Economic Impact of Dairy Processing Expansion in Nebraska

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Executive Overview
The University of Nebraska – Lincoln Department of Agricultural Economics and College of Business were asked by the Alliance for the Future of Agriculture in Nebraska (**AFAN**) and the Nebraska Soybean Board to conduct an analysis detailing the economic impacts of adding various types of dairy processing plants in different locations in Nebraska. The findings presented represent assumptions about processing capacity by plant type, development of supporting dairy structure, and resulting impacts on feed demand.

The main findings are as follows:

- We find the economic impact is largest for butter plants. Butter plants require the largest volume of dairy input followed by cheese plants and yogurt plants. The magnitude of impacts also varies by the size and breadth of the local economy.
- Impacts are largest for Grand Island, followed by Norfolk and the Sioux City area (Nebraska portion). The magnitude of the impact also varies by plant size.
- Total expenditures and feed quantities are averages and conditional on the number of new dairy cows. More feed is required for larger dairies. Thus, the largest quantity of feed would be required for butter, then cheese, then yogurt plant.
- On average across the type of dairy and location, the impacts are $12,000 per new dairy cow. The per cow impacts are largest for the Grand Island Metro, then Norfolk Metro, and then Sioux City Metro.
- Per cow, impacts are largest for cheese plants. Butter and yogurt plants have similar per cow impacts regardless of location and size.

Detailed assumptions are listed in the report document and appendix along with an accompanying interpretation of the results. Questions and comments regarding the assumptions or reported results can be addressed to Elliott Dennis at elliott.dennis@unl.edu.

Introduction

With productivity gains over the past decade, Nebraska has significantly expanded its annual corn and soybean production, creating an opportunity to expand value-added agricultural production in the state. In particular, opportunities are present to expand livestock production and processing, with the subsequent economic activity for rural economies.

One opportunity is to significantly expand the dairy cattle industry in the state, by bringing in a cluster of dairies in conjunction with a type of dairy processor, such as cheese, butter, or yogurt plant. The associated leap in production would be difficult to achieve but has the potential to significantly expand employment opportunities in Nebraska's small metropolitan and micropolitan areas, as well as rural regions. This report considers the potential economic impact from developing a new cluster of dairies in conjunction with differing sizes of either fluid milk, butter, cheese, or yogurt plant located in either the Grand Island metropolitan area, Norfolk micropolitan area, and the Nebraska portion of the Sioux City metropolitan area.

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Nebraska Dairy and Processing Industry

The Nebraska milk cow inventory has decreased from a high of approximately 700,000 milking cows in the 1930s and 1940s to approximately 60,000 milking cows between 2000-2020 (see Figure 1). Nebraska per milk cow productivity, as measured by the number of pounds of milk per head, has steadily increased from 2500 pounds per head per year between 1930-1950 to approximately 25,000 pounds of milk per cow per year. Breeding, genetics, multi-day milking things, and improved feeding conditions are reasons why per cow milk productivity has dramatically increased.

Trends in milk cow numbers in Nebraska are like the US long-term trends. The number of milk cows in the United States has remained consistent since 1995. Total US milk production per cow has increased. The rate of change in these two measures has historically been faster in the US than in Nebraska. This is evidenced by Nebraska's share of production continuing to decrease through time. In 1930, the Nebraska share of milk cow inventory and production was approximately 3% of the national average. This has deteriorated to 0.65% of annual milk production and milk cow inventory in 2020.

However, Nebraska's share of milk cow inventory and annual milk production relative to the US has been slightly increasing since 2015. Two measures that point to this are the per cow milk production and production of milk fat - two commonly used productivity measures. Figure 2 plots the percent difference between Nebraska's and the US national average for these two productivity measures. Positive numbers indicate that Nebraska is relatively more productive than the US, on average. Between 1930-2008, Nebraska produced 7% last milk fat and 17% fewer pounds of milk per cow per year on average relative to the US. In 2008, per milk cow productivity and milk fat, relative to the US national average began increasing and since 2015, Nebraska has produced approximately 5% more milk pounds of milk per head per year and 5% more pounds of milk fat.

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Summary of Previous Dairy Processing Impact Analyses

A list of all available models that estimated the economic impact of dairy and dairy processing on a state's economy was collected and analyzed. Two groups of studies were found. The first group was conducted by either government or academic institutions. In this group, not every state with major dairy processing or dairy production had publicly reported economic impact estimates. Some states had multiple studies over time. The second group of studies was conducted by the International Dairy Foods Association (IDFA). These estimates are available for each of the US lower 48 states and reported by either state or US Congressional District and are published each year.

Table 1 tabulates and compares the gross economic impacts and impacts per milk cow in the top 10 states with the largest dairy cow inventories and other select states. For states that had multiple studies only the most recent study is used. All values are inflated to 2020 values using the Consumer Price Index (CPI). For the academic studies, per cow estimates ranged from approximately $10,000 to $35,000. The per cow impact in Nebraska was approximately $20,000, similar to neighboring states of South Dakota and Iowa. The primary difference between these two groups of studies is that the IDFA studies included the retailing and transportation of dairy products whereas the government and academic studies tended to focus on the economic impact of processing and the dairies need to support the processing industry. As such, the gross and per cow estimates from IDFA were nominally larger than the other group. IDFA economic impact estimates ranged from approximately $13,000 to $68,000. IDFA per cow impacts in Nebraska were approximately $65,000 – the second largest.

Comparison of Methodologies in Government and Academic Studies

As previously mentioned, the per cow estimates from the group of IDFA studies were always larger since they accounted for the economic impacts of retailing and transportation. These studies are useful to compare across states because of a consistent methodology that is applied each year. The government and academic studies capture more of the "true effect" of processing and dairy production on a state's economy because they focus only on the dairy's production and dairy processing impacts. However, the drawback is that the methodologies differ. Thus, we categorize and summarize the primary differences between these two methodologies and why estimates could vary substantially between different reports in the following section. We restrict our focus to economic impact estimates that used the input-output economic framework and used IMPLAN to estimate economic impacts.

