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The Location of Food Manufacturing Plant Investments in Corn Belt Counties

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Capturing value-added activity is often promoted as a rural development strategy, but this is difficult for specific communities lacking the resources to support food manufacturing activity. This study analyzes the relationship between local attributes and food manufacturing plant investments in Corn Belt counties between 1987 and 1995. Plant investment locations tend to occur in counties with access to input and product markets, developed transportation networks, agglomeration economies, favorable fiscal policies, and a low wage environment. Supply-oriented firms locate near agricultural commodities and low-cost labor. Demand-oriented firms favor locations near product markets and transportation systems.

Key words: Corn Belt, food manufacturing, negative binomial models, plant investment location

Introduction

The "new generation cooperative" is the latest instrument designed to capture the value-added activity associated with commodity processing as a means of stimulating rural economic growth in communities that have been unable to attract other investment (Harris, Stefanson, and Fulton). Food manufacturers are more likely to locate in rural areas than other manufacturers (Testa). Recruiting food manufacturing is often touted as a rural development strategy because the value-added activity can increase farm incomes through backward linkages to agricultural production with increased commodity demand, in addition to employment opportunities they provide (Capps, Fuller, and Nichols; Kane and McNamara). If cooperatives can help rural areas capture the manufacturing activity, they will strengthen the rural economy.

While attracting a food manufacturer can stimulate local income and employment growth, it can be difficult for communities to secure external investment. Communities wishing to promote development through support of either investor-owned manufacturers or new generation cooperatives should understand the risks associated with a successful plant location. Benirschka and Binkley warn producers in areas far from markets about assessing investment risk. Understanding the county characteristics associated with food manufacturing investments provides insight into the risks local officials and producer/investors could face with their respective investments.

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Studies analyzing growth in the food manufacturing sector suggest rural communities should be cautious about investing in food manufacturing. For example, Goetz investigated the relationship between state and county characteristics and the net growth in food manufacturing establishments at the three-digit Standard Industrial Classification (SIC) level for the entire U.S. However, consistent findings failed to emerge at the county level based on empirical results across the nine SIC industry categories. Henderson and McNamara analyzed net growth of food manufacturing establishments for U.S. Corn Belt counties. Incorporated in their conceptual model was the notion that supply and demand characteristics of food processors influence location decisions.[1] Their findings indicate that supply-oriented industry establishment growth was influenced by county-level supply characteristics, while demand-oriented industries were influenced by demand characteristics.

The objective of this study is to identify local characteristics influencing the location of new food manufacturing plant investments. Past literature has examined the net growth in food manufacturing establishments, which includes plant closings along with plant openings. Results from such studies may not provide insight into food manufacturing plant attractions, as plant closings may dominate the net growth data. A focus on analysis of new plant investments avoids this potential problem.

The remainder of the article proceeds as follows. First, we provide an overview of past literature addressing agribusiness plant locations and the growth in the food manufacturing sector. The conceptual model incorporating location theory used to analyze the location of food manufacturing plant investments is then presented, followed by a description of the data and a discussion of the results. Conclusions of our study are reported in the final section.

Review of Literature

During the past century, the United States food manufacturing industry followed U.S. population expansions to the West and Southwest (Connor and Schiek). This geographic redistribution of the food manufacturing industry has been influenced by materials, market, technology, and policy considerations (Capps, Fuller, and Nichols). However, these factors have not impacted the concentration and distribution of the food manufacturing industry uniformly. Examination of the cost structure of food processing firms suggests the geographic location of food manufacturing establishments is related to firms' cost structure. Location choices are driven by a firm's dominant cost, if any (Connor and Schiek).

Connor and Schiek group food manufacturers into three categories—supply-oriented, demand-oriented, and footloose—according to the firms' cost structure (see table 1 for illustrations of firms falling under these categories). Supply-oriented firms are characterized by agricultural inputs accounting for a high share of production costs. These firms locate near inputs to reduce procurement costs, ceteris paribus. Fruit and vegetable processors, corn and soybean processors, as well as firms requiring highly perishable inputs before processing (such as seafood), are examples of supply-oriented firms.

[1] The food manufacturing industry was separated into three categories: supply-oriented, demand-oriented, and footloose—according to the sector's supply and demand characteristics.

Table 1. Examples of Food Manufacturing Industries Categorized by Three Locational Types

Supply-Oriented Firms	Demand-Oriented Firms	Footloose Firms
Soybean Oil	Soft Drink Bottling	Canned Specialties
Meat Packing	Fluid Milk	Frozen Specialties
Cheese	Animal Feeds	Breakfast Cereals
Butter	Bread and Rolls	Flour Mixes and Doughs
Cottonseed Oil	Ice Cream	Pet Foods
Cane Sugar	Manufactured Ice	Cookies and Crackers
Flour Milling	Pasta	Frozen Baked Goods
Rice Milling	Cooking Oils and Margarine	Sugar Confectionery
Meat Processing	Potato Chips and Snacks	Chocolate Confectionery
Frozen Seafood	Pickles and Sauces	Nuts and Seeds
Poultry	Beer	Wines and Brandy
Beet Sugar		Distilled Spirits
Coffee		Flavorings
Rendering		Miscellaneous Foods
Canned Seafood		
Processed Milk		
Wet Corn Milling		
Canned Fruits and Vegetables		
Dried Fruits and Vegetables		
Frozen Fruits and Vegetables		
Other Vegetable Oils		
Malt		

Source: Table adapted from Connor and Schiek (1997, Table 6-3).

