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Factors Influencing Growth of Dairy Product Manufacturing in the United States

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Abstract

The paper analyzes factors influencing the growth of the number of dairy product manufacturing establishments in the United States. We hypothesize that the growth pattern is affected by the size of the establishments. The empirical findings presented in the paper suggest that the growth of the number of small-size dairy product manufacturing establishments is strongly affected by the proximity of both input and output markets as well as by the presence of competition from medium-large-size establishments. In contrast, the growth of the number of medium-large-size establishments is affected by the proximity of the input market and the absence of competition from small-size establishments. The proximity of the output market does not seem to have a strong effect on the growth of the number of medium-large-size establishments.

Keywords: dairy product manufacturing, growth, United States.

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Introduction

Food manufacturing is an important segment of the food supply chain that links the agricultural production stage with consumers. Therefore, economic development trends of food manufacturing impact consumers, agricultural producers and performance of the food supply chain as a whole. In the current market environment, consumer demand and changes in consumer preferences are the key factors that influence the growth of food manufacturing industries, and thus create additional demand for agricultural commodities. Many food manufacturing industries establish their businesses in rural areas because these regions provide easy access to agricultural raw materials and to low cost labor. Thus, food manufacturing industries contribute to the economic development of agricultural communities and are traditionally considered to be important determinants of economic development of rural areas.

Location and growth of food manufacturing industries are some of the indicators that have received attention in the previous literature. Past studies (Henderson and McNamara 1997, 2000); (Goetz 1995); (Lambert et al. 2007); (Brown et al. 2008); (Davis and Schluter 2005) have analyzed various factors—often referred to as community attributes –that influence location and growth of food manufacturing industries. These factors are typically associated with agricultural input markets, food industry output markets, labor markets, agglomeration and fiscal policy. These existing studies provide a wide array of results that can be used in developing regional policies as well as in the strategic business decision-making of food manufacturing businesses.

To the best of our knowledge, the following important issues have not been addressed in the existing literature in this area. First, growth patterns of small-scale versus medium-large-scale food manufacturing businesses have not been examined. Some food manufacturing industries are comprised of many small-size food manufacturing establishments, which are likely to have a different growth pattern than medium-large-size establishments. Furthermore, small-scale food manufacturing businesses are likely to be locally owned and/or organized and operated by agricultural producers.

Second, growth patterns of individual food manufacturing industries have received very limited attention. A typical study would analyze all food manufacturing industries aggregated in a single group. According to the U.S. Economic Census, there are nine groups of food manufacturing industries: animal food manufacturing, grain and oilseed milling, sugar and confectionary product manufacturing, fruit and vegetable preserving and specialty food manufacturing, dairy product manufacturing, animal slaughtering and processing, seafood product preparation and packaging, bakeries and tortilla manufacturing, and other food manufacturing. The growth patterns of individual industries are likely to be different from the growth pattern of all food manufacturing industries aggregated in a single group.

Our study aims to address some of the identified gaps in the literature. We focus our analysis on an individual industry, dairy product manufacturing, which is characterized by a relatively large share of small-scale establishments. The objective of our paper is to examine factors influencing the growth of the dairy product manufacturing industry in the United States. In particular, we analyze the growth patterns of two groups of dairy product manufacturing establishments: small-size establishments, those with less than 20 employees, and medium-large-size establishments,

those with more than 20 employees. We use publicly available data reported by the U.S. Census Bureau, U.S. Economic Census, and the U.S. Census of Agriculture. The results of our study can be used by dairy industry participants in developing their strategies and by government authorities in drafting various policies targeting the development of small-scale dairy product manufacturing businesses.

The paper is organized as follows: the next two sections present a review of relevant literature and a brief introduction of the U.S. dairy product manufacturing industry. They are followed by a section discussing the conceptual model, data and hypotheses. Finally, the estimation results and the conclusion of our research are presented.

