factors that may or may not be directly influenced by specific economic development strategies. Many factors cannot be directly

influenced, but some can be adjusted. Policy makers might investigate public infrastructure financing and its relation with manufacturing activity, or payment in lieu of taxes (PILOT) programs. While it might be difficult to acquire funding for interstate construction, county planners may be able to improve access to highways on a cost-share basis through negotiations with potential investors.

The empirical evidence presented here suggests that a “one size fits all” approach towards development of basic sectors may miss the mark in many cases. While this idea is not new, the methodology presented here is a first step towards measuring heterogeneity due to spatial regimes in food manufacturing site selection in particular, and manufacturing location studies in general. Site selection factors may be more (or less) attractive to potential investors depending on the location of a county within a wider economic region. The importance of location factors may be heterogeneous across space, and inference from global location models may miss important local or regional variation.

The “old development” paradigm of attracting investment from the manufacturing sector may still be viable in some non-metropolitan counties, but an innovative approach to economic development may be preferable in other situations. Rural communities already endowed with a manufacturing base may find that spending scarce development resources on projects geared toward retaining businesses will produce better payoffs in the long-run. Indeed, the ability of a community to retain businesses through economic downturns and recoveries may send a strong signal to potential investors that local conditions are favorable (Barkley, 2001). Such a strategy might entail creating environments conducive to the growth of local service and trade businesses, improvement of social capital infrastructure, and promotion of small business development and entrepreneurship. In other cases, development of agricultural resources for tourism through branding of regional appellations

may be an alternative mechanism to link non-metropolitan communities to urban core economies.

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**Table 1. Firm types, specialization, and North American Industry Classification code (NAICS)**

Firm type	Specialization	NAICS
Demand	Fluid Milk Manufacturing	311511
	Ice Cream and Frozen Dessert Manufacturing	311520
	Retail Bakeries	311811
	Commercial Bakeries	311812
	Dry Pasta Manufacturing	311823
	Tortilla Manufacturing	31183
	Other Snack Food Manufacturing	311919
	Mayonnaise, Dressing, and Other Prepared Sauce Manufacturing	311941
	Soft Drink and Ice Manufacturing	31211
	Breweries	31212
Supply	Flour Milling and Malt Manufacturing	31121
	Sugar Manufacturing	31131
	Frozen Fruit, Juice, and Vegetable Manufacturing	311411
	Fruit and Vegetable Canning, Pickling, and Drying	31142
	Creamery Butter Manufacturing	311512
	Cheese Manufacturing	311513
	Dry, Condensed, and Evaporated Dairy Product Manufacturing	311514
	Animal Slaughtering and Processing	31161
	Seafood Product Preparation and Packaging	3117
	Coffee and Tea Manufacturing	31192
Footloose	Tobacco Manufacturing	3122
	Animal Food Manufacturing	3111
	Breakfast Cereal Manufacturing	31123
	Chocolate and Confectionery Manufacturing from Cacao Beans	31132
	Confectionery Manufacturing from Purchased Chocolate	31133
	Nonchocolate Confectionery Manufacturing	31134
	Frozen Specialty Food Manufacturing	311412
	Frozen Cakes, Pies, and Other Pastries Manufacturing	311813
	Cookie and Cracker Manufacturing	311821
	Flour Mixes and Dough Manufacturing from Purchased Flour	311822
	Roasted Nuts and Peanut Butter Manufacturing	311911
	Flavoring Syrup and Concentrate Manufacturing	31193
	Spice and Extract Manufacturing	311942
	All Other Food Manufacturing	31199
	Wineries	31213
	Distilleries	31214

Source: Connor and Schiek (1997), and US Census.