Demand-oriented firms are those for which distribution costs account for a large share of production costs. Locations of these firms' establishments are sensitive to the proximity of household demand. Thus their plants are situated near population centers to decrease distribution costs. Manufacturers of beer, soft drinks, and other watery products, as well as highly perishable products (e.g., fluid milk), are examples of demand-oriented firms.

Footloose food manufacturing firms do not have dominant procurement or distribution costs.[2] Neither procurement nor distribution costs dominate production costs. Footloose food manufacturers commonly produce multiple products, such as cookies/crackers and frozen specialties, rather than a single product. Locations are chosen to gain access to labor, capital, business services, transportation, and technology while meeting procurement/distribution requirements of the firm.

Lopez and Henderson studied the location decisions of 56 single-establishment, small food processing firms in Mid-Atlantic states that were involved in processing vegetables, fruits, eggs, poultry, and/or seafood. Plant location decisions were found to be similar to the decisions of other manufacturing industries, i.e., input supply, product markets, infrastructure, labor, and environmental regulations influence site selection. However, firms in their study were generally restricted to locations within commuting distance of the owner's residence.

[2] It is likely that manufacturing costs (narrowly defined) are high relative to either procurement or distribution costs for the footloose firm category.

Leistritz surveyed agribusiness firms in Nebraska, North Dakota, and South Dakota to acquire information about the firms' location decisions and local economic impacts. Access to factor markets and water influenced the location decisions of agribusiness firms. However, variation in the attributes influencing location decisions by type of firm led Leistritz to suggest that communities target development policies for specific firms rather than for a sector to enhance plant attraction.

Vesecky and Lins surveyed 868 agribusiness firms in Illinois to assess the factors influencing their location and expansion decisions. They found that transportation, infrastructure, proximity to existing facilities, labor, and access to demand markets influenced location and expansion decisions. Contrary to other manufacturing survey studies, fiscal policies had little direct influence on location decisions. Survey respondents reported that state development incentives were largely ineffective and, further, that such incentives even hindered expansion.

While the above survey studies found that food manufacturing firms consider several factors in their plant location decisions, these investigations did not measure the relative importance of various location attributes on location decisions. Econometric models of location decisions provide a measure of relative importance rather than subjective measures obtained from survey techniques (Barkley and McNamara 1994b).

As briefly noted in the previous section, two recent studies (Goetz; and Henderson and McNamara) analyzed food manufacturing industry growth using econometric models. Goetz estimated county and state growth models for food manufacturing firms at the three-digit SIC level for the U.S. Findings of his study suggested that food manufacturing establishment growth is similar to that of other manufacturing industries. Results of the state-level analysis showed that transportation, labor, and infrastructure factors influence food manufacturing establishment growth. However, results for county-level models failed to provide consistent insight into food manufacturing growth across the nine three-digit SIC code categories. For example, of the eight models which found population to be significant, three models indicated a positive relationship and five models a negative relationship.

Henderson and McNamara examined location factors associated with county-level growth in food manufacturing establishments in the U.S. Corn Belt counties. Following Connor and Schiek, establishments were classified as "supply-oriented," "demand-oriented," and "footloose" (refer to table 1) to test if the impact of factor markets or product markets on location decisions differed for each food manufacturer type. Henderson and McNamara found that food manufacturing establishment growth was influenced by factors similar to those reported for other manufacturers: urban/suburban location, access to business service, and the presence of a manufacturing base were important location considerations. Input and product markets were also found to influence the growth of supply-oriented and demand-oriented food manufacturers, respectively.

Food manufacturing industry growth studies provide insight into the factors influencing the net growth of food manufacturing plants. However, an implicit assumption of net growth analysis is that the factors influencing exit and entry decisions are similar, which may not generally hold true. As shown in table 2, between 1987 and 1995, 533 food manufacturing plant investments that added 50 or more jobs, added 20,000 square feet of production space, or represented $1 million or more in capital investment were situated in Corn Belt states. Yet the Corn Belt experienced a net loss of 73 food manufacturing establishments employing 50 or more persons. Also, net growth in the

Table 2. Number of Food Manufacturing Plant Investments and Counties Receiving Investments, by Corn Belt State (1987–1995)

		NO. OF FOOD MANUFACTURING PLANT INVESTMENTS					NO. OF COUNTIES RECEIVING FOOD MANUFACTURING INVESTMENTS			
		Food Manufacturing Firm Type					Food Manufacturing Firm Type			
Corn Belt State	Total No. of Counties in State	Supply-Oriented	Demand-Oriented	Footloose	Total Firms	Net Establishment Growth[a]	Supply-Oriented	Demand-Oriented	Footloose	Total Counties Represented[b]
IA	99	26	10	11	47	7	23	8	8	31
IL	102	20	12	27	59	-6	16	11	14	30
IN	92	19	18	10	47	-25	12	11	8	23
KS	105	13	5	9	27	-8	8	3	5	14
MI	84	5	8	7	20	-18	6	8	6	14
MN	87	15	3	9	27	10	10	4	6	17
MO	114	33	16	20	69	-3	23	13	15	31
NE	93	53	19	13	85	-4	18	10	7	21
OH	88	31	29	44	104	-33	18	19	19	33
WI	72	24	9	15	48	7	16	5	11	22
Totals:	936	239	129	165	533	-73	150	92	99	236

Source: *Site Selection Handbook* (Conway Data, Inc., 1987–96 February issues).