Literature Review

First, we provide a brief summary of the theory that developed a classification of food manufacturing industries, which is often used in empirical research on economic development trends of food manufacturing industries. Second, we present an overview of empirical studies that analyzed factors influencing the location and growth of food manufacturing industries in the United States. The majority of these studies analyzed the location decisions of food manufacturing industries. The framework used to analyze the patterns of growth is similar to the framework used to analyze location decisions.

Food manufacturing industries are traditionally classified into three categories: supply oriented industries, demand-oriented industries and footloose industries (Connor and Schiek 1997). The supply-oriented industries locate their establishments in areas providing easy access to agricultural input markets. The cost of agricultural inputs represents a high share of the total costs of the firms operating in these industries. In addition, characteristics of many agricultural raw materials such as bulkiness and high perishability are important determinants of the location decisions of these firms. Therefore, supply-oriented industries are typically located in rural areas.

The demand-oriented industries tend to locate their establishments in urban areas. These industries depend on easy access to food manufacturing output markets. The transportation and distribution costs represent a significant share of the total costs of the firms operating in these industries. The footloose industries are involved in the production of multiple products. Neither agricultural input costs nor transportation and distribution costs are prevailing determinants of their location decisions.

Past empirical studies analyzed various factors influencing location decisions and growth of food manufacturing industries (Henderson and McNamara1997, 2000); (Goetz 1995); (Lambert et al. 2007). These factors are typically associated with agricultural input markets, labor markets, food manufacturing industry output markets, agglomeration and fiscal policy. The geographic markets under analysis were as large as the national market and as small as an individual state market. Some studies used publicly available data sources such as the U.S. Economic Census and the U.S. Census of Agriculture to collect variables for empirical analysis, and some studies developed and conducted their own surveys.

Goetz (1997) examined U.S. state- and county-level determinants of food manufacturing growth and focused on the footloose firms. This study found that the level of transportation costs and wages, as well as infrastructure and property taxes, tended to have a negative effect on the growth of the food manufacturing industries. Similarly, Lambert et al. (2007) found that the infrastructure, agglomeration, accessibility of output and input markets, labor markets and fiscal policies were important determinants of the location decisions of the food manufacturing companies.

Singer and Bartels (1996) focused on the U.S. Midwestern States and they found that demand-oriented food manufacturing industries grew more slowly relative to the footloose and supply-oriented industries. A high level of transportation costs tended to prevent demand oriented firms from competing outside the local and regional markets. The footloose and supply oriented industries, on the other hand, were able to take advantage of increasing demand in distant markets. The study found that the wage level was negatively related to the growth of food manufacturing industries, while population was positively related to it. The footloose and supply oriented firms had the greatest potential.

Henderson and McNamara (1997) studied community attributes influencing local food processing growth in the U.S. Corn Belt. Their study found that food processing establishments grew in the communities located near cities that offered quality access to business services and had already established a manufacturing base. The supply-oriented industries tended to expand in areas with easy access to agricultural raw materials. The demand oriented industries grew in the areas characterized by a high population density, thus providing easy access to food industry output markets. The study concluded that rural communities had a smaller chance of attracting food manufacturing industries than urban communities.

Rainey and McNamara (1999) found that the location decisions of firms in Indiana were sensitive to labor costs and productivity, tax level, agglomeration economies, and infrastructure. Also, the presence of development groups influenced a county's success in attracting food manufacturing firms. Holcomb et al. (2000) compared the determinants of plant location for food and non-food agricultural processors in Oklahoma. The authors found that tax and crime rates were some of the major factors considered by both agricultural and non-agricultural food processors. Some other factors influencing the plant location decisions were water availability, skilled labor, telecommunications and quality of life.

Holcomb et al. (1999) studied the location decisions of eight groups of food manufacturing industries that were classified according to the type of product marketed. The results suggest that the availability of utilities, waste disposal, raw materials, and labor strongly influenced the location decisions of these firms. Jensen and Pompelli (2002) studied the location preferences of small agribusiness firms in Tennessee. Their study found that the proximity to buyers and sellers was the most influential factor in selecting location sites. Other factors affecting these decisions included labor supply as well as the proximity and adequate supply of raw materials.