**Table 2. Means (standard error) of location determinants and new plant sites**

Variable	Description	Units	----Metro----		----Micro----		----Rural----	
AGRI	Crop and livestock receipts, 2000 1/	\$/ac	493.95	21.65	312.13	12.36	235.66	8.64
POP	Population, 2000 2/	10,000s	21.58	1.47	4.29	0.11	1.46	0.03
POPTOT	State population, 2000 2/	10,000s	874.26	22.40	722.68	24.11	648.12	17.65
FMLND	County farmland percent, 2000 3/	Percent	42.5%	0.9%	53.7%	1.2%	58.2%	0.9%
LAND	County size 4/	Sq. mi./1000	0.83	0.04	1.06	0.06	1.04	0.03
UNEM	Percent unemployed, 2000 2/	Percent	5.5%	0.1%	6.1%	0.1%	6.1%	0.1%
HS00	High school diplomas, 2000 2/	Percent	80.1%	0.2%	77.2%	0.3%	75.2%	0.2%
PCI	Per capita income, 2000 2/	10,000s \$/person	2.59	0.02	2.22	0.02	2.04	0.01
UNION	Percent workers in unions, 1999 2/	Percent	15.13%	0.24%	15.28%	0.31%	14.87%	0.20%
RTW	Right to work, 1999 2/	1 = yes	49.3%	1.5%	50.2%	1.9%	59.0%	1.3%
WAGE	Manuf. wage, 2000 1/	10,000s \$	3.42	0.04	3.01	0.23	3.07	0.77
MFGS	Food. manuf. estab./all estab., 2000 2/	Percent	0.44%	0.02%	0.48%	0.02%	0.56%	0.02%
MEMP	% employed in manuf., 2000 2/	Percent	12.7%	0.2%	15.1%	0.4%	12.2%	0.2%
EDUC	Technical school, junior college, 2000 2/	1 = yes	66.9%	1.5%	47.1%	1.9%	14.4%	1.0%
INTER	Interstate 4/	1 = yes	67.9%	1.4%	43.2%	1.9%	27.0%	1.2%
RIVER	River, Great Lake 4/	1 = yes	38.0%	1.5%	32.3%	1.8%	28.5%	1.2%
FISC	Property tax/total expenditures, 2000 2/	Ratio	0.31	0.01	0.32	0.01	0.36	0.01
DIST	Distance to nearest metro area	Miles	0.00	.	53.02	1.50	71.05	1.35
SOCIO	Social diversity index 2000 2/	Index (between 0 and 1)	0.29	0.01	0.25	0.01	0.21	0.005
Demand	New plant locations, 2000-2004 /2	Count	6.05	0.67	0.96	0.05	0.35	0.02
Supply	New plant locations, 2000-2004 /2	Count	1.75	0.14	0.64	0.05	0.36	0.02
Footloose	New plant locations, 2000-2004 /2	Count	3.22	0.30	0.81	0.05	0.36	0.02

Sources: 1/ Bureau of Economic Analysis; 2/ US Census Bureau; 3/ Ag. Census, 2000; 4/; ESRI ArcView data files.

**Table 3. Negative binomial regression results for metropolitan (Metro), non-metropolitan (Micro), and rural location determinants**