[a] Data in this column denote the change in number of establishments with 50 or more employees (*County Business Patterns*, U.S. Department of Commerce, Bureau of the Census).

[b] Note: Because many counties had multiple investments, totals in this column do not represent sums across rows.

number of establishments does not account for expansions at existing plants. Past research provides limited insight into factors that influence the location decisions of plant investment. Thus the focus of our analysis is to specifically address this issue.

The Conceptual Model

Location theory was used as a framework to analyze the location decisions of manufacturing plant investments (Smith, Deaton, and Kelch; Carlton; Schmenner, Huber, and Cook; Bartik 1985, 1989; McNamara, Kriesel, and Deaton; Kriesel and McNamara; Coughlin, Terza, and Arromdee; Woodward). Location theory assumes that firm managers select plant sites to maximize profits (Allen and Stone; Alonso; McNamara, Kriesel, and Deaton; Schmenner, Huber, and Cook; Woodward). Consequently, managers base the location decision upon the plant's expected cost structure.

The plant location decision was modeled in this study as a two-stage process (following Schmenner, Huber, and Cook; Woodward; and Bartik 1985, 1989). In the first stage, the firm identifies a general region for investment based upon a broad set of company objectives—the acquisition of raw materials, the entrance into product markets, or increased market share. Once the region is identified, the firm searches for a minimum cost site within the region (Kriesel and McNamara). During the second stage, firms are hypothesized to evaluate available sites on the basis of local attributes. Given the desire to identify characteristics which make communities attractive location sites, and given that local attributes influence the site selection in the second stage of the decision process, we examine only the second-stage decision here.

Attributes that influence the second-stage decision can be grouped into market, labor, infrastructure, agglomeration, and fiscal policy categories. Firms compare these attributes across available sites to identify the minimum cost site. The two stages are assumed to be independent of each other, although location choices in the second stage are limited to the region selected in the first stage.

The mathematical representation of this second stage is specified as follows:

$$FP_i = f(\mathbf{M}, \mathbf{L}, \mathbf{I}, \mathbf{A}, \mathbf{Q}, \mathbf{F}), \tag{1}$$

where FP_i is the level of food manufacturing investment in county i, $\mathbf{M}$ is a vector of market factors, $\mathbf{L}$ is a vector of labor market characteristics, $\mathbf{I}$ is a vector of infrastructure available, $\mathbf{A}$ is a vector of agglomeration economies, $\mathbf{Q}$ is a vector of quality of life, and $\mathbf{F}$ is a vector of fiscal policies.

Model Specification and Data

The dependent variable in the food manufacturing industry location decision was the number of food manufacturing plant investments that were located in a Corn Belt county over the 1987–95 period. The Corn Belt region was identified as the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, and Wisconsin.[3] New food manufacturing investment locations were identified as firms with

[3] The classification of the Corn Belt was based upon the U.S. Department of Agriculture (USDA) regions used for the *1987 Census of Agriculture*. Analysis was limited to these regions to provide a consistent commodity base in terms of the farm products produced.

a Standard Industrial Classification (SIC) code falling under major group no. 20, "food and kindred products." Data on investment locations were obtained from 1987–96 annual February issues of the *Site Selection Handbook* (Conway Data, Inc.), which identified new manufacturing investments that either led to 50 new jobs, represented $1 million or more in capital investment, or created a minimum of 20,000 additional square feet of production floor space.[4] The identification of major product allowed investments to be classified into Connor and Schiek's supply-oriented, demand-oriented, and footloose groups, as defined earlier.

The *Site Selection Handbook* identified 533 food manufacturing plant investments in the Corn Belt between 1987 and 1995 (table 2). Ohio had the largest number of new food manufacturing plant investments at 104, followed by Nebraska with 85 investments. States with the lowest numbers of food manufacturing plant investments during this period were Michigan (20), Minnesota (27), and Kansas (27). Of the 936 counties comprising the Corn Belt states, food manufacturing investments were located in 236 (or approximately 25%). Single investments could be found in 124 counties, and 112 counties had multiple investments. Of these 112 multiple-investment counties, 20 had more than five plant investments.

As seen by the table 2 totals, supply-oriented investments were located in 150 counties, demand-oriented investments in 92 counties, and footloose investments in 99 counties. Although not detailed in the table 2 data, Douglas County, Nebraska, reported the largest number of supply-oriented plant investments; Marion County, Indiana, reported the largest number of demand-oriented plant investments; and Hamilton County, Ohio, reported the largest number of footloose manufacturing plant investments.