<u>Study Area Size</u>

The study area size used to estimate dairy processing impacts varied from large agricultural regions to the county level. This is notable because modeling behavior changes depending on the size of the research area. Statewide models contained within economic models, such as IMPLAN, are understood to be the most accurate, with margins of error increasing as the focus area gets smaller. Statewide studies are the most frequently published studies and researchers tend to not modify these models much. For example, the 2020 "Comprehensive Review of Iowa's Dairy Industry" report examines industry heterogeneities within the state, but

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ultimately the economic impact analysis was conducted at a state level and the model was assumed to be representative.
Statewide impacts can also be aggregated up using impacts from smaller sub-regions. Each of these studies included large-scale statewide analysis *in addition to* the detailed breakdown of the value of the dairy industry for smaller sub-regions. This method is used for three primary reasons. First, it allows for impacts to vary across space to determine locations that have a greater reliance on dairy processing (Matthews and Sumner 2019). Second, it helps examine the multiplier impact of regional dairy and processing activity on its home region, but also in the other regions of Nebraska to emphasize the wide-reaching effects of dairy processing (Johnson et al. 2014). And third, it facilitates calculations of own-region and cross-region multipliers to determine the degree of connectedness between each regions' economy (Watson et al. 2014).

Varying Definitions of "Dairy Industry"

Reports on the "economic impact of the dairy industry" often define the supporting "dairy industry" in three ways. First, the impact of only dairies. Second, the impact of only dairy processing. Third, the impact of both dairy and dairy processing. As such, the methods and subsequent conclusions have important differences. Modifications can be made to the IMPLAN framework to accommodate the dairy sectors being studied in various impact analyses. Many studies evaluate dairy production in-depth, running models for dairy farms' various revenue streams, which include milk and cattle sales (Lemke 2012). Milk and cattle sales have a combined NAICS-coded sector in IMPLAN, which researchers can use to measure dairy production impacts.

Other studies focus only on the processing and manufacturing sectors of the dairy industry. These studies look at dairy production only as it relates to being an input in the dairy processing equation (John Dunham & Associates, Inc. 2019). Dairy processing is segmented into five NAICS-coded industries, each of which has its sector model in IMPLAN. Studies can model these five industries in aggregate (Watson et al. 2014), separately (Timms et al. 2020), or on a restricted subset conditional on the processing segment established in the study area (Guerrero, Amosson, and Jordan 2012; Taylor 2015). For example, Guerrero, Amosson, and Jordan (2012) only model the impacts of the Fluid Milk Products and Cheese Products sectors because the Southern Ogallala Region is home to only those kinds of manufacturers.

Many studies examine the impacts of dairy production and dairy processing *independent* of each other, they also discuss their *combined* total economic impact. In these cases, the customization of the IMPLAN framework is crucial to prevent the double-counting of economic activity. Two primary methods are used to avoid double counting. First, purchases of milk by processors may be excluded from the multiplier impact of the processing facility to avoid this (Johnson et al. 2014). Second, regional purchasing percentages are adjusted so that no processors are buying from local farmers and no processors are to buying from or selling to other processors in the study area (Timms et al. 2020). In either method, the net result is the minimization of double-counting the value of industry elements.

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Further Processing and Retailing

The definition of the dairy industry can also vary by including the wholesaling and retailing of dairy products as is the case with the frequently-used IDFA "Dairy Delivers" tool. The tool is an interactive map that allows the user to access pre-run IMPLAN reports of the economic impact of dairy processing on the entire United States, on each state individually, and on each congressional district within each state. The wholesaling and retailing tiers refer to "employees whose jobs depend on the sale of dairy products to the public", such as warehousing and transportation of dairy products and ice cream scoop shop clerks, servers in restaurants, and amusement park employees. These jobs are estimated by multiplying the employment levels for said businesses by dairy product sales as a percentage of total retail sales. The argument is that this establishes an "estimate of the employment in each sector generated solely by dairy product sales," which should be added as additional direct impacts because the dairy processing industry creates these jobs.

However, the dairy-related retail activity of a state may not necessarily be a direct output of the state's dairy industry alone. For example, similar retail activity is found in states that do not contain a large dairy or dairy processing industry. For example, Matthews and Summer study on the California dairy industry recognizes that California's sector of shipping and handling export dairy products relies heavily on the in-state production and processing of dairy products, and so export shipping and trucking could be analyzed as direct outputs but separate from the primary analysis of dairy and dairy processing impacts. This consideration of transportation impacts could also be applied to the transportation of farm milk to dairy processing plants as well as transportation of feed resources to dairy operations. Thus, the inclusion of retail and wholesale as direct outputs may be plausible if the study area is in countries or large geographical regions. For example, if the whole country stopped processing dairy, ice cream shop clerks would probably lose jobs. However, for state-by-state or smaller regional analysis, the inclusion of these sectors can lead to an inflated measure of impacts making comparisons between studies an issue.

Forward-Looking Modeling Methods

Most dairy impact studies are historical analyses rather than hypothetical impacts due to a change in processing capacity. A report by Johnson et al. (2014) models a scenario for hypothetical dairy industry expansion in three multicounty regions in Nebraska, one in the east, one in the northeast, and a central region. Each region contains 5-7 contiguous counties that are specifically modeled in IMPLAN. They examine the ongoing annual impacts if the 3 regions were to each adds 8 dairy producers, and if each dairy farm had 2,500 cows. Therefore, they model a 60,000-cow increase total, where some counties receive more than one dairy while others receive one or none. Johnson et al. (2014) determined this expansion would necessitate two of the regions to also add a processing facility to process 20,000-cows-worth of milk each, while the third would send milk to be processed out-of-state. In all, their model includes "16 dairy counties, two dairy and processing counties, three remaining counties in each region (rest of region), and the rest of the state", totaling 24 dairies (all of the same size) and two processors (same size). To model these in IMPLAN, it is assumed the "Dairy cattle and milk production"

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sector represents the dairy producers; however, it's unclear what sectors are used to represent the processing facilities.

Watson et al.'s (2014) study predict the economic impacts of a single dairy processor that was recently added to their region in Idaho. Because this study specifies a new plant, the researchers examine the expansion in two parts. First, they analyze the facility as a short-term construction project that will add value to the economy as a "one-time injection". Then second, they follow the typical route and evaluate the processing facility's long-term impacts from daily operations. The two are modeled entirely separately in the EMSI SAM database. This database is very similar to IMPLAN in that it's based on regional trade flows and can be edited to better fit research applications. The researchers adjust each model according to the planned specifications of the plant and analyze the impacts separately.