Variable	Demand-Oriented			Supply-Oriented			FOOTLOOSE		
	<u>Metro</u>	<u>Micro</u>	<u>Rural</u>	<u>Metro</u>	<u>Micro</u>	<u>Rural</u>	<u>Metro</u>	<u>Micro</u>	<u>Rural</u>
	( a )	( b )	( c )	( a )	( b )	( c )	( a )	( b )	( c )
Intercept	-1.706	-1.307	-2.069** b	-3.090*	-3.509*	-2.451*	-2.975*	-4.673*	-2.577*
AGRI	6.E-05 b	3.E-04* ac	-2.E-05 ab	9.E-05** b	0.001* a	2.E-04	9.E-05* b	4.E-04* ac	4.E-04* b
POP	0.013* bc	0.118* ac	0.334*	0.006* bc	0.131* ac	0.299* ab	0.006* bc	0.132* ac	0.321* ab
POPTOT	-2.E-05	5.E-05	6.E-05	-1.E-04**	-1.E-04	-2.E-04*	1.E-04	1.E-04	8.E-05
%FRMLND	-0.278	-0.304	-0.497**	0.365** b	1.326 a	0.740*	-0.097	0.505	0.156
LAND	0.017	0.069**	0.098**	0.053* b	-0.056 a	0.047	-0.014	0.002	-0.028
UNEM	0.036** b	-0.018 a	-0.007	0.072* c	0.022	-0.009 a	-0.015	0.049**	-0.012
HS00	0.114	-0.394	0.099	1.443	1.987	-0.321	1.680**	2.944*	0.565
PCI	0.335*	0.560*	0.503*	0.191*	0.187	0.356*	0.467*	0.365*	0.467**
UNION	-0.346	-1.057	-2.491**	-0.811	-2.022**	-1.923	-1.831*	-1.992	-2.285
RTW	-0.027	-0.247	-0.482** a	-0.339** b	-0.982* a	-0.539**	-1.149*	-0.400	-1.028*
RTWXUN	-0.659 c	0.144	2.598	2.132**	3.267**	3.157**	4.508*	2.396	4.678*
MWAGE	0.042	-0.024	-0.004	0.003	-0.003	-0.007	-0.058 bc	-0.008 a	-0.027 a
MFGS	-1.576	25.340*	22.921* a	6.276 b	53.578* ac	37.020* b	4.829 b	46.467* a	31.792*
MEMPL	-0.333 bc	-0.022 a	0.488	1.453* bc	-0.268	1.525* a	2.233*	-0.506	-0.115
EDUC	1.201	0.113	0.104 b	0.664*	-0.067	-0.041	1.012*	0.192 c	0.268** b
RIVER	0.072	-0.033 c	0.032 a	0.060	0.001	-0.015	0.100 bc	0.033 a	-0.092 a
FISC	0.027 bc	0.180 a	0.370	-0.422* bc	0.132	-0.037 ab	-0.052	-0.052	0.133
ROADDIST	.	0.001	-0.004*	.	-2.E-04	-0.002	.	-0.001	-0.004**
SOCDIV	1.083*	-0.849**	-0.856	1.810*	-0.476	0.774*	1.796*	0.223	0.341
Dispersion		0.436**			0.352**			0.414**	
Log likelihood (R <sup>2</sup> )		-3,857 (0.75)			-3,119 (0.50)			-3,507 (0.64)	

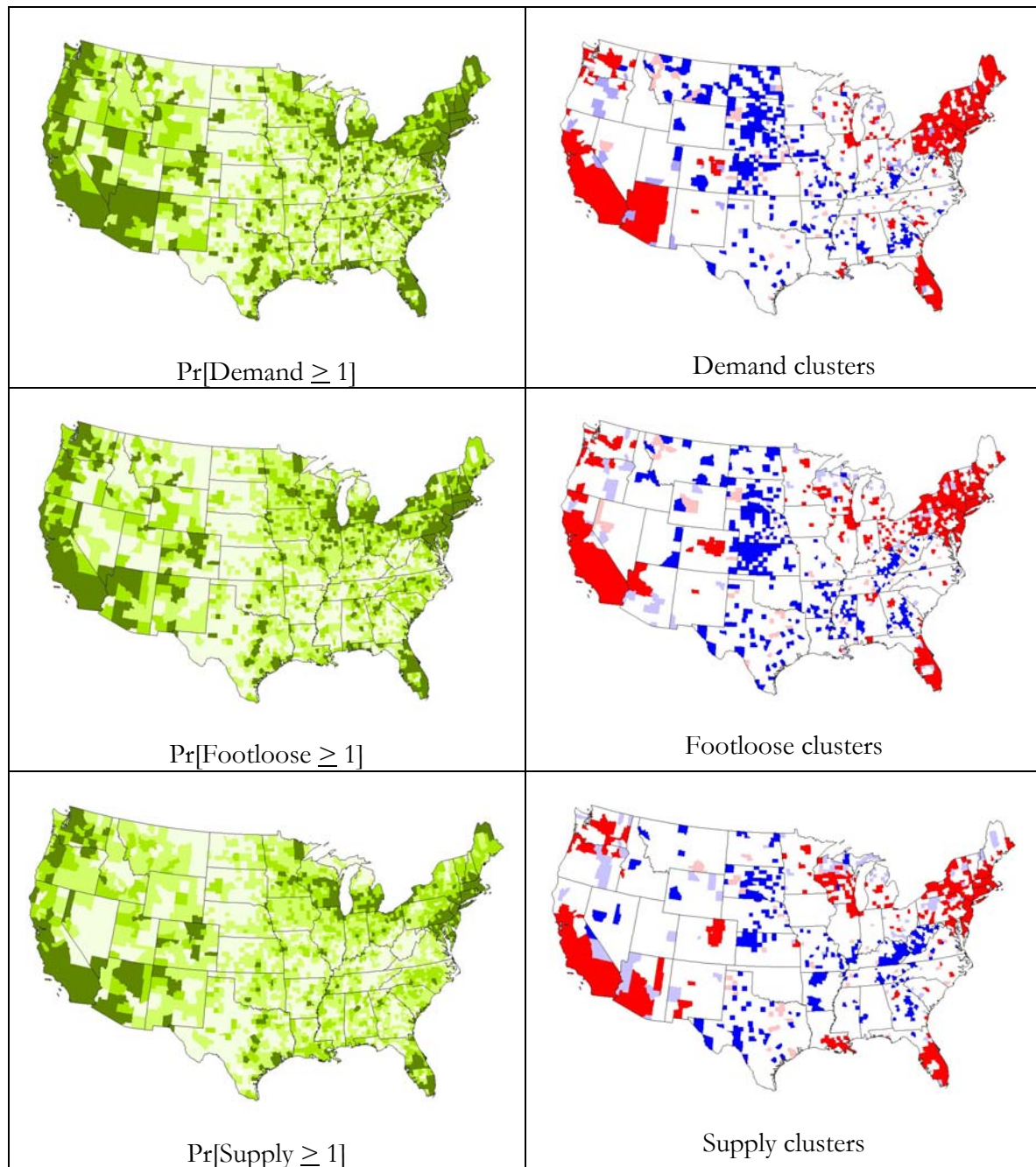
Notes: \*, \*\* significant at the 5% and 10% levels, respectively. Letters a, b, and c indicate significant column differences within hashed lines based on pairwise t-test at a 90 percent confidence level or higher. R<sup>2</sup> is based on Cameron and Windmeijer's (1996) deviance measure. Regional controls are not presented, but available on request. Source: authors' estimates.

