Idaho's Cheese Industry: The Competitive Situation

Chris Werner, John C. Foltz, and Shunxiang Wu

As the fifth largest U.S. cheese-producing state, Idaho increased cheese production by 182 percent (390 million pounds) between 1992 and 1995. Idaho's competitiveness in the cheese industry is important not only to processors but also to dairy farmers since approximately 85 percent of the milk produced in Idaho is processed into cheese. Idaho was found to be competitive with other major cheese-producing states, including California, Wisconsin, Minnesota, and New York. Among the study states, Idaho was the second lowest-cost provider, behind California, to selected cities across the United States. Idaho's advantage was the lowest production costs, excluding milk cost, due in large part to lower labor and utility rates.

In 1995, Wisconsin, California, Minnesota, New York, and Idaho were the top five U.S. cheese-producing states, accounting for 67 percent of total U.S. cheese production (USDA(a), 1993–96). Cheese production has traditionally been perceived as existing primarily in the Upper Midwest. In fact, this region continues to produce the greatest volume of cheese in the nation. However, its percentage of total production has decreased over the last decade as several western states, including Idaho, have increased cheese production more rapidly. The expansion of cheese production in the West benefits from the ability of dairy farmers in the region to produce milk at a low cost. Western dairy farmers are incorporating low-cost housing, high quality and reasonably priced forages, and specialization in genetics, nutrition, and management to help maximize their profit on large dry lots (Werner, 1996). The current situation—of increasing milk and cheese production in the West and declining milk and cheese production in the Upper Midwest—provides a unique opportunity to speculate about future trends in cheese production.

Continuous structural change has taken place in the U.S. cheese processing industry. The cheese industry is consolidating into fewer plants producing more cheese in order to strive for more productive and efficient use of resources. For instance, in 1995, the cheese industry in Idaho consisted of 11 cheese plants, which produced 390 million pounds of cheese (Table 1) while, in 1992, 12 cheese plants in the state produced 214 million pounds (USDA(b), 1993–96). With fewer plants and increased cheese production, the average size of cheese plants has increased. Average cheese production per plant in Idaho increased from 20.2 million pounds in 1992 to 35.5 million pounds in 1995, an increase of 77 percent over the three-year period (USDA(b), 1993–96). A similar trend exists for other cheese-producing states.

Unlike other major cheese-producing states, Idaho produces much more milk than the population of the state can consume (see comments on arbitrage below and Table 1). In addition, Idaho is located too far from major metropolitan areas to make transportation of excess fluid milk feasible. The need to process milk into a commodity that is condensed and does not spoil forces the Idaho dairy industry to rely on the demand for cheese in the U.S. market. Recent farm-policy legislation expands a free market approach by removing milk support prices. Movement toward a more dynamic and competitive environment underscores the need for dairy farmers and cheese producers to improve their production efficiency. Determining the competitive situation of Idaho cheese producers will aid evaluation of the long-term dairy situation in the state of Idaho.

As defined by economists, arbitrage takes place when demand (and thus price) in a region exceeds the cost of the product plus transportation to that region. Thus, even if the population of a state could consume all of the cheese produced in that state, it might make economic sense for producers to ship product to other states that are willing to pay more. Idaho potatoes are a good example: Native Idahoans can rarely purchase potatoes produced in the state as those potatoes are not available in grocery stores because producers receive better prices for them elsewhere

The purpose of this study is to focus on the cost of milk production and cheddar cheese production, and the costs of transportation to major

Chris Werner, John C. Foltz, and Shunxiang Wu are, respectively, a former graduate student, associate professor, and former research associate, Department of Agricultural Economics and Rural Sociology, University of Idaho, Moscow, ID.

Table 1. Cheese Production and Consumption, Selected States, 1995.[a]

Cheese	Wisconsin	California	Minnesota	New York	Idaho
Production (mil. lbs.)	2,091	921	678	557	390
Percent of U.S. Production (%)	30.1	13.3	9.8	8.0	5.6
Rank	1	2	3	4	5
Number of Plants	142	46	16	30	11
Consumption (mil. lbs.)[b]	147	903	132	519	33
Difference[c] (mil. lbs.)	1,944	18	546	38	357
Percent Consumed in State[d] (%)	19.4	98.1	7.0	93.1	8.5
Average Annual Production Per Processing Plant (mil. lbs.)	14.7	20.2	42.4	18.6	35.5

[a]Cheese, unless otherwise stated, is defined by the U.S. Department of Agriculture as including colby, washed curd, high- and low-moisture jack, monterey, granular cheese, and full-skim American cheese; it excludes cottage cheese.
[b]Consumption based on state population x average cheese consumption.
[c]Production minus consumption.
[d]Cheese consumption was divided into cheese production.