Harrison and Sambidi (2004) examined location decisions of the U.S broiler complex entities. The authors used a conjoint analysis to determine factors that influenced the location decisions of industries involved in broiler growing, feed milling, and broiler processing. This study differs

from other studies in the data collection strategy. The authors interviewed the top executives of broiler firms to collect information about the factors that influenced the location decisions. The results of this study show that the top five factors that affected the location decisions of the broiler companies were feed costs, community attitude toward the broiler industry, availability of geographically concentrated growers, and unemployment rates. Other factors that were found to be important were the road quality between feed mills and growers, and the cost of electricity, heating, and sewage.

Pruitt and Tilley (2008) used both county-level and state-level data to analyze the location patterns of confectionery manufacturers in the post-NAFTA environment. Their study used data from 1993 to 2005 and employed a zero-inflated-poisson model. The results indicate that confectionary industries locate their establishments close to sugarcane and sugar beet refineries. The study also revealed that manufacturers were more likely to locate their businesses in counties close to the Mexican and Canadian borders. Agglomeration had a negative effect on the location of firms due to the presence of competition from the firms concentrated in the area. The variable, NAFTA, which intended to capture the policy effect on location of the firms, was not found to be statistically significant. Finally, the level of wages was found to positively influence location decisions of the confectionary industries.

The U.S. Dairy Product Manufacturing Industry

U.S. dairy product establishments generally tend to locate near dairy farms for easy access to raw milk supply, which makes these firms mostly supply-oriented establishments. Also, small-size establishments are often owned by farmer cooperatives, which tend to operate near the dairy farms. The U.S. dairy product manufacturing industry (NAICS[1] 3115) consists of establishments that produce dairy products from raw milk, processed milk, and dairy substitutes. Dairy product manufacturing includes two industries: dairy product (except frozen) manufacturing (NAICS 31151) and ice cream and frozen dessert manufacturing (NAICS 31152). The former includes four sectors: fluid milk manufacturing (NAICS 311511), creamery butter manufacturing (NAICS311512), cheese manufacturing (NAICS 311513) and dry, condensed and evaporated dairy product manufacturing (NAICS 311514).

Table 1 presents the structure of the U.S. dairy product manufacturing industry. In 2002, there were 1,681 establishments involved in dairy product manufacturing, which represented 6% of all establishments involved in food manufacturing in the United States. The dairy product manufacturing industry generated $66,176 million in value of shipments and garnered $22,292 million in value added. This constituted 14.4% of the value of shipments and 11% of the value added generated by all food manufacturing industries in the United States. In terms of the value of shipments, the two largest sectors are fluid milk manufacturing (37.6%) and cheese manufacturing (33.3%), followed by dry, condensed and evaporated dairy product manufacturing (14.3%), ice cream and frozen dessert manufacturing (12.4%), and creamery butter manufacturing (2.4%).

[1] NAICS North American Classification System.

Table 1. The structure of the U.S. dairy product manufacturing industry (2002).

NAICS Code	Industry Sector	No. of establishments *counts*	Value of shipments *$1,000*	Value added *$1,000*
3115	**Dairy product manufacturing**	**1,681 (100.0)**	**66,175,885 (100.0)**	**22,291,744 (100.0)**
31151	Dairy product (except frozen) manufacturing	1,274(75.8)	57,969,908 (87.6)	17,880,827 (80.2)
311511	Fluid milk manufacturing	528 (31.4)	24,888,743 (37.6)	8,367,532 (37.5)
311512	Creamery butter manufacturing	35 (2.1)	1,604,947 (2.4)	268,567(1.2)
311513	Cheese manufacturing	500 (29.7)	22,006,031 (33.3)	5,002,480 (22.4)
311514	Dry, condensed and evaporated dairy product manufacturing	211 (12.6)	9,470,187 (14.3)	4,242,248 (19.0)
31152	Ice cream and frozen dessert manufacturing	407 (24.2)	8,205,977 (12.4)	4,410,917 (19.8)

The shares of individual dairy product manufacturing sectors in the total dairy product manufacturing are in the parentheses.