**Table 4. Elasticities for the probability of attracting at least one food manufacturing plant**

<u>Variable</u>	Demand-oriented food manufacturers			Supply-oriented food manufacturers			Footloose food manufacturers		
	<u>Metro</u>	<u>Micro</u>	<u>Rural</u>	<u>Metro</u>	<u>Micro</u>	<u>Rural</u>	<u>Metro</u>	<u>Micro</u>	<u>Rural</u>
AGRI	.	0.031	.	0.010	0.079	.	0.008	0.050	0.049
POP	0.013	0.157	0.286	0.017	0.260	0.264	0.010	0.210	0.273
POPTOT	.	.	.	-0.029	.	-0.092	.	.	.
%FRMLND	.	.	-0.200	0.055	.	0.287	.	.	.
LAND	.	0.024	0.065	0.011	.	.	.	.	.
UNEM	0.043	.	.	0.127	.	.	.	0.138	.
HS00	.	.	.	0.375	0.805	-0.161	0.356	1.015	.
PCI	0.161	0.464	0.677	0.149	.	0.482	0.287	0.355	0.625
UNION	.	.	-0.247	.	-0.160	.	-0.073	.	.
RTW	.	.	-0.200	-0.066	-0.288	-0.222	-0.209	.	-0.436
RTWXUN	.	.	.	0.044	0.102	0.155	0.088	.	0.235
MWAGE	0.024	-0.030	-0.010	.	.	.	.	.	.
MFGS	.	0.045	0.080	.	0.118	0.120	.	0.092	0.106
MEMPL	.	.	.	0.062	.	0.120	0.081	.	.
EDUC	.	.	.	0.097	.	.	0.087	.	0.019
FISC	.	.	.	-0.046	.	.	.	.	.
ROADDIST	.	.	-0.195	.	.	.	.	.	-0.201
SOCDIV	0.053	-0.083	.	0.139	.	0.110	.	.	.

Notes: The reported elasticities are based on coefficients significant at the 10% level in Table 3.