Estimating Employment and Value of Output

Estimation of inputs is an important element of any predictive model, and their accuracy is crucial for this analysis to be representative of the study area. However, no definitive guidelines have been established in the existing body of literature to define how inputs are used. For example, studies have different ratios of cows to employees which can vary by the size of operation. For example, Lemke (2012) assumes economies of scale within dairy production and assumes that a 6,000-cow dairy will need 50 employees, while a 4,000-cow dairy would need 40, and a 2,000-cow would need 25 employees. In contrast, Johnson et al. (2014) assume smaller dairies are less efficient and each 2,500-cow dairy farm would need 28 employees. These employment considerations result in differing dairy impacts. More employees per cow lead to more employee compensation and thus larger estimates of economic impacts.

The products that are reported as gross sales/output for dairy and dairy processing also differ. For dairies, most studies consider only the gross sales from milk (Lemke 2012) rather than counting other potential sources of revenue such as dairy steers and manure (Johnson et al. 2014). Dairy processing is more complicated to model and often depends on the specific plant type, size, and product mix. While broad estimates can be given, economic impacts for dairy processing plants often rely on proposed plant financials to estimate accurate impacts where construction impacts are considered separate from the long-term operating impacts. For example, in their 2014 study of adding a yogurt processor in Idaho, Watson et al. (2014) used the estimates of sales and employment from the proposed facility to estimate the direct impact of the construction of the plant and estimates of the long-term operational impact.

Location Considerations

Regional or statewide dairy reports often discuss what competitive advantages support their dairy industries. These comparative advantages within the state often drive the location of processing plants and the supporting dairies. These assumptions can affect the magnitude of impacts since different regions have varying degrees of potential employment, feed and water resources, accessibility to transportation, etc.

The first consideration is the availability of feed. This is one of the most important constraints when discussing the expansion of any livestock operation and is often cited as a crucial

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competitive advantage for regions with growing dairy industries (Owens 2018; Guerrero et al. 2019). Central location in the Midwest provides valuable proximity to many crop producers, increasing the odds that surplus feed will be available should more cows be introduced (Timms 2013). Additionally, growing feed on or very near to dairy farms helps lower operating costs and decrease the risk of volatility in feed prices (Shields 2010).

The second consideration is proximity to water. Water is crucial not only for the direct use of drinking water for cows and facility maintenance, but also for the indirect purpose of growing crops (Guerrero, Amosson, and Jordan 2012). The silage makeup of dairy rations makes it particularly expensive to transport dairy cattle feed over long distances, so dairy producers tend to concentrate near irrigated crop production (Guerrero et al. 2019). As such, the literature shows that the availability of water is a primary determinant of dairy producer and processor location (Owens 2018; Guerrero et al. 2019).

The third consideration is ease-of-transportation of goods to dairy operations and dairy processing plants. Dairy processors want to minimize the transportation costs of milk inputs. Matthews and Sumner report that the California dairy industry is heavily clustered around dairy processors generally confined to the same meteorological region. However, not all dairy industries are organized the same way. In Iowa, dairy facilities are not grouped into clusters, but instead, appear more spread out across the state (Timms et al. 2020). Dairy processors in Iowa tend to locate near the state's major transportation routes, like the two interstates that bisect the state so this is not necessarily a disadvantage as proximity to trucking and shipping can cut down on operating expenses for dairy producers and processors. The location of the dairies that support a new or existing dairy processing plant is an important consideration as it directly impacts the economic impact estimates. Impacts will be large for a given region if dairies are assumed to only be located in that region and smaller if more geographically spread out.

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Methods

Model

We use the IMpact analysis for PLANing (IMPLAN) framework model to estimate the impacts of adding either a butter, cheese, or yogurt processing plant in Nebraska. IMPLAN is an input-output model that examines how direct investments multiple through a large economy (Deller and Williams 2009) and is an industry-standard tool for economic impact analysis (John Dunham & Associates, Inc. 2019). The total economic impact from a potential new dairy plant is the sum of the direct and multiplier impact. The direct impact is the annual sales and labor directly associated with the dairy processing plant. The multiplier effect captures the inter-industry trade flows and consumer spending patterns that result from the dairy processing plant's new economic activity. The results are reported in a) annual sales and b) total new employment.

IMPLAN has been the preferred method in other economic studies measuring the impact of dairy and dairy processing plants. The tool has been used by academics, government officials, and industry. The "Dairy Delivers" report by The International Dairy Foods Association (IDFA) is the most highly referenced report that uses IMPLAN to estimate the total economic impact of the dairy industry in the lower 48 states and features impacts by US Congressional Districts. The IMPLAN model also can be used to analyze the impact of a cluster of dairies collocated with a processor, if care is taken to avoid "double counting" of economic activity. Double counting can occur between different stages of the supply chain. For example, the multiplier impact of a processor such as a cheese plant would include the total economic impact of dairies. In this study, the economic impact of dairies is removed from the multiplier impact of cheese plants. Likewise, the multiplier economic impact of dairies would include the total economic impact of crop production. To avoid double-counting the total impact of crop production is excluded from the multiplier impact of dairies.

Assumptions

<u>Locations</u>

Three metropolitan regions were used as potential locations for plant location: Grand Island, NE, Norfolk, NE, or Sioux City, NE. The impacts of the plant were limited to the surrounding metropolitan statistical areas (e.g., Hall, Hamilton, Howard, and Merrick counties for Grand Island, NE; Madison, Pierce, and Stanton counties for Norfolk, NE; Dixon and Dakota for Sioux City, NE).

<u>Processing Plants</u>

Either a butter, cheese, or yogurt hypothetical dairy processing plant is built in Nebraska. These plants are chosen as they represent plants that process different milk classes (e.g. Fluid Milk – Class I, Yogurt – Class II, Cheese – Class III, and Butter – Class IV). Products that come from these plants also have export potential thus not limiting the geographic market size. For each plant type, there are three plant sizes: small, medium, or large. Size is defined by both millions of pounds of milk processed per day and plant square footage. Estimates of plant size and processing capacity are taken from personal conversations with various industry, organizational, and academic leaders in food and dairy processing.