Sources: USDA(b) (1993–96); USDA(c); U.S. Census Bureau (populations) (1995).

metropolitan areas. The specific objectives are to estimate, using Cheese-Eco, costs of cheese production for selected major milk-producing states to compare the cost of cheddar cheese among these states, and to analyze Idaho's competitiveness in the cheese production market.[1]

This paper is organized as follows: Studies on cheese consumption and production are reviewed in Section 2; analytical procedures and data requirements are discussed in Section 3; simulation results are reported and discussed in Section 4; and conclusions are drawn in the final section.

Relevant Literature

The consumption of cheese in the United States has increased constantly during the past 20 years. For instance, per capita consumption of cheese was 11.4 pounds in 1970, 17.5 pounds in 1980, and 26.8 pounds in 1994 (USDA(c), 1996). This increased consumption has been largely due to the fast expansion of the prepared food industry, especially pizza manufacturing. Over time, per capita consumption of Italian-type cheeses, such as mozzarella, has increased from 2.1 pounds in 1970 to 4.4 pounds in 1980, and further to 10.3 pounds in 1994 (USDA(c), 1996). The production of Italian cheeses is slowly becoming a large part of the cheese industry.

Despite increased concerns regarding low-fat diets and cholesterol levels, the demand for cheese seems to have continued to grow unabated. This situation may be attributed to the cheese industry's attempt to meet the needs of the consumer and advertising activities. Low-fat cheeses, with some of the same characteristics of regular cheese, have been developed and are seemingly accepted by consumers. Blaylock and Blisard (1988) found that advertising through milk check-off funds, provided by the Dairy and Tobacco Adjustment Act of 1983, raised both natural and processed cheese sales for home consumption. Households purchasing natural cheese did not increase consumption due to generic advertising, but households that normally did not purchase cheese were affected by generic advertising. Blisard, Sun, and Blaylock (1991) observed a similar finding that advertising increased fluid milk sales by 5.98 billion pounds and cheese sales by 252 million pounds during the period 1984 through 1990.

Several recent studies have attempted to evaluate regional competitive advantage in the cheese industry. Buekeboom and Jesse (1991) found that California and Texas could deliver cheddar cheese to major cities in the United States at a lower cost (including the cost of milk) than Wisconsin, Minnesota, or New York could. They also found that, holding plant size constant

[1] Cheese-Eco is a computer program that simulates the operation of a cheese processing plant. It was developed by Brian Gould at the Wisconsin Center for Dairy Research, University of Wisconsin-Madison, and has been widely used within the cheese industry (Buekeboom and Jesse, 1991).

and excluding milk cost, Wisconsin had lower cheese manufacturing costs than any of the study states had. They concluded that Wisconsin's competitive position was better than what was suggested by current price relationships. This was because, at the farm level, Wisconsin dairy farmers had lower cash costs of producing milk due to their home-produced forages and feed. However, Wisconsin farms had higher fixed costs due to the inclusion of returns to owner's equity and unpaid family labor. Therefore, Wisconsin compared favorably with other states in the full cost of production at the farm level, but the returns to family labor and owner's equity were very high.

Mesa-Dishington, Aplin, and Barbano (1987a; 1987b) provided several approaches for developing a base plant for cheese processing. Six different plant sizes—varying in milk processing capacity from 0.48 to 2.4 million pounds per day—were selected. Five possible production methods—varying from the cheddaring process to the hooping/packing process—were used in each of the plants. Different production schedules of 18, 21, and 24 hours per day and 5, 6, or 7 days per week were used with each of the different sized plants and production methods. The estimated costs of cheese production ranged from $0.11 to $0.27 per pound. Labor expenses were found to be the most important component in production costs, accounting for an average of 41 percent of the total production cost. Different production technologies caused costs of production to vary, but not significantly. The change in production schedules increased the cost per pound of cheese produced when the plant was used at less than full capacity. Full capacity for plant operation was 24 hours a day, seven days a week.

Babb (1980) analyzed the cost and financial performance of 44 cheese plants in Wisconsin. He concluded that no economies of size could be identified in these plants. However, he stated that possible external economies or diseconomies of size needed to be balanced against internal economies of size. In his study, he found that large plants received a higher price for cheese than did small plants. However, higher raw milk costs almost exactly offset the price and revenue advantage of large plants, which typically purchased supplemental milk from other plants at a higher price than that paid to dairy farmers for direct ship milk. Babb concluded that plant success and survival appeared to depend more on good management than it did on large volume.