Table 2 presents the distribution of dairy product manufacturing establishments of different sizes from the years 1997 and 2002. During this time, the total number of establishments decreased from 1,830 in 1997 to 1,677 in 2002, or by approximately 8%. The number of small-size establishments, those with less than 20 employees, decreased from 791 in 1997 to 759 in 2002, or by 4%. The number of medium-large-size establishments, those with more than 20 employees, decreased from 1,039 in 1997 to 918 in 2002, or by almost 12%. However, the share of small-size establishments increased from 43.2% in 1997 to 45.3% in 2002. The share of medium-large-size establishments decreased from 56.8% in 1997 to 54.7% in 2002.

Table 2. The U.S. dairy product manufacturing: Number of establishments (1997-2002).

Size	1997 number (% of the total)	2002 number (% of the total)	Difference 2002-1997 (% change)
Small-size establishments (less than 20 employees)	791 (43.2)	759 (45.3)	- 32 (-4.0)
Medium-large-size establishments (more than 20 employees)	1,039 (56.8)	918 (54.7)	-121 (-11.6)
Total	1,830 (100.0)	1,677 (100.0)	- 153 (-8.4)

As for the individual states, Wisconsin had the largest number of total dairy product manufacturing establishments (240) in both 1997 and 2002. In 1997, Wisconsin also had the largest number of medium-large-size dairy product manufacturing establishments (147). In 2002 California reported the largest number of medium-large-size dairy manufacturing establishments (109). California had the largest number of small-size dairy product manufacturing establishments in 1997 (92). The states with the smallest number of the total dairy product manufacturing establishments in 2002 were Mississippi, Delaware and West Virginia; in 1997 it was West Virginia with four establishments. The states with the fewest number of medium-large-size establishments in 2002 were West Virginia, New Hampshire and Delaware. Each of these

states had two manufacturing establishments reported. The states with the smallest number of small-size establishments in 1997 was Mississippi with zero establishments reported. The average number of dairy product manufacturing establishments per state in 1997 was 38 and it decreased to 35 in 2002.

Conceptual Model, Data and Hypotheses

Following the approaches used by previous studies, we hypothesize that the growth of the dairy product manufacturing industry depends on access to dairy industry input and output markets, labor markets, and agglomeration. Therefore, the conceptual model used in this study is represented as:

$$Growth = f(Input\ Markets, Output\ Markets, Labor\ Markets, Agglomeration)$$

This model is used to study the growth of dairy product manufacturing establishments using state-level data. We hypothesize that the growth pattern of dairy product manufacturing establishments depends on their size, and thus we expect to find differences in the patterns of growth between small-size and medium-large-size dairy product manufacturing establishments. Our variable of interest (i.e., "Growth") is a change (i.e., increase or decrease) in the number of dairy product manufacturing establishments. Growth is calculated as the difference in the total number of dairy product manufacturing establishments in each state during the years 1997 and 2002, and is the dependent variable in our econometric models. This measure takes into account the effect of new establishments, establishments that exited the industry, and the establishments that were active during these two years. To collect data on the number of establishments, we used the U.S. Economic Census surveys that are conducted every five years; 1997 and 2002 are the most recent surveys for which data is publicly available.[2]

We considered the state-level analysis for two main reasons. First, the vast majority of counties in many states do not have dairy product manufacturing establishments. Second, in the cases of the counties with few establishments, there are data reporting problems. In particular, the total number of dairy product manufacturing establishments reported on a state level is not equal to the sum of the number of dairy product manufacturing establishments across all counties in the state. Also, we had to eliminate five states (Alaska, Minnesota, Oklahoma, Rhode Island, and Wyoming) from our study due to unavailable data.