The ability to group food manufacturing investments into supply-oriented, demand-oriented, and footloose categories allowed estimation of four different models. First, a model analyzing the location decisions of all food manufacturers was estimated. Second, three models were estimated to account for each of the different types of food manufacturers—supply-oriented, demand-oriented, and footloose food manufacturing plant locations, respectively. The models by food manufacturer type were estimated to determine if location decisions differed among food processing types.

Data for the independent variables were obtained from various sources. Variable names, definitions, summary statistics, and sources are presented in table 3. Descriptions of variables and a discussion of model specification are given below. Independent variables were measured as close to the beginning of the 1987–95 time period as possible in order to evaluate the information available during the decision process.

Markets

Market factors can be grouped into two types: input and product markets. Food manufacturing firms enter input markets to acquire production inputs with the goal of minimizing procurement costs. In the food manufacturing industry, input markets are especially important for supply-oriented firms. Since input costs dominate a supply-oriented firm's total production costs, these firms are highly sensitive to the access to input markets. The total value of crops (*VCROP*) and livestock (*VSTOCK*) produced in

[4] The criteria of 50 new jobs, $1 million in investment, or 20,000 square feet of production floor space were used in the *Site Selection Handbook* (Conway Data, Inc.) to determine the actual investments reported.

Table 3. Variable Definitions, Summary Statistics, and Sources

Variables	Mean	Std. Dev.	Definition	Source
DEPENDENT VARIABLES:				
All Firms	0.57	1.59	All food manufacturing locations	[1]
Supply-Oriented Firms	0.26	0.81	Supply-oriented food manufacturing locations	[1]
Demand-Oriented Firms	0.14	0.52	Demand-oriented food manufacturing locations	[1]
Footloose Firms	0.18	0.67	Footloose food manufacturing locations	[1]
INDEPENDENT VARIABLES:				
Markets:				
VCROP	29.33	24.97	Value of crops produced in the county, 1992 ($ mil.)	[2]
VSTOCK	36.65	43.68	Value of livestock produced in the county, 1992 ($ mil.)	[2]
PCI87	13.16	2.24	County per capita income, 1987 ($000)	[2]
DISTMSA	36.95	53.79	Distance to nearest metropolitan statistical area (miles)	[3]
Labor:[a]				
WAGE	27.82	6.88	Annual manufacturing earnings, 1987 ($000)	[4]
UNEMP	15.91	34.66	Unemployed people, 1987 (000s)	[5]
CZGRAD90	0.37	0.04	% of population 25 years of age or greater with high school diploma or equivalent, 1990	[6]
Infrastructure:				
TRANSP	0.10	0.11	Density of interstates and principal arteries, 1992 (miles/square mile)	[7]
FARM	277.6	209.9	Farmland, 1987 (000 acres)	[2]
Agglomeration:				
ESTAB	5.93	18.05	Existing food manufacturing establishments, 1987	[8]
NODE	0.25	0.43	County identified as a regional economic center	[9]
Fiscal Policies:				
GOVRATIO	3.49	1.34	Ratio of per capita property tax to per capita local government expenditure, 1987	[2]
CAP86	92.22	5.28	State tax capacity, 1986 (index)	[10]
EFF86	103.6	13.35	State tax effort, 1986 (index)	[10]

[a] Region of measure is commuting zone, identified from the Louisiana Population Data Center's public use microdata sample (PUMS) (online at http://lapop.lsu.edu/ftp.html).

Sources:

[1] *Site Selection Handbook* (Conway Data, Inc.)
[2] *U.S. Counties 96*, CD-ROM (U.S. Department of Commerce, Bureau of the Census)
[3] Rand McNally Road Atlas
[4] Regional Economic Information System (REIS) database (U.S. Department of Commerce, Bureau of Economic Analysis)
[5] U.S. Department of Labor, Bureau of Labor Statistics (online at www.bls.gov/datahome.htm)
[6] *U.S. Census of the Population, 1990* (U.S. Department of Commerce, Bureau of the Census)
[7] U.S. Department of Transportation, "County Road Mileage–1992"
[8] *County Business Patterns* (U.S. Department of Commerce, Bureau of the Census)
[9] U.S. Department of Commerce, Bureau of Economic Analysis (online at www.bea.doc.gov/bea/regional/articles/0295rea/maintext.html)
[10] Advisory Commission on Intergovernmental Relations (ACIR)

a county were used to identify input market access. These measures (used by Goetz in his earlier study) captured the size of agricultural production in a county.

Food manufacturers enter product markets to distribute final products with the goal of minimizing distribution costs. Providing access to these markets at the lowest cost enhances the ability to attract a firm (Fox and Murray; Coughlin, Terza, and Arromdee).

Geographic areas with higher income and wealth levels should have greater demand for food products (Coughlin, Terza, and Arromdee). Per capita income in 1987 (*PCI87*) was used to measure market demand.[5] In addition to market demand, per capita income has also been used as a proxy for quality of life (O'Huallachain and Satterthwaite). The distance from a county to the nearest metropolitan statistical area (*DISTMSA*) was used to measure proximity and access to demand markets. Closer proximity to a metropolitan area provides greater access to demand markets for food manufacturers. Product markets should be relatively more important for demand-oriented firms that are highly sensitive to distribution costs and access to product markets.