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Employment at each plant is categorized by either hourly or management on a full-time equivalent basis (FTE). Workers are assumed to work 40 hours per week plus 4 hours of overtime. Wages for each category are taken from the Bureau of Labor Statistics (BLS) and reflect Nebraska wages rates. Overtime is costed at a time and a half and benefits are assumed to 52% of wages, an industry average.

Annual sales are specific to plant type and size and are based on two sources. First, some estimates come from confidential reports that detail a generic processing plant's gross and net sales. Second, some estimates from estimating the relationship between dairy processing plant size (sq. ft.) and annual sales. Plant size and annual sales were taken from Duns and Bradstreet's (2020) proprietary database. All the dairy processing plant assumptions are in Table A.1 of the report appendix.

Supporting Dairies

All milk used in the hypothetical dairy processing plant is assumed to be supplied by new construction dairies all located within the specific geographical region of interest. The total number of cows need for each plant size and type is conditional on the millions of pounds per day needed and an average dairy cow productivity of 75 lbs. per day per cow over 320 milking days or 24,029 pounds of milk per cow per year. Measures of dairy cow productivity are taken from a 10-year average of dairy producer financial records supplied by the University of Minnesota Farm Financial Management Database (FINBIN 2020).

Employment for each hypothetical dairy is categorized by either hourly or management on a full-time equivalent basis (FTE). The number of employees is based on the ratio of cows to workers – one hourly employee per 100 cows and 1 management employee per 1,000 cows. Workers are assumed to work 40 hours per week plus 4 overs of overtime. Wages for each category are taken from the Bureau of Labor Statistics (BLS) and reflect Nebraska wages rates. Overtime is costed at a time and a half and benefits are assumed to 52% of wages, an industry average.

Annual sales for each dairy are conditional on the type of milk being produced, historical market prices, number of milking cows, and milk production per cow per year. Historical class II, III, and IV milk prices are 10-year averages of CME futures prices assuming 24,029 pounds of milk per cow per year from the University of Minnesota Farm Financial Management Database (FINBIN 2020). All the new dairy operation assumptions to be built to support a hypothetical processing plant are in Table A.2 in the report appendix.

Feed Resources

Milk cows convert feed into energy and milk. The feed necessary to supply the dairies is assumed to be completely raised and harvested in Nebraska. Total feed costs are calculated from USDA's Margin Protection Program (MPP) which uses feed prices and fixed ratios to calculate feed costs per hundredweight of milk produced attributed to either a) hay, b) corn, or c) soybean meal. Using a 10-year average of hay and corn from Nebraska and Central Illinois

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Soybean Meal prices, the total feed cost per hundredweight of milk was $9.81 or $2,357 per cow per year assuming a 24,029 per pound per cow per year production. Total costs attributed to hay, corn, and soybean meal is $570 (24%), $1,147 (49%), and $639 (27%), respectively.

The total quantity of feed consumed by dairy cows by plant type and size is calculated using annual per cow feed costs and 10-year average historical feed price costs. On average, each dairy cow is assumed to consume 11.61 metric tons of feed per year – 3.29 tons of hay, 6.55 tons of corn, and 1.77 tons of soybean meal. These estimates of feed consumption per cow per year are consistent with other studies estimating dry matter feed consumption. The total feed use and cost for alternative types and sizes of processing plants are reported in Table 5.

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Limitations

Economic impacts *not* captured in these estimates include a) heifer development, b) dairy steer finishing, c) one-time impacts due to cheese plant and dairy construction, d) shifts in crop choice attributable to dairy expansion, and e) the sale of manure. It is likely that at least some of the dairy heifer development and steer finishing would occur in Nebraska, construction would have a large, one-time impact, crop-choice would change to more silage-based products, and dairies would sell some of their manure to local crop operations. Thus, these estimates likely represent a lower bound for both the supporting dairies and dairy processing industry.

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Results
A summary of the direct, multiplier, and total output, employment, and employee compensation are in Tables 2, 3, and 4. The direct impact refers to economic activity at butter, cheese, or yogurt plants themselves *plus* associated dairies, which are assumed to collocate in the same area. The multiplier impact refers to additional economic activity which occurs in the local economy. The multiplier impact occurs as cheese, butter, or yogurt plants and dairies purchase supplies and services within the local economy or as their workers spending paychecks on normal household items such as mortgage or rent, insurance, health care, food, fuel, other retail, recreation, entertainment, and other services. Multiplier impacts as a result support businesses throughout the economy. The total economic impact is the sum of the direct and multiplier impact.

Output is the broadest measure of economic impact and refers to the value of business sales. Employee compensation and employment are measures of impact on the labor market. Employee compensation refers to wages, salaries, benefits, and proprietor income. Employee compensation is a component of output and *should not be added to the output.* Employment includes both full- and part-time jobs. Direct jobs would be expected to be full-time but multiplier employment would occur throughout the economy and could be either full-time or part-time.

Plant Type
The economic impact of this expansion would be felt in the local economies. Butter, cheese, and yogurt plants are very capital and input-intensive operations, implying that the value of business sales is large compared to employment and employee compensation. As a result, the economic impact in terms of output (business sales) is concentrated in the dairies and cheese, butter, and yogurt plants themselves. By contrast, the multiplier impact for employment is often larger than the direct employment impact.

Given that dairies are assumed to collocate with butter, cheese, and yogurt plants, the economic impact is largest for butter plants. Butter plants require the largest volume of dairy input followed by cheese plants and yogurt plants. The magnitude of impacts also varies by the size and breadth of the local economy. Impacts are largest for Grand Island, followed by Norfolk and the Sioux City area (Nebraska portion). The magnitude of the impact also varies by plant size.

Plant Size
<u>Large Plants</u>
The annual economic impact of a large butter plant and associated dairies in Grand Island is $1.68 billion, including 208 million in employee compensation spread out over an estimated 4,184 jobs. More than half of these jobs are due to the multiplier impact. The annual economic impact of a large butter plant would fall to $1.65 billion in the Norfolk area and $1.48 million in the Sioux City area (Nebraska portion).