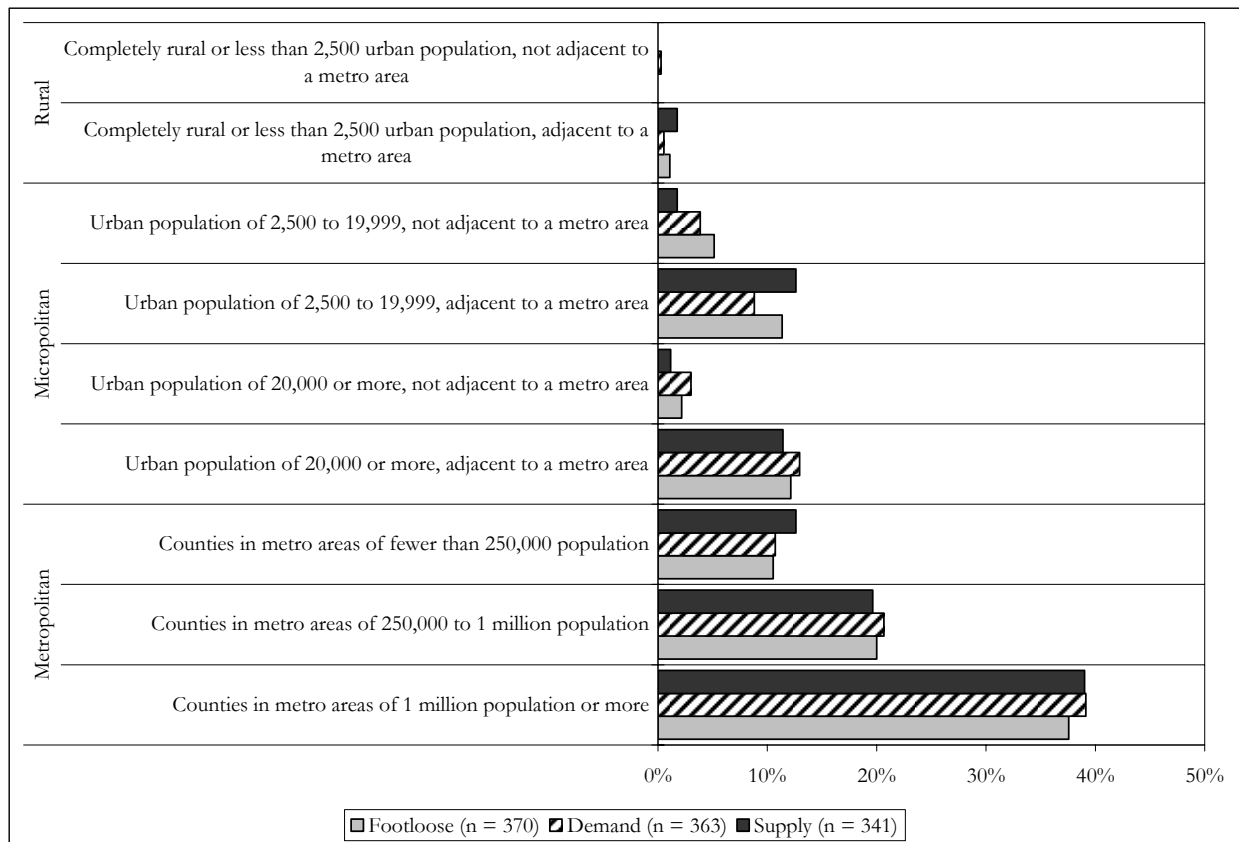
Source: authors' estimates.



**Figure 1. Predicted location probabilities and Local Indices of Spatial Association (LISA)**

#### probability clusters

Key: The probabilities are visualized as quantiles, with the lightest shade containing low probability counties (0-25%), and the darkest shade representing the highest probability quantile (75-100%). Red clusters are regions of counties where location probabilities are high. Blue regions are clusters where location probabilities are low. Clusters are significant at the 10% level. Pseudo-probabilities were determined using a Monte Carlo permutation test. Source: authors' estimates.



**Figure 2. Distribution of demand-, supply-, and footloose firm clusters across an urban-rural continuum**

Source: authors' estimates.