Labor

As reported by previous studies, characteristics of the labor force play an important role in plant location decisions (Schmenner, Huber, and Cook; Smith, Deaton, and Kelch; McNamara, Kriesel, and Deaton). Potential sites with lower labor costs have a competitive advantage over sites with higher labor costs. Past research on manufacturing locations found wages to be negatively related to plant attractions (Coughlin, Terza, and Arromdee; Barkley and McNamara 1994a). *WAGE* is the annual earning of manufacturing labor in 1987.

The availability and skill level of the labor force might also influence the location decision. Food manufacturers were expected to favor counties with an available workforce. *UNEMP*, the number of unemployed people in 1987, measures labor availability. Similar measures were used by Barkley and McNamara (1994a); Coughlin, Terza, and Arromdee; and Plaut and Pluta. Education levels measuring labor quality were found to influence a firm's location decision (Barkley and McNamara 1994a; Bartik 1989; McNamara, Kriesel, and Deaton). The variable *CZGRAD90* represents the percentage of population 25 years of age or older with a high school diploma or equivalent in 1990.

The labor market measures (*WAGE*, *UNEMP*, and *CZGRAD90*) were derived for the commuting zone since many manufacturing firms employ workers from neighboring counties.[6] Low wage levels, high labor availability, and high skill levels are expected to enhance a county's probability of attracting a food manufacturing investment.

Infrastructure

Infrastructure is the set of fixed real assets that support household and business activities. Infrastructure includes transportation systems and land availability. Transportation infrastructure provides access to product and factor markets and encourages plant locations (Smith, Deaton, and Kelch; Bartik 1989). Transportation system access was measured by the miles of interstate and primary arterial roads per county land area (*TRANSP*). Based on past research, manufacturers have been found to locate in areas

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[5] A gravity-weighted income measure (Goetz) or a measure derived by dividing total income by the industry level of employment (O'Huallachain and Satterthwaite) may be the most appropriate income proxy to measure access to product markets. However, disclosure problems for food manufacturing employment in certain counties limit the development of these measures. Due to the strong correlation between total income and *NODE*, the per capita income measure is used as a proxy for access to product markets, following Coughlin, Terza, and Arromdee.

[6] Commuting zones are groups of counties with strong commuting ties identified by analyzing county-to-county flows in a hierarchical clustering algorithm. Data are available from the Louisiana Population Data Center (online at http://lapop.lsu.edu/ftp.html).

providing access to interstates (Woodward; Barkley and McNamara 1994a; Smith, Deaton, and Kelch).

Availability of land provides potential sites for expansion. Measures of land availability have been found to influence plant attractions and investments (Woodward; Bartik 1985, 1989). The square miles of farmland in the county (*FARM*) was used to measure undeveloped land availability. Infrastructure, in general, is expected to increase a county's attractiveness as an investment site.

Agglomeration

Since firms are assumed to base location choices on profit maximization, forces that reduce information costs are hypothesized to support growth. Agglomeration forces represent one set of factors that can influence information costs. The potential to capture information spillovers from agglomeration may influence the location decisions of plant investments.

Agglomeration economies are commonly grouped into two broad categories (Henderson, Kuncoro, and Turner). One, the presence of firms in the same industry, allows for easier communication and the potential for enhanced information spillovers about market conditions. These spillovers lead to localization economies in which industries tend to congregate in a specific region (Ellison and Glaeser; Henderson, Kuncoro, and Turner; O'Huallachain and Satterthwaite). Localization benefits may also arise from the natural advantages certain regions possess for a given industry (Ellison and Glaeser). The variable *ESTAB* is the number of food manufacturing establishments in the county in 1987, and measures the localization of the food manufacturing industry.

The second type of agglomeration benefits arise from the general size and diversity of an urban area (Henderson, Kuncoro, and Turner). Areas with larger sized economies and more diversity may lead to the establishment of a larger store of information and historical knowledge. Businesses that locate in these areas may be able to capture information spillovers from these urbanization economies. Urbanized economies also provide better access to infrastructure business services, such as financial institutions and commercial services, leading to lower average costs of production (Barkley, Henry, and Bao; Henry, Barkley, and Bao; O'Huallachain and Satterthwaite). A dummy variable (*NODE*), denoting counties that are economic nodes, was used to identify regional economic centers providing urbanization benefits (Henry, Barkley, and Bao; Barkley, Henry, and Bao). The U.S. Bureau of Economic Analysis defines economic nodes as "metropolitan centers or similar areas that serve as centers of economic activity." *NODE* also could indicate and detect access to market demand, as economic nodes possess a larger body of business and personal consumers. Agglomeration benefits, in general, are expected to increase the likelihood of attracting a food manufacturing plant investment.

