PB 1843-C

Regional Milk Supply for a Possible Tennessee Milk Plant

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THE UNIVERSITY OF TENNESSEE

Regional Milk Supply for a Possible Tennessee Milk Plant

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Table of Contents

Executive Summary

Food processors in the U.S. are showing an increased interest in regional-local or short-chain food systems. A new milk condensing plant has the potential for enhancing the profitability of current dairy operations and the contributions of the dairies and dairy processing to the Tennessee economy. A vital step in determining the feasibility of any regionally based value-added processing facility is to assess the willingness and ability of local farms to supply the operation in question. To provide such an analysis, we initially examine the movement of milk through the processing process. We then review overall trends for the dairy industry both nationally and in Tennessee, and survey Tennessee dairy farmers regarding their willingness to supply a regional milk processing facility.

Surveyed farmers were responsible for 34 percent of Tennessee milk production. The distribution of respondents was representative of the state industry. Survey respondents indicated an interest in supplying such a plant given a weighted (by level of production) premium of 12.5 percent over currently received prices with an estimated 512.7 million pounds of Tennessee milk available to the plant at that price premium. Producer willingness to ship (as weighted by level of production) would be 163.3 miles. When we extend our estimate to the entire industry for this distance, an estimated 335.2 million pounds of Tennessee milk would be available for the plant.

In terms of contract attributes, respondents saw quantity of purchase guarantee, right of notification regarding contract changes, and right of termination as the most important aspects of a possible contract with a milk processing plant. In summary, most survey respondents indicated a willingness to supply a new milk processing plant given an adequate received price and appropriate contract attributes.

CHAPTER I. Introduction

Food processors in the U.S. are showing an increased interest in regional-local or short-chain food systems (Hughes and Boys, 2015). A growing consumer preference for locally and regionally produced foods and concerns related to the carbon footprint of transportation in the food system are at least part of the reason for this interest. Local, regional, and state agricultural and economic development leaders are also starting to see food processing as a means of facilitating economic growth. The growth potential for processing is especially enhanced when it is based on locally produced agricultural products. This interest is coupled with the view that the local food movement can serve as a means of facilitating local and regional economic growth. In support of this assertion is a body of developing research indicating that the future of local food systems is based on intermediated (indirect) sales by regional farmers to regional customers (Low et al., 2015, Hughes and Isengildina-Massa, 2015).

The dairy industry, including dairy-based food products, is an important component of the U.S. food system. In 2014, the U.S. dairy industry was directly responsible for $102 billion in sales (Statista, 2015). In Tennessee, cash receipts for milk sales by state dairy farmers were valued at $192.5 million (NASS, 2015).

Despite its contribution, however, the Tennessee dairy industry has not experienced growth in recent years. The generation of new markets in the form of a milk processing plant could reverse this trend in the state industry. A new plant has the potential for enhancing the profitability of current dairy operations and the contribution of the dairies and dairy processing to the Tennessee economy.

This study is being conducted in response to the requests of the leadership of the dairy industry, state agricultural officials and the state processing industry. A vital step in assessing the feasibility of any regionally based, value-added processing facility is to assess the willingness and ability of local farms to supply the operation in question. To provide such an analysis, we initially examine the movement of milk through the processing process. We then review overall trends regarding the dairy industry both nationally and in Tennessee. The core of the analysis centers on a survey of Tennessee dairy farmers regarding their interest in supplying an in-state milk processing operation. This publication is also linked to three companion documents: UT Extension publication PB 1843-A "Overview and Implications of Milk Marketing Orders" (Griffith, 2016), UT Extension publication PB 1843-B "A Preliminary Review of Dairy Processing/Manufacturing Regulations in Tennessee" (Critzer and Holland, 2016), and UT Extension publication PB 1843-D "A Tennessee milk plant as a possible way of growing the Tennessee dairy industry" (Hughes et al., 2016). The first of these documents provides an explanation of the milk marketing order system; the second document examines the role of health safety regulations in milk production and marketing; and the third document examines the possible economic impact of a new milk processing facility on the Tennessee economy.

The growth potential for processing is especially enhanced when it is based on locally produced agricultural products.

Chapter II. General Review of the Movement of Milk and the Manufacturing of Milk Products from Farm to Consumer

This chapter is intended to provide a broad overview of the movement of milk from farm to consumer given a variety of dairy products that may be manufactured from fluid milk. It is not intended to provide a comprehensive review of the manufacturing of all dairy products.

Introduction

The flow of milk from the dairy farm to the consumer is a complicated, albeit interesting, process. The path that milk takes depends largely on how it will be used. And how it will be used is largely a function of the price that is paid for it, and pricing is largely a function of the federal milk marketing orders. Additional information regarding the implications of federal milk marketing orders is available in the section/report titled UT Extension publication PB 1843-A "Overview and Implications of Milk Marketing Orders" by Andrew Griffith (2016).

Class I milk is used for fluid milk and is the highest priced. Class II and Class III milk are used in making dairy products such as cheese, ice cream and yogurt. Class II and Class III milk are purchased at a lower price than Class I. Class IV milk is used for processing butter and powder and, as such, is purchased at a price lower than Class II and Class III.