Western dairy farmers' ability to produce milk at a low cost greatly enhances the competitiveness of the cheese industry in this region. According to a report published by the U.S. Department of Agriculture (USDA(d), 1993), the Upper Midwest had a slight advantage in terms of total cash expenses over the Northeastern and Pacific regions until 1993. Total cash expenses included feed, veterinary, machinery and building repairs, dairy supplies, hired labor, general farm overhead, taxes, insurance, interest, and other cash expenditures. The Pacific region was represented by Washington and California, and excluded Idaho. Production costs for farmers in Idaho are similar to those in eastern Washington. Total cash expenses in the Pacific region decreased slightly during the four years and did not make a dramatic jump in 1993. The price of feed (primarily hay, silage, and pasture) in the Upper Midwest and Northeast was unusually high in 1993, causing the total cash cost of producing milk to increase sharply.

During the years 1990 through 1993, the Pacific region had a definite advantage over the other two regions in terms of total economic costs. The total economic cost includes the total cash expense and all other economic costs, such as capital replacement, land, and unpaid labor. This is likely a result of the use of open feedlots, which require less capital investment per cow than many typical midwestern and eastern dairy setups. The Upper Midwest and Northeast have more traditional farms that utilize large amounts of family labor, land, and tillage equipment, which is used for feed crops.

Analytical Procedures

Cost relationships in producing cheese can be determined using accounting data or an economic-engineering approach. The analysis of accounting data involves combining estimates of average costs into various classes or developing a cost function. The inability to clearly define the various cost-influencing factors may lead to differences among plants in accounting classifications, record-keeping, managerial efficiency, scale, production methods, input prices, and degree of plant utilization. Furthermore, such an analysis relies on the accuracy of the data provided and the interest of plant operators to share data. Data limitations and defects usually lead to biased estimates of cost functions (Mesa-Dishington, Aplin, and Barbano, 1987a; 1987b).

In this study, cost relationships were developed using the economic-engineering approach. It permits the researcher to fix technical requirements, managerial effectiveness, and other factors of cheese plants while focusing primarily on variation in the cost of inputs. Also, this method allows the use of the Cheese-Eco program to estimate production costs. In this study, Cheese-Eco was used to calculate production costs by fixing the production schedules, technology, and plant size. Unless otherwise stated, all the data was made current to 1995 using appropriate producer price indices.

The base plant for producing cheese was simulated with the following centers: receiving, treatment, starter culture, cheese vat, cheese chilling, cream separator and fines saver, laboratory, refrigeration, cleaning in place system, water treatment, water well, offices, lockers and rest rooms, lunchroom, dry storage, alternating vat system, advanced cheddar, and block former.

Cheese-Eco requires four groups of input variables to run a simulation: milk, cheese, and whey parameters; plant-wide constants; cost center parameters; and building and equipment parameters. Selected key parameters are reported in Table 2 by study state.

Milk, cheese, and whey parameters determine the yield and final cheese product. Milk characteristics—like nonstandardized milk price, fat content, and casein content—allow for variation in the raw milk received by the cheese plant. The mailbox price for milk (USDA(f), 1997) was used as the milk price for all states, except for California. Such a price is not the actual price paid for milk by the processors but rather the price received by farmers, excluding discounts, hauling charges, and premiums charged or paid to the farmers. However, it is readily available for each state and provides a milk price that is consistent between states. Since California is not covered by a Federal Milk Marketing Order, we employed the California 4b milk price (CDFA, 1996). The fat content of milk was the 1995 average according to the USDA(e) (1996). The casein content of the milk was estimated via the percentage of fat. Cheese yield was then calculated from the percent casein in the milk received.

Table 2. Input Data Used in Cheese-Eco, Selected States, 1995.

Cheese Production Cost and Revenue	Study States				
	California	Idaho	Minnesota	Wisconsin	New York
Milk Characteristics					
milk price ($/cwt.)[a]	11.41	12.01	13.55	14.82	13.69
percent fat (%)[b]	3.64	3.59	3.71	3.65	3.76
Plant-Wide Constants					
land price ($/acre)[c]	99,999	40,000	40,000	99,999	40,000
supervisory wage ($/hr.)[d]	19.84	15.00	18.74	17.37	17.88
regular labor wage ($/hr.)[d]	12.32	10.06	12.32	12.08	10.98
natural gas ($/therm)[e]	0.26	0.28	0.30	0.48	0.33
electricity ($/kwh)[e]	0.07	0.03	0.04	0.06	0.04
fringe benefit rate (%)[f]	37.00	37.00	41.20	41.00	41.20
water ($/1,000 gal.)[g]	1.39	0.62	1.61	1.34	0.66
wastewater ($/1,000 gal.)[g]	2.17	0.69	2.66	1.51	0.99
property tax ($/$1000)[h]	11.00	22.86	32.79	65.36	66.77
property taxed (%)[h]	100.00	100.00	83.90	100.00	55.00
equipment exempted[h]	no	yes	yes	yes	yes

[a]All milk prices—except those for California, which were from CDFA (1996)—were from the USDA(f) (1996).
[b]USDA(e) (1996).
[c]Phone interviews with various real estate agents in the selected states (maximum Cheese-Eco limit is $99,999 per acre).
[d]U.S. Department of Commerce (1992).
[e]Energy Information Administration (1993).
[f]USBLS (1995).
[g]Ernst and Young LLP (1995).
[h]Gould (1995).