Fiscal Policies

Fiscal policies affect the regulations and the cost of conducting business at a specific location (Bartik 1989; Fox and Murray; Kriesel and McNamara). Counties with more stringent environmental controls, business regulations, higher taxes, etc., are less attractive locations for manufacturing plants. Thus, local governments that are able to finance local public services with nonlocal revenue sources will be more attractive because they are able to reduce local tax burdens to a given expansion in public services. The ratio of per capita property tax to per capita local government expenditure in 1987 (*GOVRATIO*) measured the dependence of government service provision on local financing. (A similar measure was used by Goetz.) The property tax to expenditure ratio is expected to negatively affect food manufacturing plant investment locations.

Fiscal policies in the Corn Belt vary by state in addition to local governments. The ability of the state to generate tax revenues was measured by *CAP86*. *CAP86* is an index created by the Advisory Commission on Intergovernmental Relations (ACIR) to measure a state's capacity to generate taxes, and identifies a potential state tax burden.[7] The effort Index (*EFF86*), also obtained from ACIR, was used to measure the will of the state to impose taxes on its constituents.[8] This index was derived by dividing a state's actual tax collections by its defined tax capacity. Plaut and Pluta found the effort index to negatively affect employment and real value-added output.

Estimation Method and Results

The investment location models were first estimated using Poisson regressions. Given the variables' discrete nature and concentrations around zero, a Poisson distribution could improve upon ordinary least squares estimation (Greene). Despite the relatively good fit of the Poisson models, tests of overdispersion rejected the assumption that the conditional mean and conditional variance were equal at the $\alpha = 0.10$ level. Thus, negative binomial regressions were used for estimation of all models. Results, reported in table 4, are discussed below.

All models had the same independent variables, differing only in the dependent variables used in the analysis. The dependent variable in Model 1 was the number of food manufacturing plant investments in each Corn Belt county. For Models 2, 3, and 4, the number of large supply-oriented, demand-oriented, and footloose investments, respectively, were the dependent variables.

In Model 1 (all firms), the independent variables were regressed on the overall number of total food processing investments. A log-likelihood test of Model 1 was found to be significant at the $\alpha = 0.01$ level. The R^2 measure was 0.3813.[9] Eleven variables in Model 1 (*VCROP, VSTOCK, PCI87, DISTMSA, WAGE, ESTAB, NODE, TRANSP, GOVRATIO, CAP86*, and *EFF86*) were significant at the $\alpha = 0.10$ level. All significant variables were found to have the expected sign.

Model 2 (the supply-oriented firm) had an R^2 measure of 0.2875. A log-likelihood test was significant at the $\alpha = 0.01$ level. Ten variables in this model were significant at the $\alpha = 0.10$ level (*VCROP, VSTOCK, WAGE, UNEMP, ESTAB, NODE, TRANSP, GOVRATIO, CAP86*, and *EFF86*). *UNEMP* was the only variable with a sign contrary to expectations.

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[7] The per capita capacity index (*CAP86*) is developed by ACIR in a multiple-step process. First, a standardized tax rate across all states is multiplied by the tax base available for taxation for each state and then divided by the state population to derive a per capita tax capacity measure. The per capita capacity measures for all the states are averaged and used to create an index where 100 represents the average.

[8] The effort index (*EFF86*) is developed by ACIR by dividing the actual per capita tax revenues by the per capita tax capacity measure and then multiplying the measure by 100.

[9] R^2 measures were derived from Cameron and Windmeijer's specification of $R^2_{DEV,NB2}$.

In Model 3 (demand-oriented firms), the R^2 measure was 0.4228, and the log-likelihood test was significant at the $\alpha = 0.01$ level. Six variables (*PCI87*, *DISTMSA*, *NODE*, *TRANSP*, *CAP86*, and *EFF86*) were significant at the $\alpha = 0.10$ level. All significant variables had the expected sign.

Finally, Model 4 (footloose firms) had an R^2 measure of 0.3661, with the log-likelihood test showing significance at the $\alpha = 0.01$ level. Five variables (*PCI87*, *DISTMSA*, *NODE*, *TRANSP*, and *GOVRATIO*) were significant at the $\alpha = 0.10$ level. All significant variables had the expected sign.

Discussion

Attributes in all location decision factor groups—markets, labor, infrastructure, agglomeration, and fiscal policy—influenced large food manufacturing investment locations. Consistent with expectations and past research, factors influencing the location decision vary by food manufacturer type. Supply-oriented investments were influenced by the availability of input markets, while demand-oriented plant investments were influenced by access to product markets.

Location Decision Factors

Access to agricultural commodity (input) markets was associated with the location of large food manufacturing investments. Consistent with the net establishment growth literature, plant investments were positively related to the total value of crops and livestock produced in the county. This evidence suggests that counties providing access to agricultural commodities were attractive investment sites for food manufacturers, ceteris paribus.

The location of large food manufacturing plant investments was associated with counties providing access to product market demand. Similar to results reported by research looking at net growth, we found that food manufacturing firms located plants near metropolitan areas. Counties with higher per capita incomes were associated with food manufacturing investment locations. These results suggest that counties providing product market access are attractive investment sites for food manufacturers. While per capita income level is incorporated to measure product markets, its significance may be measuring the influence of the quality of life on plant investment locations.