Based on the approach used by the U.S. Economic Census to report data, we define a small-size establishment as one having less than 20 employees and we define a medium-large-size establishment as one having more than 20 employees. The U.S. Economic Census provides data on the total number of establishments and the number of establishments with 20 or more employees. Based on this information, we calculate the number of establishments with less than 20 employees (i.e., small-size dairy product manufacturing establishments). We analyze the growth characteristics of three groups of dairy product manufacturing establishments: small-size establishments, medium-large-size establishments and the overall group. Small-size

[2] The 2007 U.S. Economic Census data are not available yet.

establishments are likely to be locally owned businesses, and in many cases they are owned by dairy producers.

Table 3 presents descriptive statistics characterizing the overall sample used in the regression analysis. The average market value of raw dairy products sold in each state was $394 million during the analyzed period. The average population was about 6 million people. The average number of people with high school education or higher was about 3 million. The average hourly wage of a production worker was $13. The average per capita income was about $20,000.

Table 3. Growth of dairy product manufacturing establishments in the United States: Descriptive statistics

Variable Name	Units	Mean	St. Dev	Minimum	Maximum
All Dairy Est. 2002	count	35	46.97	4	240
Medium-Large Est. 2002	count	19	25.84	2	146
Small Est. 2002	count	16	48.97	1	109
All Dairy Est. 1997	count	38	56.97	4	240
Medium-Large Est.1997	count	22	57.97	2	148
Small Est. 1997	count	16	58.97	0	96
Independent Variables	***Input and Output Market***				
Population	million	6.00	6.38	0.61	33.87
Value of raw dairy products	$ million	394.14	638.36	19.26	3177.8
	Labor Market				
Education	million	3.12	3.18	0.34	16.36
Wage	$ per hour	13.02	1.79	9.95	17.87
Per capita income	thousand	20.76	2.92	15.85	28.77
	Agglomeration				
Concentration	count	38.49	48.31	4.00	240.00
Small-size/medium-size	ratio	1.59	1.13	0.00	6.00

Using the conceptual model and data collected, we estimate an econometric model for each of the identified groups of dairy product manufacturing establishments. While the dependent variables differ across these models, the same independent variables are used in all three models. These independent variables represent dairy product manufacturing industry input and output markets, labor markets, and agglomeration. Table 4 summarizes the explanatory variables, their expected signs and the data sources used to collect information for each variable. Below we provide a discussion of the variables and the corresponding hypotheses.

Dairy industry input and output market. The growth of food manufacturing establishments is affected by the availability and accessibility of agricultural input and output markets (Turhan et al. 2007); (Lambert et al. 2007). Supply oriented industries locate their establishments close to the sources of raw materials to ensure the quality of the raw materials needed for processing. Also, the firms save on transport costs due to the bulky nature and high perishability of the raw materials. Demand oriented industries locate their establishments close to the output markets to minimize transportation costs. The location decisions of the footloose industries are independent of the source of raw materials or the output market (Connor and Schiek 1997). The proximity of both the output and input markets decreases transportation costs and provides better information for decision-making (Rainey et al. 1999).

Table 4. The explanatory variables and data sources

Variable (Expected Sign)	Definition	Data Source
Dairy product manufacturing input market		
Value of raw dairy products (+)	Market value of raw dairy products (1997)	U.S. Census of Agriculture
Dairy product manufacturing output market		
Population (+)	Population (2000)	U.S. Census Bureau
Income (+)	Per capita income (1999)	U.S. Census Bureau
Labor market		
Education (+)	Number of people with at least high school degree (2000)	U.S. Census Bureau
Wage (-)	Ratio of production workers' wages to production workers' hours(1997)	Calculated using data reported by the U.S. Economic Census
Agglomeration effect		
Concentration (-)	Number of dairy product manufacturing establishments (1997)	U.S. Economic Census
Small-size/medium-large-size establishments ratio (+)	Ratio of the number of small-size establishments to the number of medium-large-size establishments (1997)	Calculated using data reported by the U.S. Economic Census

Data collected at state level.