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The annual economic impact is smaller for cheese and yogurt plants. The annual economic impact is $1.59 billion for a large Grand Island cheese plant and its associated dairies versus $1.54 billion in the Norfolk area. The annual economic impact for a large Grand Island yogurt plant and its dairies is $648 million versus $569 million in the Nebraska portion of the Sioux City area.

Medium Plants
Economic impacts are less in medium-size plants, given lower levels of output and employment and less need for associated local dairies. The annual economic impact of a medium-size butter plant and associated dairies in Grand Island is $1.36 billion, including 167 million in employee compensation spread out over an estimated 3,375 jobs. The annual economic impact of a medium-size butter plant would fall to $1.33 billion in the Norfolk area and $1.20 million in the Sioux City area (Nebraska portion).

The annual economic impact is smaller for cheese and yogurt plants. The annual economic impact is $885 million for a medium-size Grand Island cheese plant and its associated dairies versus $858 million in the Norfolk area and $788 million in the Sioux City area (Nebraska portion).

Small Plants
The annual economic impact of even a small butter plant and associated dairies would be from $700 to $800 million. The largest annual impact again would be in Grand Island. The annual impact in Grand Island would be $807 million including $99 million in employee compensation spread over nearly 2,000 jobs. The annual economic impact of a small cheese plant in Grand Island would be $354 million versus $343 million in Norfolk. The annual economic impact of a small yogurt plant in Grand Island is $162 million versus $142 million in the Nebraska portion of the Sioux City area.

Feed Resources
Expenditures on feed by crop type from supporting dairies are calculated (see Table 5). Total expenditures and feed quantities are averages and conditional on the number of new dairy cows. More feed is required for larger dairies. The largest quantity of feed would be required for butter, then cheese, then yogurt plant. To support a medium size cheese plant in Grand Island, approximately $38 million, $76 million, and $42 million per year would be spent on hay, corn, and soybeans, respectively. This equates to approximately 773,000 metric tons of feed.

Per cow impacts
Direct outputs (Table 2) and the new additional dairy cows (Table A.2) are used to calculate impacts per cow. On average across the type of dairy and location, the impacts are $12,000 per new dairy cow. The per cow impacts are largest for the Grand Island Metro, then Norfolk Metro, and then Sioux City Metro. Likewise, per cow impacts are the largest for cheese plants. Butter and yogurt plants have similar per cow impacts regardless of location and size.

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Conclusion and Implications

The proceeding analysis shows that there are large annual economic impacts associated with butter, cheese, and yogurt plant development. Even relatively small facilities have a large impact on the economy given that a dairy industry would also need to be developed in the surrounding region. As seen in Table 6, the local economic impact per cow is typically in the $10,000 to $14,000 range, which is modest compared to many statewide estimates from around the country presented in Table 1.

Nonetheless, the local economic impact under each scenario is large, reaching nearly $1.7 billion on an annual basis and thousands of jobs in some cases. While the impacts are large, the challenge also will be substantial for economic developers who are tasked with attracting a major dairy and processor cluster to the state.

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Supporting Figures

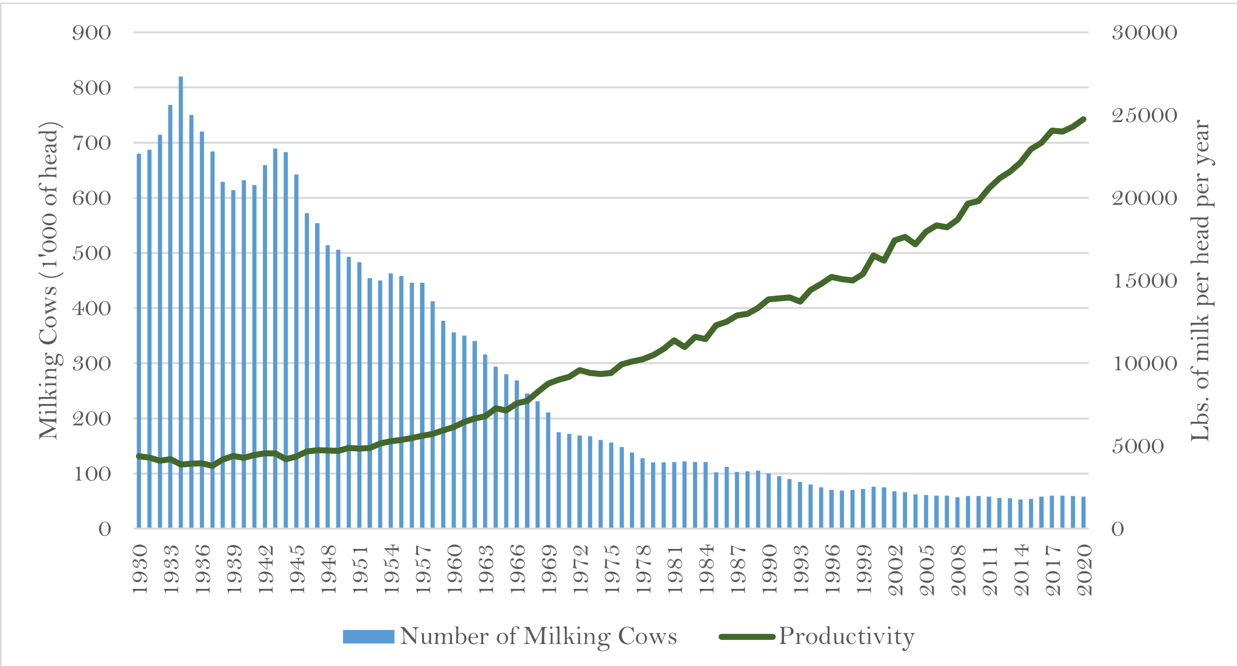

Figure 1. Annual Milk Cow Inventory and per Milk Cow Productivity in Nebraska, 1930-2020
Source: USDA-NASS (2020)