Cheese characteristics included the type, final moisture, and price of cheese produced. A 38%-moisture cheddar cheese was assumed to be produced. The cheese price was set equally for all states at $1.33 per pound, that is, the 1995 average price for 40-pound blocks of cheddar cheese at Wisconsin assembly points (USDA(g), 1996). Whey is an important by-product from cheese production. It is used in a variety of different products, ranging from animal feed to milk replacer and is often processed into whey protein concentrate, which is used in everything from baby food to high-protein body-building bars. In fact, the need for a market for this by-product often helps to dictate plant location and profitability. However, due to data limitations, whey was removed from the analysis, which allows a focus on cheese costs.

The plant-wide constants included plant, land, labor, financial, and utility parameters as well as general plant-wide costs. The plant parameters—such as the plant capacity, operating days per week, operating hours per day, and milk through-put—allow the plant size to be changed. It is assumed that the firms would operate 24 hours a day, six days a week, to maximize plant use. This study projected production costs for plants with capacities of 1.44 and 2.40 million-pounds of milk/day. The 1.44-capacity firm was selected as a smaller plant that, while being close to standards of the plant size being built today, would still enjoy economies of scale. The 2.4 million-pound plant was selected as the largest plant capacity in this study.

Land parameters included the price of land and the amount of land needed for the plant. The value of industrial land for each state was obtained from real estate agents (Werner, 1996). Land prices in New York and California were set at the maximum allowable entry in Cheese-Eco ($99,999/acre). Approximately five acres of land are required for cheese plants of these sizes, according to Mead and Hunt (1987). Cheese-Eco uses a land factor as follows: Land estimates in square feet are converted to acres and divided by building area to obtain land input factors per 10,000 square feet of plant building area. Land cost enters this by looking at the initial investment in land, buildings, and cost of work on the plant site, and annualizing this cost over the useful life of the plant (25 years).

Labor parameters involve supervisory labor, a labor wage rate, a supervisory wage rate, and a labor fringe benefit rate. Supervisory labor was based on 24 hours of supervisory labor per operating day for both sizes of plants. The labor wage rate was derived by dividing total production worker wages by production worker hours (U.S. Department of Commerce, 1992). The supervisory annual wage rate was computed by dividing the difference in all employees' payroll and wages paid to production workers by the difference in total employees and production workers. The supervisory hourly wage rate was obtained by dividing the annual salary by the product of 52 weeks multiplied by 40 hours per week. The rate of the supervisor wage in Idaho was increased by 25 percent because it was unusually low. In addition, the growth of the Idaho dairy industry has increased the demand for supervisory labor, causing the supervisory wage rate to increase since 1992. Labor costs in Idaho appear to be low due to the state's small population base as compared to more densely populated states and to relatively few employment alternatives. The fringe benefit rate is the percentage of the wage that would be paid in benefits. The percentage of total compensation for working was decomposed into wages and benefits to employees for each U.S. region (USBLS, 1995). The rate was then calculated by dividing the benefits by the wages for each region.

Financial parameters included the insurance rate, property tax, and interest rate. Since it is difficult to specify an exact insurance rate without site-specific data, the insurance rate for each state was set equally at $4 per $1,000 of value. This rate is very reasonable according to Mesa-Dishington, Aplin, and Barbano (1987a). Property tax rates and laws differ between and within each state. Cheese-Eco does not allow for variability in tax laws and just uses $1 per $1,000 of property value. Property tax rates were higher in Minnesota and Wisconsin, but their tax laws were less strict than those of California and New York (Table 2). Moreover, property tax rates are not a significant factor in the production cost per pound of cheese. For instance, the cost per pound of cheese for a $20 tax per $1,000 of property value is three-tenths of a cent. Thus, even though property tax rates varied somewhat among the states, property tax rates were set equally among them at $20 per $1,000 of land value. The interest rate was also held constant and was set at 8.25 percent. With flexible interstate banking laws and such firms being large borrowers, it should be possible to source funds anywhere in the nation.

The utility parameters were natural gas, electricity, and water and wastewater rates. The natural gas and electricity rates were obtained from the Energy Information Administration (1993). Water and wastewater rates were derived from Ernst and Young (1994). The monthly water and wastewater rates were converted from monthly charges to a per-gallon base. For Idaho, the water and wastewater rates for Salt Lake City, Utah, were used since it is the closest city to Boise, Idaho, in the Ernst and Young database. An average value from nine California cities was used for California. Milwaukee was the only entry in Wisconsin. An average value of St. Paul and Minneapolis was used for Minnesota. The figure used for New York was the average value from five cities in New York. Among study states, Wisconsin and Idaho had much lower water and wastewater rates than the other states did. California had the highest water rates, presumably due to significant demand and limited supplies of fresh water.