In general, the proximity of agricultural input markets is more important to supply oriented firms because of the unique nature of the products that they use in food manufacturing (i.e., bulkiness and high perishability). The supply oriented firms are able to minimize the cost of transportation when they locate close to the input sources. Lambert et al. (2007) reported that higher value crops tend to be produced near urban centers, while lower value crops are produced in noncore regions. This study found that the proximity of the input market had a positive and significant effect on the location decisions of food industries. Henderson and McNamara (1997, 2000) and Lambert et al. (2007) used the sum of cash receipts for crops and livestock in each county as a measure of access to raw materials. Following these studies, we use the value of raw dairy products to measure the availability of raw materials in each state. This variable is expected to be positively related to the growth of the number of dairy product manufacturing establishments, independent of their size.

It is hypothesized that access and proximity to the product market has a positive effect on the location and growth of food manufacturing establishments. Population and per capita income have been used by previous studies to measure the size of the product market. Following Lambert et al. (2007), Henderson et al. (1997), and Pruitt and Tilley (2008), we use per capita income to measure the relative purchasing power of residents in the state. State population is used to measure the number of people in the state, which also indicates the size of market demand. Both input and output market variables are hypothesized to have a positive effect on the location decisions and on the growth of food manufacturing industries.

Labor Market. The productivity of food manufacturing depends on labor availability and diversity (Lambert et al. 2006, 2007, 2008). Rural areas will use labor as a means of attracting new manufacturing plants, which is a key economic development strategy (Davis and Schuler 2005). This is because most rural areas have a high percentage of unskilled labor earning low wages. Labor as a factor that influences the location and growth decisions of firms can be

characterized in terms of quality, quantity and cost. A county with a high level of labor heterogeneity will be able to attract and maintain more manufacturing establishments than those with a low level of labor heterogeneity (Davis and Schuler 2005).

A set of the labor market variables captures the effect of the quality, quantity, and cost of labor. A proportion of the population having a higher education is a proxy for labor quality. Following Henderson and McNamara (2000), Brown et al. (2009), and Pruitt and Tilley (2008), we used the number of people over 25 years of age and having at least a high school education to measure labor quality. A high level of labor quality leads to greater productivity and lower cost (Lambert et al. 2008).

Population is used to measure the availability of labor in the county (Lambert 2007); (Henderson and McNamara1997, 2000). A higher population in a county will provide firms with a larger labor pool (Lambert et al. 2008). We hypothesize that a large population base will have a positive effect on the location and growth of the firm. The cost of labor is also an important factor, as firms tend to locate their establishments in low labor cost areas (Lambert et al. 2008). A high labor cost is generally expected to have a negative effect on the location and the growth of firms, as a higher labor cost increases the cost of production (Brown et al. 2009); Lambert et al. 2008, 2007). However, this is not always the case, as Chen (2006) showed that firms will locate in regions with high cost of labor, which could indicate a high quality of labor and lifestyle of the people in the county. To measure the cost of labor, we use the ratio of the annual production workers' wages to the total number of production worker hours in dairy product manufacturing, which is the cost of one production worker hour.

Agglomeration. Agglomeration characterizes the intensity of business activities in and around a specific geographic area. The positive features of agglomeration include easier access to other businesses, a lower transport cost, and skilled labor availability. O'Sullivan (2003) observes that when firms locate close to each other, they can produce at a lower cost. Conversely, agglomeration could lead to more severe competition among firms, leading to higher input prices (Cohen and Morrison 2005). These positive and negative effects of agglomeration are more pronounced in rural areas because of remoteness and limited resources.

Henderson and McNamara (1997) used total population, the percentage of people employed in a manufacturing industry, and the total number of business service establishments as measures of agglomeration. Similarly, Togo and Arikwa (2002) used the number of establishments to measure industry agglomeration because of a high correlation between the number of establishments and the level of investment.