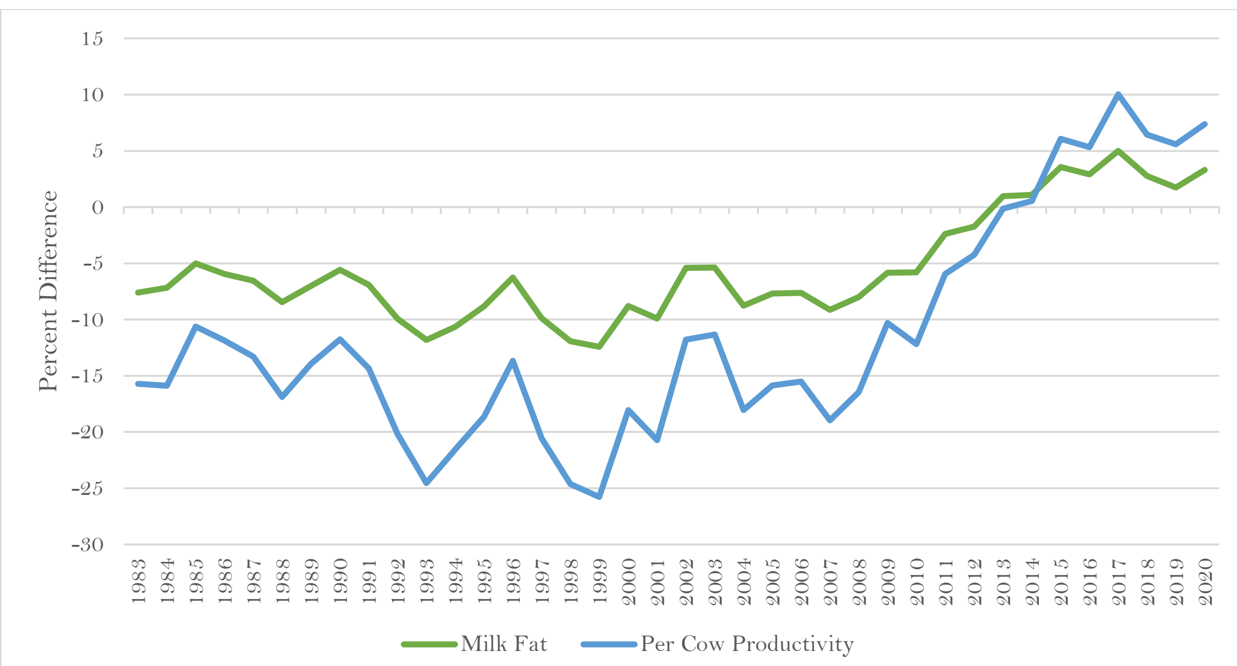

Figure 2. Percent Difference in Milk and Per Cow Productivity Between National Average and Nebraska
Source: USDA-NASS (2020)

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Supporting Tables

Table 1: Economic Impact of Cows in the Selected States

State	Cow Inventory (1'000 hd.)[1]	Gross Economic Impacts ($1'000'000)		Impacts per Cow ($)		Source
		Studies	IDFA[2]	Studies	IDFA	
California	1725	58,610	90,394	33,879	52,251	Matthews and Sumner, 2019
Wisconsin	1260	47,522	58,712	37,419	46,230	Deller, 2019
New York	625	16,850	35,268	26,959	56,429	Schmit, 2014
Idaho	640	7,349	11,426	11,969	18,610	Watson et al., 2014
Texas	580	n.d.[3]	33,864	n.d.[3]	62,135	
Pennsylvania	480	15,821	25,028	31,329	49,560	Nicholson et al., 2018
Michigan	427	13,774	24,198	30,609	53,773	Ye, 2011
Minnesota	445	11,330	16,747	26,848	39,686	Knudson, 2018
New Mexico	330	n.d.[3]	4,155	n.d.[3]	12,786	
Washington	282	5,911	10,018	21,111	35,779	Neibergs and Brady, 2013
Iowa	215	5,797	10,689	26,350	48,587	Timms et al., 2020
South Dakota	127	2,694	2,832	22,079	23,209	Taylor, 2015
Nebraska	58	1,323	3,434	22,421	58,208	Thompson et al., 2020

Source: Various sources
Notes: [1] From USDA-NASS (2020); [2] From IDFA's "Dairy Delivers" (2020) https://www.idfa.org/dairydelivers.com; [3] No data found

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Table 2. Calculated IMPLAN Output Impacts (millions of USD)

	Direct A	Multiplier B	Total C = A + B	Source
Panel (a): Grand Island Metro Area				
Fluid Milk				
Small	38.35	15.17	53.52	Calculated
Medium	98.76	41.10	139.86	Calculated
Large	171.77	67.81	239.58	Calculated
Butter				
Small	598.47	208.16	806.64	Calculated
Medium	1006.18	351.29	1357.47	Calculated
Large	1245.95	435.03	1680.98	Calculated
Cheese				
Small	274.92	79.35	354.27	Calculated
Medium	687.30	197.52	884.82	Calculated
Large	1237.14	355.43	1592.57	Calculated
Yogurt				
Small	122.21	39.63	161.84	Calculated
Medium	244.44	78.83	323.27	Calculated
Large	488.88	159.14	648.02	Calculated
Panel (b): Norfolk Metro Area				
Fluid Milk				
Small	38.35	13.84	52.19	Calculated
Medium	98.76	37.60	136.36	Calculated
Large	171.77	62.09	233.86	Calculated
Butter				
Small	598.47	194.71	793.19	Calculated
Medium	1006.18	328.35	1334.53	Calculated
Large	1245.95	406.89	1652.84	Calculated
Cheese				
Small	274.92	68.50	343.42	Calculated
Medium	687.30	170.47	857.77	Calculated
Large	1237.14	306.76	1543.90	Calculated
Yogurt				
Small	122.21	37.52	159.74	Calculated
Medium	244.44	74.66	319.10	Calculated
Large	488.88	150.67	639.55	Calculated
Panel (c): Sioux City Metro Area				
Fluid Milk				
Small	38.35	7.38	45.73	Calculated
Medium	98.76	20.17	118.93	Calculated
Large	171.77	33.43	205.20	Calculated
Butter				
Small	598.47	112.90	711.37	Calculated
Medium	1006.18	190.00	1196.18	Calculated
Large	1245.95	235.85	1481.79	Calculated
Cheese				
Small	274.92	40.49	315.41	Calculated
Medium	687.30	100.84	788.14	Calculated
Large	1237.14	181.46	1418.60	Calculated

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Yogurt				
Small	122.21	20.07	142.28	Calculated
Medium	244.44	39.93	284.37	Calculated
Large	488.88	80.56	569.44	Calculated