Labor market factors also influenced food manufacturers' location decisions. Counties with a low labor wage level were associated with new investments. This result is consistent with Goetz. However, measures for the quality and size of available labor were not found to be associated with plant investment locations.

Access to transportation was related to the location of food manufacturing investments. Access to interstates and major highways reduces costs of input and product distribution costs. This result provides evidence that food manufacturers favor counties providing access to transportation infrastructure.

Agglomeration economies, providing localization and urbanization benefits, were associated with the location of large food manufacturing investments. Consistent with expectations, but inconsistent with the results of Goetz, the presence of existing food manufacturers was found to be positively associated with the occurrence of new food

Table 4. Negative Binomial Regression Results for Models 1–4

MODEL 1: ALL FOOD PROCESSING INVESTMENTS

Independent Variables	Coefficient	Standard Deviation	Marginal Effects
Constant	2.486	2.005	2.027
VCROP	9.636*	3.867	7.857
VSTOCK	5.944*	1.610	4.846
PCI87	0.127*	0.043	0.104
DISTMSA	-0.006*	0.003	-0.005
WAGE	-0.028*	0.017	-0.023
UNEMP	-0.004	0.003	-0.003
CZGRAD90	1.607	1.792	1.310
TRANSP	3.949*	0.879	3.220
FARM	0.000	0.001	0.000
ESTAB	0.008*	0.003	0.006
NODE	0.923*	0.175	0.753
GOVRATIO	-0.230*	0.077	-0.188
CAP86	-3.906*	1.635	-3.184
EFF86	-1.611*	0.609	-1.313
R^2	0.3813		
Test for Overdispersion (α):	1.2609*	0.2142	

MODEL 3: DEMAND-ORIENTED FOOD PROCESSING INVESTMENTS

Independent Variables	Coefficient	Standard Deviation	Marginal Effects
Constant	2.862	3.551	0.405
VCROP	9.890	6.583	1.400
VSTOCK	4.376	3.435	0.619
PCI87	0.139*	0.071	0.020
DISTMSA	-0.014*	0.007	-0.002
WAGE	-0.021	0.032	-0.003
UNEMP	-0.003	0.003	0.000
CZGRAD90	1.973	2.796	0.279
TRANSP	3.864*	0.967	0.547
FARM	0.000	0.001	0.000
ESTAB	0.002	0.005	0.000
NODE	1.185*	0.298	0.168
GOVRATIO	-0.130	0.136	-0.018
CAP86	-5.500*	2.904	-0.779
EFF86	-2.746*	1.014	-0.389
R^2	0.4228		
Test for Overdispersion (α):	0.495	0.332	

Note: An asterisk (*) denotes significance at the $\alpha = 0.10$ level.

Table 4. Extended

MODEL 2: SUPPLY-ORIENTED FOOD PROCESSING INVESTMENTS			
Independent Variables	Coefficient	Standard Deviation	Marginal Effects
Constant	2.545	2.498	0.688
VCROP	11.955*	4.800	3.232
VSTOCK	7.399*	1.755	2.001
PCI87	0.045	0.063	0.012
DISTMSA	-0.004	0.003	-0.001
WAGE	-0.042*	0.019	-0.011
UNEMP	-0.011*	0.004	-0.003
CZGRAD90	2.972	2.566	0.803
TRANSP	4.441*	0.953	1.201
FARM	0.000	0.001	0.000
ESTAB	0.007*	0.004	0.002
NODE	0.866*	0.209	0.234
GOVRATIO	-0.160*	0.099	-0.043
CAP86	-3.743*	2.024	-1.012
EFF86	-1.851*	0.809	-0.500
R^2	0.2875		
Test for Overdispersion (α):	1.168*	0.336	

MODEL 4: FOOTLOOSE FOOD PROCESSING INVESTMENTS			
Independent Variables	Coefficient	Standard Deviation	Marginal Effects
Constant	-0.343	3.398	-0.067
VCROP	2.398	5.290	0.470
VSTOCK	-0.229	4.576	-0.045
PCI87	0.208*	0.072	0.041
DISTMSA	-0.009*	0.005	-0.002
WAGE	-0.011	0.028	-0.002
UNEMP	-0.005	0.003	-0.001
CZGRAD90	-2.143	2.928	-0.420
TRANSP	3.046*	1.228	0.597
FARM	0.000	0.001	0.000
ESTAB	0.005	0.006	0.001
NODE	0.883*	0.295	0.173
GOVRATIO	-0.266*	0.128	-0.052
CAP86	-3.037	2.706	-0.595
EFF86	-0.355	1.001	-0.070
R^2	0.3661		
Test for Overdispersion (α):	1.446*	0.495	

manufacturing investments.[10] This evidence suggests that counties with existing food manufacturers might be more attractive sites for new investments. Results also indicate that the location of food manufacturing investments was associated with counties identified as regional economic centers.

Tax policies at the state and local levels are also significant location determinants. These results are consistent with food manufacturing growth studies finding a negative relationship between local (Goetz) and state (Henderson and McNamara) tax measures and growth. States with greater capabilities to generate tax revenues were not associated with large food manufacturing investments. In addition, states that exert the most effort in taxing are not associated with food processing investment locations. Large food manufacturing investments are also negatively associated with high local tax-to-expenditure ratios. These results suggest food manufacturers are sensitive to tax liabilities.