In our study, two variables are used to quantify agglomeration. The first is the concentration of dairy product establishments existing in a state in the previous period as a proxy for the agglomeration effect. This measure has also been used by other studies (Henderson and McNamara 1997, 2000); (Goetz 1997); and (Pruitt and Tilley 2008). This variable is hypothesized to have a negative effect on the growth of the number of dairy product manufacturing establishments because the more establishments there are in the current period, the less likely the total number of establishments is to increase in the future. The more establishments there are in the current period indicates that competition is very high, which means lower profitability and discourages firms to locate in this area in the future. Second, we

develop a new variable that is calculated as a ratio of the number of small-size establishments to the number of medium-large-size establishments. This variable captures the effect of competition between the small-size and medium-large-size dairy product manufacturing establishments in the region. An increase in this ratio is expected to have a positive effect on the growth of the number of dairy product manufacturing establishments.

Results

The ordinary least square (OLS) technique was used to estimate the three models: all, medium-large-size, and small-size dairy product manufacturing establishments. We used a Breusch-Pagan method to test for the presence of heteroskedasticity. The results indicate that at the 5% level, heteroskedasticity was present in the model for all dairy manufacturing establishments and also for the small dairy manufacturing establishments. We therefore corrected for the heteroskedasticity for these two models using White's robust covariance matrix approach. The Breusch-Pagan test for medium-large-size dairy manufacturing establishments did not indicate the presence of the heteroskedasticity.

Table 5. Factors explaining growth of dairy product manufacturing establishments in the U.S.: OLS Estimation Results.

Variable	**Dairy Product Manufacturing Establishments**		
	All	Medium-Large > 20 employees	Small < 20 employees
Dairy product manufacturing input market			
Value of raw dairy products	0.65E-02**	0.23E-02	0.42E-02**
	(1.93)	(1.06)	(1.66)
Dairy product manufacturing output market			
Population	5.13**	-0.31	5.44***
	(1.90)	(-0.33)	(3.21)
Per capita income	0.56*	-0.11E-01	0.57***
	(1.60)	(-0.62E-01)	(2.38)
Labor market			
Education	-10.40**	0.24	-10.64***
	(-1.82)	(0.12)	(-3.00)
Wage	-0.27	0.81E-01	-0.35
	(-0.63)	(0.31)	(-1.08)
Agglomeration effect			
Concentration	-0.89E-01	-0.38E-01*	-0.51E-01*
	(-1.60)	(-1.31)	(-1.33)
The ratio of small-size to medium-large-size establishments	0.21	-0.47*	0.68***
	(0.59)	(-1.30)	(2.48)
R_2	0.37	0.30	0.58
Breusch-Pagan P values	0.00	0.24	0.00
Number of observations	45	45	45

The dependent variable is a change in the number of dairy product manufacturing establishments between 1997 and 2002. The data are collected at the state level. The entries in the cells are the estimated coefficients. *, **, *** indicates statistical significance using a one-sided Z-test at a 10%, 5% and 1% significance level. T-ratios are in parentheses.

Table 5 presents the OLS estimation results for the growth models based on all, medium-large-size, and small-size dairy product manufacturing establishments. Our empirical findings indicate that there are differences in the pattern of growth for small-size and medium-large-size establishments.

In the case of small-size dairy product manufacturing establishments, the concentration of establishments was found to be significant at the 10% level. Market value of raw dairy products was found to be statistically significant at the 5% level. Per capita income, the level of competition between the small-size and medium-large-size establishments, labor quality, and population were also significant at a 1% level. An increase in the market value of raw dairy products, an increase in population, or an increase in per capita income would result in an increase in the number of small-size dairy product manufacturing establishments in the region. An increase in the labor quality would have a negative effect on the growth of the number of small-size establishments.

The sign of the labor quality coefficient for all establishments and small-size establishments contradicts our hypothesis, and it is statistically significant. Similar to the result of Chen (2006) we note that a high labor quality could be associated with a high level of wage rate and this could be an explanation to the negative relation between the labor quality and growth. It is also possible that small firms may not be able to afford high labor quality. Therefore, a high quality of labor in the state may have a negative effect on the growth of the dairy manufacturing industry. The sign of the cost of labor coefficient is consistent with our hypothesis; however, the coefficient is not statistically significant.