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Table 3. Calculated IMPLAN Employment Impacts (Number of New Jobs)

	Direct A	Multiplier B	Total C = A + B	Source
Panel (a): Grand Island Metro Area				
Fluid Milk				
Small	104	93	197	Calculated
Medium	313	256	569	Calculated
Large	476	419	895	Calculated
Butter				
Small	764	1226	1990	Calculated
Medium	1307	2068	3375	Calculated
Large	1620	2564	4184	Calculated
Cheese				
Small	368	470	838	Calculated
Medium	901	1168	2069	Calculated
Large	1620	2102	3722	Calculated
Yogurt				
Small	197	242	439	Calculated
Medium	383	481	864	Calculated
Large	782	972	1754	Calculated
Panel (b): Norfolk Metro Area				
Fluid Milk				
Small	104	81	185	Calculated
Medium	313	225	538	Calculated
Large	476	367	843	Calculated
Butter				
Small	764	1033	1797	Calculated
Medium	1307	1744	3051	Calculated
Large	1620	2162	3782	Calculated
Cheese				
Small	368	386	754	Calculated
Medium	901	959	1860	Calculated
Large	1620	1726	3346	Calculated
Yogurt				
Small	197	213	410	Calculated
Medium	383	423	806	Calculated
Large	782	855	1637	Calculated
Panel (c): Sioux City Metro Area				
Fluid Milk				
Small	104	47	151	Calculated
Medium	313	128	441	Calculated
Large	476	212	688	Calculated
Butter				
Small	764	690	1454	Calculated
Medium	1307	1163	2470	Calculated
Large	1620	1442	3062	Calculated
Cheese				
Small	368	251	619	Calculated
Medium	901	625	1526	Calculated
Large	1620	1125	2745	Calculated

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Yogurt				
Small	197	127	324	Calculated
Medium	383	252	635	Calculated
Large	782	509	1291	Calculated

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Table 4. Calculated IMPLAN Employee Compensation Impacts (Millions of Dollars)

	Direct A	Multiplier B	Total C = A + B	Source
Panel (a): Grand Island Metro Area				
Fluid Milk				
Small	6.79	4.58	11.37	Calculated
Medium	21.51	12.43	33.95	Calculated
Large	32.02	20.58	52.61	Calculated
Butter				
Small	34.74	63.78	98.52	Calculated
Medium	59.54	107.87	167.41	Calculated
Large	74.95	133.26	208.21	Calculated
Cheese				
Small	18.73	24.52	43.26	Calculated
Medium	45.51	61.06	106.57	Calculated
Large	81.77	109.88	191.64	Calculated
Yogurt				
Small	10.62	12.39	23.01	Calculated
Medium	20.59	24.65	45.24	Calculated
Large	43.44	49.72	93.17	Calculated
Panel (b): Norfolk Metro Area				
Fluid Milk				
Small	6.79	3.94	10.73	Calculated
Medium	21.51	10.73	32.24	Calculated
Large	32.02	17.67	49.70	Calculated
Butter				
Small	34.74	50.90	85.64	Calculated
Medium	59.54	85.92	145.46	Calculated
Large	74.95	106.42	181.37	Calculated
Cheese				
Small	18.73	19.41	38.14	Calculated
Medium	45.51	48.29	93.80	Calculated
Large	81.77	86.89	168.66	Calculated
Yogurt				
Small	10.62	10.57	21.19	Calculated
Medium	20.59	21.03	41.61	Calculated
Large	43.44	42.45	85.89	Calculated
Panel (c): Sioux City Metro Area				
Fluid Milk				
Small	6.79	2.61	9.40	Calculated
Medium	21.51	7.01	28.52	Calculated
Large	32.02	11.77	43.80	Calculated
Butter				
Small	34.74	41.71	76.45	Calculated
Medium	59.54	70.12	129.66	Calculated
Large	74.95	87.04	161.99	Calculated
Cheese				
Small	18.73	15.01	33.75	Calculated
Medium	45.51	37.43	82.95	Calculated
Large	81.77	67.37	149.14	Calculated

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Yogurt				
Small	10.62	7.35	17.97	Calculated
Medium	20.59	14.64	35.23	Calculated
Large	43.44	29.46	72.90	Calculated

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Table 5. Feed Use and Costs Due to Processing Plant Development

	Small[1]	Medium[1]	Large[1]	Source
Panel (a): Feed Expenditures from Supporting Dairies (Millions of USD)[2]				
Fluid Milk				
Hay	2.28	5.32	9.13	USDA-FSA MPP (2020) & Calculated
Corn	4.59	10.71	18.35	USDA-FSA MPP (2020) & Calculated
Soymeal	2.56	5.97	10.23	USDA-FSA MPP (2020) & Calculated
Total	9.43	22.00	37.71	USDA-FSA MPP (2020) & Calculated
Butter				
Hay	38.03	64.65	79.11	USDA-FSA MPP (2020) & Calculated
Corn	76.48	130.01	159.07	USDA-FSA MPP (2020) & Calculated
Soymeal	42.63	72.47	88.67	USDA-FSA MPP (2020) & Calculated
Total	157.14	267.14	326.85	USDA-FSA MPP (2020) & Calculated
Cheese				
Hay	15.21	38.03	68.46	USDA-FSA MPP (2020) & Calculated
Corn	30.59	76.48	137.66	USDA-FSA MPP (2020) & Calculated
Soymeal	17.05	42.63	76.74	USDA-FSA MPP (2020) & Calculated
Total	62.86	157.14	282.85	
Yogurt				
Hay	7.61	15.21	30.42	USDA-FSA MPP (2020) & Calculated
Corn	15.30	30.59	61.18	USDA-FSA MPP (2020) & Calculated
Soymeal	8.53	17.05	34.10	USDA-FSA MPP (2020) & Calculated
Total	31.43	62.86	125.71	USDA-FSA MPP (2020) & Calculated
Panel (b): Feed Quantities from Supporting Dairies (metric tons)[3]				
Fluid Milk				
Hay	13,168	30,724	52,672	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Corn	26,192	61,113	104,769	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Soymeal	7,065	16,483	28,258	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Total	46,425	108,320	185,698	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Butter				
Hay	219,466	373,089	456,488	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Corn	436,538	742,109	907,997	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Soymeal	117,743	200,161	244,904	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Total	773,747	1,315,359	1,609,389	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Cheese				
Hay	87,787	219,466	395,037	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Corn	174,616	436,538	785,764	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Soymeal	47,097	117,743	211,936	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Total	309,501	773,747	1,392,737	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Yogurt				
Hay	43,892	87,787	175,571	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Corn	87,305	174,616	349,226	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Soymeal	23,548	47,097	94,193	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated
Total	154,745	309,501	618,990	USDA-FSA MPP (2020), USDA-AMS (2020) & Calculated