General plant-wide costs were assumed constant between states but varied between the size of plants. These costs included administrative, laboratory, laundry, packaging, and production materials other than milk, and were obtained from Mead and Hunt (1987).

The cost-center parameters included labor and material requirements, and utility usage. These parameters were held constant between states but changed depending upon the size of plants. In Cheese-Eco, labor requirements were entered as fixed or variable. Fixed labor was the number of man-hours required by the plant per day while variable labor was the number of man-hours required per million pounds of milk processed. Material requirements included cleaning supplies as well as supplies needed for day-to-day operation. Utility usage included the amount of electricity and natural gas used in fixed and variable amounts, the amount of water used, and the volume of sewage produced during processing. Water and sewage amounts were based on number of gallons per operating day.

The building and equipment parameters each had seven variables: original cost, setup site, salvage value, upper limit of life, remaining useful life, fixed maintenance, and variable maintenance. Assuming the plant was new, the remaining useful life was equal to the upper limit of life, which was 25 years for buildings and 15 years for equipment. The salvage value was set at 10 percent of the original purchase price.

The data described above were used to develop the costs, revenues, and net profit of cheese production. Transportation costs to several cities were then added to the production costs. The cities were selected to be representative of each region of the country: Seattle in the Northwest; Los Angeles in the Southwest; Dallas in the south central region; Denver in the central region; Chicago in the north central area; Atlanta in the Southeast; New York in the Northeast; and Boise in Idaho. A nationwide trucking company[1] provided refrigerated transportation costs. These costs were given in dollars per loaded road mile. These rates were then converted to dollars per pound.

Results and Discussion

The simulated results from Cheese-Eco provided itemized cost, total cost, total revenue, and net revenue for a cheese processing plant in each state. These results can be reported on an annual, daily, and per-unit basis. The focus in this study was the total cost per pound of cheese produced and how this cost differed among states. Therefore, we only report the total cost per pound for the 1.44 and 2.4 million-pound capacity plants by states in Table 3.

The results in Table 3 show that California could produce cheddar cheese at a least production cost of $1.32 per pound for the 1.44 million-pound plant and $1.28 per pound for the 2.4 million-pound plant. With the smaller plant size, Idaho could produce a pound of cheddar cheese for only 4.8 cents (or 3.65 percent) more than the price for which California could produce it. The rest of the states could produce a pound for at least 17 cents (or 13.44 percent) per pound more than the price for which California could produce it. In the production of cheddar cheese, the greatest manufacturing expense was the cost of milk, which accounted for approximately 86 percent of the total cost of production.

[1]The trucking company wished to remain anonymous.

Table 3. Costs of Processing Per Pound of Cheddar Cheese, Selected States, 1.44 and 2.4 Million-Pound Milk/Day Capacity Plants, 1995.

Cheese Production Cost and Revenue	Study State				
	California	Idaho	Minnesota	Wisconsin	New York
	($/lb.)				
1.44 Million-Pound Milk Capacity					
Milk	1.130	1.203	1.317	1.326	1.464
Labor	0.066	0.055	0.067	0.060	0.066
Utilities	0.030	0.015	0.022	0.020	0.032
Materials	0.049	0.049	0.048	0.048	0.049
Capital Investment	0.030	0.030	0.029	0.029	0.030
Repair and Maintenance	0.002	0.002	0.002	0.002	0.002
Other Expenses	0.002	0.002	0.002	0.002	0.002
Total Cost	1.317	1.365	1.495	1.494	1.654
2.4 Million-Pound Milk Capacity					
Milk	1.130	1.203	1.317	1.326	1.464
Labor	0.044	0.037	0.038	0.040	0.044
Utilities	0.025	0.013	0.019	0.017	0.027
Materials	0.047	0.048	0.046	0.046	0.047
Capital Investment	0.022	0.022	0.022	0.021	0.022
Repair and Maintenance	0.002	0.002	0.002	0.002	0.002
Other Expenses	0.002	0.002	0.002	0.002	0.002
Total Cost	1.279	1.333	1.458	1.460	1.616

California had a significant advantage over the other states in their cost of milk, at $1.13 per pound. The milk cost per pound of cheese in Idaho was 7 cents (or 6.07 percent) greater than the cost in California. However, it was also at least 11 cents (or 9.48 percent) less than the cost in other states in the study.

Also included in Table 3 are the processing costs (not including milk costs) per pound of cheddar cheese. Idaho had a slight advantage over Minnesota and Wisconsin in terms of processing costs. This advantage was a little more than 1 cent per pound for a 1.44 million-pound capacity plant and less than 1 cent in a 2.4 million-pound capacity plant. Processing costs in California and New York were at least 2 cents or more greater than they were in Idaho.