Location Decisions by Manufacturing Type

Consistent with initial expectations and previous research on food manufacturing growth, factors influencing large plant investment locations varied by the type of food manufacturer examined. Supply-oriented investment locations were associated with counties providing access to input markets, while demand-oriented investment locations were related to product market access. The sensitivity to input and product markets also altered the importance of other factors for supply-oriented and demand-oriented food manufacturers.

Supply-oriented plant investments (Model 2) were associated with counties producing large amounts of agricultural commodities. Other types of food manufacturing investments were not associated with agricultural commodity production. Large supply-oriented investments were also related to counties providing localization and urbanization benefits from agglomeration. Supply-oriented investments were associated with counties providing access to a developed transportation system. These firms also located investments in states with lower tax effort and capacity and lower dependence on local financing of local government services.

Contrary to findings reported by Henderson and McNamara, we found supply-oriented plant investment locations to be sensitive to labor characteristics. An explanation could be that larger agricultural commodity-producing counties tend to be more rural, with smaller pools of available labor. Thus supply-oriented investment locations associated with access to input markets leave these firms with a smaller labor pool and increased sensitivity to labor concerns than other food manufacturers. The difference in findings also suggests that labor characteristics have effects on new plant locations that were difficult to detect in studies focusing on net growth. By combining plant exits and entry in net growth, the impact of labor characteristics on plant investment locations could be hidden in previous net growth literature.

Large demand-oriented plant investments (Model 3) were associated with counties providing access to product markets. These firms located investments near metropolitan areas and in counties with higher income levels. Due to the proximity to larger

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[10] *ESTAB* is a proxy measure for localization economies. The presence of multiple plants in a region and the attraction of additional investments may be an indication of more natural advantages of the region beyond those controlled in the model than localization economies.

populations and labor pools, labor characteristics were not as important to demand-oriented firms. While demand-oriented firms located investments in counties with agglomeration characteristics, existing food manufacturing establishments were not associated with plant investments. Demand-oriented investments, however, were associated with counties providing access to a developed transportation system in states with low tax effort and capacity levels.

Similar to the results of Henderson and McNamara, footloose plant investments (Model 4) were associated with access to product markets and urbanization benefits. Footloose investment firms chose locations in counties near metropolitan areas with higher personal income levels. Investment locations were also related to urbanization benefits, but localization benefits were not associated with footloose investment locations. Contrary to supply-oriented and demand-oriented firms, state tax policy was not a statistically important location factor for footloose firms. Moreover, local government fiscal policy was negatively related to footloose plant investments. This evidence suggests that counties with less dependence on local property taxes to finance local government expenditures were more likely to receive food manufacturing plant investments.

Conclusions

Food manufacturers are important generators of jobs and output in Corn Belt states. They provide critical off-farm income opportunities and markets for local agricultural producers. The economic benefits are strong enough that economic development agents have advocated the attraction of food processing plants as a development strategy for rural areas. Nevertheless, knowledge of the factors influencing new food processing plant locations is limited.

In this study we have analyzed the county characteristics associated with the location of food processing plant investments. Access to input and product markets, agglomeration economies, access to a transportation system, low wages, and local tax policies are factors that influence food manufacturing investment locations. These factors should be taken into account when assessing a particular community.

The impact of local amenities on locations differed by food manufacturing type. Supply-oriented food manufacturing investments were located in counties with access to agricultural commodities. Locating in more rural regions of the Corn Belt may make supply-oriented firms more sensitive to labor factors than other food manufacturers. Demand-oriented food manufacturing investments were found to locate in counties providing access to product markets. Footloose investments were associated with counties providing access to product markets, urbanization benefits, and less dependence on local property tax revenues. These results apply to manufacturing investments that met the minimum size threshold criteria identified in the *Site Selection Handbook* (Conway Data, Inc.)—i.e., these investments added 50 or more new jobs, represented $1 million or more in capital investment, or created at least 20,000 additional square feet of production floor space.

The prospects of attracting a food manufacturing plant investment depend upon factors that may or may not be directly influenced by specific economic development strategies. While location and proximity to an urbanized area cannot be directly altered, other factors may be adjusted. Results indicate that labor characteristics as well as input markets influenced supply-oriented investment locations. Community leaders in counties providing large supplies of agricultural commodities might try to understand the dynamics of local labor amenities to identify the prospects of attracting supply-oriented investments. Additionally, policy makers should investigate public service financing and its relationship to the location of food manufacturing activity. Local investors, be they farmers seeking a way to add value to production, or others, should be cautious in making plant investments in communities that appear to lack attributes associated with plant investment locations.

Economic development initiatives that encourage food manufacturing activity also enhance the potential for general business expansions. Counties with access to input and product markets, low-wage labor, transportation systems, and agglomeration economies seem to be in the best position to use manufacturing recruitment as an economic development strategy. Other counties might consider alternative economic growth strategies with greater probabilities of success. In either case, community leaders and potential investors should consider the risks associated with the recruitment of food manufacturing activity and how the location sites affect these risks.

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