Source: Various and author's calculations

Notes: [1] Number of milk cows per plant size and type are taken from Table A.2 in the report appendix and assumes a 24,029 pound per cow per year production; [2] Feed costs are calculated using USDA-FSA Margin Protection Program (MPP) ration where 24% of feed costs are attributed to hay, 49% to corn, and 27% to soybean meal. Total costs per hundredweight of milk are calculated to be $9.81 or $2,357 total feed costs per cow per year; [3] Calculated using total feed costs and costs per ton of feed.

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Table 6. Additional Value of Impact per Cow

	Marginal Value of Expansion[1]		
	Small	Medium	Large
Panel (a): Grand Island Metro			
Fluid Milk	13,380	14,986	14,974
Butter	12,100	11,978	12,122
Cheese	13,285	13,272	13,271
Yogurt	12,138	12,122	12,150
Panel (b): Norfolk Metro			
Fluid Milk	13,048	14,610	14,616
Butter	11,898	11,775	11,919
Cheese	12,878	12,866	12,866
Yogurt	11,981	11,966	11,992
Panel (c): Sioux City Metro			
Fluid Milk	11,433	12,743	12,825
Butter	10,670	10,555	10,686
Cheese	11,828	11,822	11,822
Yogurt	10,671	10,664	10,677

Source: Author's Calculations and 2017 Nebraska Agriculture Impact Report

Notes: [1] Calculated by dividing the Total Output from plant expansion (Table 2) by the number of new dairy cows required to support the new plant (Table A.2);

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Appendix

Table A.1. Dairy Processing Plant Assumptions

	Small[1]	Medium[1]	Large[1]	Source
Panel (a): Processing Capacity (Millions of lbs. per day)				
Fluid Milk	0.3	0.7	1.2	Confidential Report
Butter	5	8.5	10.4	Confidential Report
Cheese	2	5	9	Confidential Report
Yogurt	1	2	4	Confidential Report
Panel (b): Plant Size (1'000 sq. ft)				
Fluid Milk	45	125	220	Confidential Report
Butter	120	200	250	Confidential Report
Cheese	80	200	360	Confidential Report
Yogurt	100	200	400	Confidential Report
Panel (c): Employment -Hourly/Management (N of Employees)				
Fluid Milk	50/10	175/35	250/50	Confidential Report
Butter	25/6	50/10	75/20	Confidential Report
Cheese	65/10	143/25	255/45	Confidential Report
Yogurt	40/10	70/20	140/55	Confidential Report
Panel (d): Total Labor Costs: Wages + Benefits (Millions of USD per year)[1]				
Fluid Milk	4.86	17.01	24.30	BLS (2020)
Butter	2.58	4.86	8.05	BLS (2020)
Cheese	5.86	13.35	23.88	BLS (2020)
Yogurt	4.19	7.72	17.71	BLS (2020)
Panel (e): Annual Sales (Millions of USD per year)				
Fluid Milk	23.04	63.04	110.54	D&B Hoovers (2020) & Confidential Report
Butter	336.59	560.99	701.24	D&B Hoovers (2020) & Confidential Report
Cheese	164.25	410.62	739.12	D&B Hoovers (2020) & Confidential Report
Yogurt	67.90	135.81	271.62	D&B Hoovers (2020) & Confidential Report

Source: Various and author's calculations
Notes: [1] Assumes 40 hours per week, 4 hours per week of overtime, 52% of wages attributed to benefits, and overtime paid at time and a half.

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Table A.2. Dairy Plant Assumptions Supporting Hypothetical Dairy Processing Development

	Small[1]	Medium[1]	Large[1]	Source
Panel (a): Cows Required (Head)[1]				
Fluid Milk	4,000	9,333	16,000	FINBIN (2020) & Calculated
Butter	66,667	113,333	138,667	FINBIN (2020) & Calculated
Cheese	26,667	66,667	120,000	FINBIN (2020) & Calculated
Yogurt	13,333	26,667	53,333	FINBIN (2020) & Calculated
Panel (b): Employment -Hourly/Management (N of Employees)[3]				
Fluid Milk	40/4	93/9	160/16	Calculated
Butter	667/67	1,133/113	1,387/139	Calculated
Cheese	267/27	667/67	1,200/120	Calculated
Yogurt	133/13	267/27	533/53	Calculated
Panel (c): Total Labor Costs - Wages + Benefits (Millions of USD per year)				
Fluid Milk	1.93	4.50	7.72	BLS (2020)
Butter	32.16	54.68	66.90	BLS (2020)
Cheese	12.87	32.16	57.89	BLS (2020)
Yogurt	6.43	12.87	25.73	BLS (2020)
Panel (d): Annual Sales[4] *(Millions of USD per year)*				
Fluid Milk	15.31	35.72	61.23	CME (2020), FINBIN (2020) & Calculated
Butter	261.88	445.19	544.71	CME (2020), FINBIN (2020) & Calculated
Cheese	110.67	276.68	498.02	CME (2020), FINBIN (2020) & Calculated
Yogurt	54.31	108.63	217.26	CME (2020), FINBIN (2020) & Calculated

Source: Various and author's calculations

Notes: [1] Assumes 75 pounds of milk per cow per day; [2] Assumes a ratio of 1 hourly worker per 100 cows and 1 manager per 1000 cows; 3 Assumes 40 hours per week, 4 hours per week of overtime, 52% of wages attributed to benefits, and overtime paid at time and a half; 4 Annual sales are based on the milk price class associated with dairy processing plant type. The 10-year average of Class II, III, and IV CME futures milk prices per hundredweight are $16.35, $17.27, and $16.95, respectively.

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