Advantages in the cost of production that were evident for Idaho and which were identified in Cheese-Eco were primarily labor and utilities costs. Idaho could produce cheddar cheese at the lowest labor and utility costs at 7 cents (5 cents) per pound for the 1.44 and 2.4 million-pound plants. Idaho is significantly lower than all other states in electricity cost because much of the state's electricity is provided by hydroelectric plants, which are low-cost electricity producers. With the smaller plant size, Idaho could produce a pound of cheese for 3 cents less than California, 2 cents less than Wisconsin, and 1 cent less than New York, respectively.

Idaho's labor cost advantage is likely to continue into the future, in large part because of the state's rural nature. While the state has experienced a large percentage population growth (22 percent) from 1990 through 1998 relative to other U.S. states (ranking second in percentage growth), total numbers are still comparatively small (Idaho ranks 32nd in total population) (U.S. Census Bureau, 1999). Electricity costs, on the other hand, may end up being a different story. Recent public policy discussion has centered on deregulation of the electric industry. If this occurs, and Pacific Northwest utilities garner the right to sell electricity on the open market, the cost for electricity in Idaho will most certainly rise.

When looking at the larger plants, each state had decreased manufacturing costs per unit relative to the smaller plants. Table 3 also illustrates the difference in the cost of production among the different plant sizes. For all of the study states, the cost of production was lower in the 2.4 million-pound capacity plant. The reader should be cautioned regarding such a difference since Cheese-Eco does not allow the full cost of the equipment for the larger plant to be entered into the program. Thus, the cost of equipment in this study was $1.2 million less than it should have been. This means that each state received equipment at a "discount price." However, the results from Cheese-Eco for the 2.4 million-pound capacity plant are acceptable for comparison purposes.

The costs of providing cheese to different cities from each study state are given in Table 4 for the 2.4 million-pound capacity plant. The least-cost provider of cheese to all the selected cities was California. The lower cost of milk and relatively competitive cost of manufacturing (excluding milk) in California allow the state to produce and transport to all areas of the United States at the lowest cost. Idaho was the second lowest-cost cheese provider to all the selected cities. Providing cheese to New York was most expensive for Idaho, at $1.41 per pound, while providing cheese to Seattle was least expensive for Idaho, at $1.36 per pound. Idaho cheese processors would have to spend an additional $118,000 in annual transportation costs for a 2.4 million-pound plant if they shipped all produced cheese to New York. Minnesota and Wisconsin were quite competitive with each other but took turns as the third least-cost provider. New York had the highest delivered cost to the selected cities among all the study states.

The competitive situation for Idaho, relative to the other study states, is also summarized in Table 4. California was the only state that could provide cheese at a lower cost than the cost at which Idaho could provide it, and it did so to all the cities selected. California's advantage over Idaho ranged from 3.4 cents per pound to Seattle to 8.6 cents per pound to Los Angeles. Idaho had an advantage over Minnesota, Wisconsin, and New York in providing cheese at least cost to all the selected cities. Idaho's margin below Minnesota and Wisconsin ranged from 7.3–15 cents per pound and from 6.5–16 cents per pound, respectively. Idaho was below New York's delivered price by a minimum of 22 cents per pound. Minnesota and Wisconsin were most competitive, with Idaho delivering to Chicago, and least competitive in providing cheese to Seattle. Idaho had the largest advantage over New York in providing cheese to Seattle at 38 cents less per pound.

These results show that the cheese industry in Idaho is quite competitive with other major cheese-producing states in the United States. Although California prevailed as the lowest-cost provider of cheese, the consumption of cheese in California was also the greatest among the study states (Table 1). In an attempt to look at overall surplus and deficiency in the cheese market, cheese consumption was divided into state cheese production to give "percentage consumed in state." Cheese consumption for each state was calculated by multiplying

Table 4. Total Production and Transportation Cost of Cheese to Selected Cities for a 2.4 Million-Pound Capacity Plant.[a]

	Processing and Transporting Cheese from								
To	Los Angeles, CA		Boise, ID	Minneapolis, MN		Milwaukee, WI		New York, NY	
	($/lb.)								
Los Angeles	1.279	(-0.086)	1.365	1.506	(0.140)	1.524	(0.159)	1.713	(0.348)
New York	1.372	(-0.042)	1.414	1.492	(0.078)	1.484	(0.070)	1.616	(0.202)
Chicago	1.350	(-0.048)	1.398	1.471	(0.073)	1.464	(0.065)	1.652	(0.253)
Denver	1.317	(-0.044)	1.361	1.484	(0.123)	1.489	(0.128)	1.673	(0.313)
Dallas	1.328	(-0.072)	1.399	1.493	(0.094)	1.493	(0.094)	1.679	(0.279)
Atlanta	1.351	(-0.061)	1.412	1.487	(0.075)	1.480	(0.068)	1.651	(0.239)
Seattle	1.321	(-0.034)	1.355	1.506	(0.151)	1.518	(0.163)	1.730	(0.375)

[a]The numbers in the brackets represent the difference in production plus transportation costs between Boise, Idaho, and corresponding metropolitan cities.