The small-size dairy product manufacturing establishments tend to grow in the areas where their number was small in the previous period and in the areas where the number of small-size establishments is large relative to the number of medium-large-size establishments. In summary, our results suggest that the growth of small-size dairy product manufacturing is strongly affected by the proximity of both the input and output markets and by the presence of competition between the small-size and medium-large-size establishments. The pattern describing growth of all dairy product manufacturing establishments is similar to the pattern describing growth of small-size dairy product manufacturing establishments.

In the case of medium-large-size dairy product manufacturing establishments, only two variables are statistically related to the growth of this group of establishments: concentration and the ratio of small-size to medium-large-size establishments. These were both significant at a 10% level. The medium-large-size dairy product manufacturing establishments tend to grow in the areas where their number was small in the previous period and in the areas where the level of competition from small-size establishments is relatively low (i.e., the ratio of small-size to medium-large-size establishments is relatively small). Unlike in the other two models, the estimated coefficient for the variable– the value of raw dairy products – is statistically insignificant for the medium-large dairy establishments.

The signs of the estimated coefficients for the variables – population, per capita income, the level of education, and wage – are not as expected and also not statistically significant. In summary, our empirical results may suggest that the proximity of the input market is likely to have a much

stronger effect on the growth of medium-large-size dairy product manufacturing establishments than the proximity of the output market. In addition, the presence of competition from small-size dairy product manufacturing establishments is likely to have a negative effect on the growth of medium-large-size dairy product manufacturing establishments.

Conclusion

Our study provides empirical evidence suggesting that the patterns of growth of the number of small-size and medium-large-size dairy product manufacturing establishments in the United States are different. The results show that the proximity of the dairy industry output market strongly affects the growth of the number of small-size establishments. However, the proximity of the output market is not likely to be a significant determinant of the growth of the number of medium-large-size establishments. The number of small-size dairy product manufacturing establishments tends to grow in the areas where the level of per capita income and population are high. Furthermore, the number of small-size establishments tends to increase in the areas where there are many small-size establishments relative to the number of medium-large-size establishments. In contrast, the number of medium-large-size establishments tends to increase in the areas where the level of competition from the small-size establishments is low. We find that the market value of raw dairy products produced in the area has a positive effect on the growth of the number of dairy product manufacturing establishments regardless of their size.

Compared to the previous literature focusing on location and growth of all food manufacturing industries as a group, we find that factors explaining the growth of dairy product manufacturing establishments are similar to those explaining the growth of all food manufacturing industries as a group. An important finding of our study is that growth patterns of small-size and medium-large-size dairy product manufacturing establishments are somewhat different. This has implications for developing policies that target economic development of small-scale dairy product manufacturing businesses and for the strategic decision-making of dairy product manufacturing industry participants.

Our study determines the factors that affect the growth of different sizes of dairy manufacturing establishments. Results and implications that could be drawn from this study are important for economic development and employment opportunities. The study also showed that manufacturing establishments could still serve as an important development strategy for rural areas in America, since they have the raw materials, available labor, and have a lower concentration of other establishments in the region. States that produce dairy products could use the results of this study as a means of attracting other businesses into the region. The results of this study indicate that the development of allied “input and output” industries is important to attract dairy product manufacturing firms and thus to the economic growth and development of rural areas. Policy implications that can be drawn in this study are that rural areas can still rely on attracting and maintaining manufacturing establishments for their long-term development goals.

Rural areas with access to metropolitan counties have always been considered as having a comparative advantage in attracting manufacturing establishments because they have relatively abundant low-skilled labor as well as inputs needed for production. Results from this study show

that rural areas could still rely on the presence and growth of dairy establishments as an economic development strategy for the state. Small manufacturing establishments have an important role in the economic development of the rural sectors of most states. The majority of these small establishments are owned by farmer cooperatives of the rural area. These small establishments serve as means of employment to the people in the rural area which also leads to the improvement of the living conditions of these people. It is important that policy makers consider means for assisting small manufacturing establishments to allow them to grow because many small manufacturing establishments are going out of business.

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