1995 state population and average per capita consumption for the United States. Each state in this study produced more cheese than it could consume. Therefore, it can be assumed that the excess is exported from the state. California used up almost all of the cheese that it produced, approximately 903 million pounds, or 98 percent of total production. Wisconsin, at the other extreme, only consumed 147 million pounds, or 7 percent of its total cheese production. Idaho utilized only 33 million pounds, or 8.5 percent of its total cheese production. Idaho was shown earlier to be the second lowest-cost provider of cheese. Thus, combining least-cost production with low in-state utilization, one has an industry that makes a very positive contribution to the state's economy. Using 1995 cheese prices, Idaho's production was valued at approximately $519 million.

Included in Table 1 is the average annual cheese production per processing plant in each of the study states. This number was calculated by dividing total cheese production by the number of plants in the state. In Idaho, annual production of 35.5 million pounds of cheese per plant is second only to Minnesota at 42.4 million pounds of cheese per plant. Though no conclusion in this study was drawn regarding economies of scale, past studies have established that economies of size are present in cheese manufacturing. Mesa-Dishington, Aplin, and Barbano (1987b) found that significant economies of size exist in the cheddar cheese industry. Economies of scale would provide Idaho and Minnesota with an advantage over the other study states due to their larger cheese plants.

Conclusions

Idaho had a continual increase in milk production during the last decade, showing particularly strong growth since 1993. As the fifth largest U.S. cheese-producing state, in 1995, Idaho produced 390 million pounds of cheese, an increase of 182 percent relative to 1992. The rapid growth of the dairy and cheese industries in Idaho gives rise to speculation regarding the future of the cheese industry in the state. Since approximately 85 percent of the milk produced in Idaho is processed into cheese (Mykrantz, 1997), the cheese industry is very important to milk producers. The Idaho dairy processing industry relies on an ability to produce milk products that are condensed and have an increased shelf life. This is primarily due to the distance from southern Idaho, where a majority of the milk is produced, to urban areas where the product can be consumed. The objectives of this study were to estimate costs of producing cheddar cheese and to analyze Idaho's competitiveness in the cheese production industry.

The competitive position of the Idaho cheese industry appears to be quite good. The ability of dairy farmers to provide milk for cheese at a relatively low price and to remain profitable allows Idaho to be competitive. Idaho dairy farmers take advantage of large open lots, high-quality forage that is available at a relatively low price, low capital investment compared to the Upper Midwest and eastern states, and economies of scale to provide milk at a low cost.

This study found that California could process and deliver cheese at a lower cost than any other states included in this study could. The cost of production for Idaho cheese processors was slightly more than the cost for processors in California, but it compared quite favorably with the cost for processors in Minnesota, Wisconsin, and New York. California's advantage over all the other states in the study was due almost entirely to the low price of milk in that state.

Excluding the cost of milk, Idaho had the lowest processing cost among the states. The cheese processing industry in Idaho benefits greatly from lower costs of labor and utilities. Labor costs in Idaho were $2.23 per hour less than they were in California, and Idaho had lower electrical, water, and wastewater rates than California had. The average plant capacity in Idaho is currently 15 million pounds more than the capacity in California. Even though the cost of milk had the largest influence on the cost of producing cheese, Idaho did gain some competitiveness, relative to California, as a result of lower processing costs. Future research might be directed to using mixed integer programming to develop a facilities location model, utilizing processing and transportation data such as that developed in this study.

Low processing costs, along with a relatively low cost of milk, makes Idaho very competitive in the nation's cheese industry. The growth of the Idaho cheese industry in recent years leads to the question of how much more the industry will grow. This change depends on the growth of the dairy industry in Idaho.

The regional effects of the 1996 Farm Bill on the dairy industry have yet to completely exhibit themselves, and the Federal Milk Order Reform process has not been completed. The loss of the Dairy Price Support Program on December 31, 1999, is expected to have minimal regional effects on cheese processors but will affect the national dairy situation. Movement toward a more competitive market will tend to decrease milk prices, and this will favor Idaho in the short term.

It would appear that Idaho dairy farmers have the ability to be profitable while receiving low milk prices and supplying as much milk as the cheese plants request. The limit to the growth of the dairy industry in Idaho may be environmental concerns and the availability of forages and water. Many environmental concerns—like runoff of farm waste, lagoon systems, and water quality for areas around farms—are already being regulated by state and federal agencies. The future of Idaho cheese processors will help to influence the future of the state's dairy industry.

References

Babb, E.M. 1980. "Cost and Financial Performance of Wisconsin Cheese Plants." Agricultural Experiment Station Bulletin No. 298, Department of Agricultural Economics, Purdue University, West Lafayette, IN. November.

Blaylock, J.R., and W.N. Blisard. 1988. "Effects of Advertising on the Demand for Cheese." Technical Bulletin No. 1752, Economic Research Service, U.S. Department of Agriculture, Washington, DC. December.

Blisard, W.N., T. Sun, and J.R. Blaylock. 1991. "Effects of Advertising on the Demand for Cheese and Fluid Milk." Economic Research Service, U.S. Department of Agriculture, Washington, DC. October.

Buekeboom, R., and E. Jesse. 1991. "Regional Competitive Advantage in the U.S. Cheddar Cheese Market." Extension Series No. 38, Department of Agricultural Economics, University of Wisconsin, Madison, WI. November.

CDFA (California Department of Food and Agriculture). 1996. "Minimum Price for Classes 1, 2, 3, 4a, and 4b Milk Market FOB Plant for November and December 1996 and January 1997." <http://www.cdfa.ca.gov/marketing/ pletter.html>.

Energy Information Administration. 1993. "State Energy Prices and Expenditures 1993, Industrial Sector." <http://www.eia.doe.gov/emeu/seper/contents.html>.

Ernst and Young LLP. 1995. "Ernst and Young 1994 National Water and Wastewater Rate Survey." Personal communication.

Gould, Brian. 1995. Personal contacts with University of Wisconsin, Lewis County Chamber of Commerce, and Minneapolis Assessor's Office.

Mead and Hunt. 1987. Engineering data from "Cheddar Cheese Manufacturing Costs Economies of Size and Effects of Different Current Technologies." Cornell University, Ithaca, NY.

Mesa-Dishington, J.K., R.D. Aplin, and D.M. Barbano. 1987a. "Economic Performance of 11 Cheddar Cheese Manufacturing Plants in Northeast and North Central Regions." Agricultural Economics Research Paper No. 87-2, Department of Agricultural Economics, Cornell University, Ithaca, NY. January.

Mesa-Dishington, J.K., R.D. Aplin, and D.M. Barbano. 1987b. "Cheddar Cheese Manufacturing Costs Economies of Size and Effects of Different Current Technologies." Agricultural Economics Research Paper No. 87-2, Department of Agricultural Economics, Cornell University, Ithaca, NY. January.

Mykrantz, J. 1997. Federal Milk Market Administrator's Office, Bothel, WA. Personal communication.

USBLS (U.S. Bureau of Labor Statistics). 1995. "Employers' Cost for Employee Compensation." U.S. Department of Labor, Washington, DC. March.

U.S. Census Bureau. 1995. *Statistical Abstract of the United States*. Washington, DC.

U.S. Census Bureau. 1999. "State Population Estimates and Demographic Components of Population Change: April 1, 1990, to July 1, 1998." <http://www.census.gov/population/estimates/state/st-98-2.txt>.

USDA(a) (U.S. Department of Agriculture). Various years. "Dairy Products Annual Summary." <http://usda.mannlib.cornell.edu:70/1/reports/nassr/dairy/pdp-bb>.

USDA(b) (U.S. Department of Agriculture). Various issues. "Dairy Products Annual Summary—Supplement." <http://usda.mannlib.cornell.edu:70/1/reports/nassr/dairy/pdp-bban>.

USDA(c) (U.S. Department of Agriculture). "Food Consumption—Table 11, Dairy Products." <http://usda.mannlib.cornell.edu/data-sets/food/89015>.

USDA(d) (U.S. Department of Agriculture). 1992–93. "Economic Indicators of the Farm Sector: Costs of Production—1993, Major Field Crops, Livestock, and Dairy." ECIFS 13-3, Economic Research Service, U.S. Department of Agriculture, Washington, DC.

USDA(e) (U.S. Department of Agriculture). 1996. "Milk Production, Disposition, and Income." <http://usda.mannlib.cornell.edu:70/0/reports/nassr/dairy/pmp-bbm/milk_production_disposition_and_income_05.16.95>. May.

USDA(f) (U.S. Department of Agriculture). 1996 and various other issues. *Dairy Market News*.

USDA(g) (U.S. Department of Agriculture). 1996. "Agricultural Outlook: Table 9—Price Indexes of Food Marketing Costs." Washington, DC. December.

U.S. Department of Commerce. 1992. *Census of Manufactures 1992*. U.S. Government Printing Office, Washington, DC.

Werner, C. 1996. "Idaho's Cheese Industry: The Competitive Situation." Master's Thesis, Department of Agricultural Economics and Rural Sociology, University of Idaho, Moscow, ID. May.