Overview of Milk Products

The remainder of this chapter provides a brief overview of four milk products and the general transportation and processing steps involved in their manufacturing. The four milk products included are:

1. Fluid Milk 2. Yogurt 3. Evaporated Milk and Milk Powder 4. Ice Cream

Fluid Milk

Milk used for fluid milk bottling is generally moved through the following five steps, with transportation often involved between each:

- Farm
- Receiving/Transfer Station[1]
- Fluid Milk Processing/Bottling Plant (pasteurize, process, bottle)
- Distribution
- Retail

Figure 2.1 provides an overview of fluid milk bottling and summarizes the key steps in processing. In general, milk destined to be consumed as a fluid product is transported from a dairy farm to a processing plant's receiving bay and pumped into a storage unit. The milk then undergoes a separation process to separate the skim milk from the cream. Milk is then blended with cream to achieve the desired percent milkfat (1 percent, 2 percent, whole, skim), which is also known as standardization. At this point, vitamins A and D can also be added back to the product to achieve levels similar to what was present in the whole milk. After standardization, the milk will flow into a pasteurizing unit where it is heat treated and subsequently homogenized.

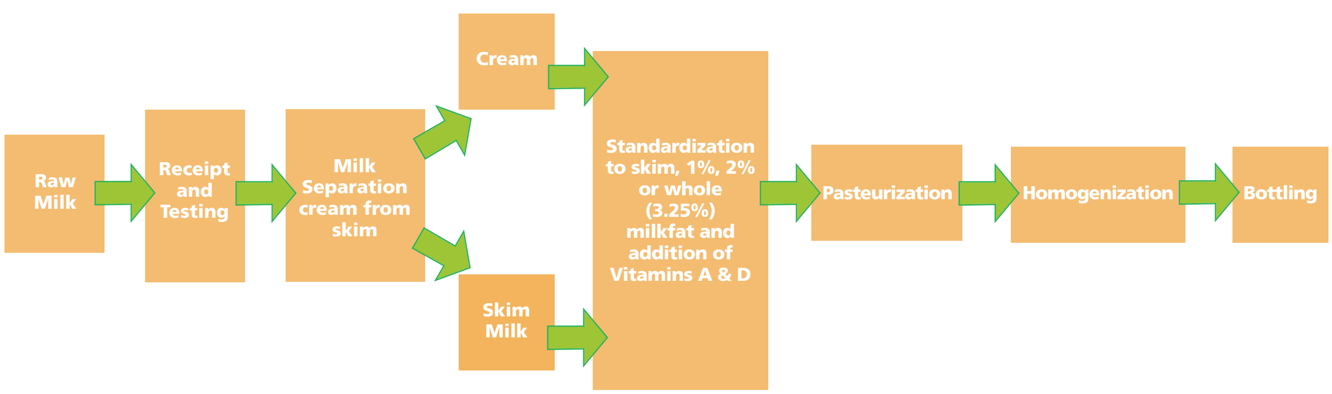


Figure 2.1. Flow of fluid raw milk from farm receipt to finish product bottling of skim, 1 percent, 2 percent and whole milk.

[1]Receiving/transfer stations are used in some parts of the nation, but generally not in the Southeast. Depending on a variety of factors, including volume (or size), milk may be moved directly from the farm to the processing plant (condensing/drying plant) bypassing the receiving/transfer station.

By products from whole milk processing typically include cream, which is not utilized unless the processing plant is only producing whole milk. The separated cream may also be used to develop other dairy products such as butter, ice cream, coffee creamer, heavy cream, half-and-half and whipping cream. Additionally, Class II and III fluid milk may be processed into these products. The separated skim milk may be evaporated to produce condensed skim milk, which is still in a liquid form, and non-fat dry milk (NFDM) powder.

Yogurt

Yogurt manufacturing typically uses whole, 2 percent fat content, 1 percent fat content, skim milk (depending upon the desired end-product fat content), NFDM powder (dehydrated skim milk), sweeteners, carbohydrate-based stabilizers, flavors and coloring agents. The process of making yogurt is very similar to that of milk in that the fluid milk is standardized with other dairy ingredients (NFDM) to achieve the desired milk solids. All ingredients with the exception of flavor and color are blended, pasteurized and homogenized. Afterward, the starter culture is added and optimal fermentation temperature is maintained. Once the desired titratable acidity is reached, the product is cooled and agitation begins. It is at this point that flavor and color may be added. Once cooled, the yogurt is packaged. Another type of yogurt, called set style, is manufactured by packaging in the finished product container prior to fermentation.

Milk used for producing yogurt on a large scale is generally moved through the following six steps, with transportation involved between each step:

- Farm
- Receiving/Transfer Station[1]
- Condensing/Drying Plant[2]
- Yogurt Manufacturing Plant (condensed milk or reconstituted powder, pasteurize, culture, process, packaging)
- Distribution
- Retail

Evaporated Milk and Milk Powder

Removal of water increases the product's shelf life and reduces transportation costs. Products can either be evaporated or dehydrated depending upon if a liquid (evaporated) or dehydrated (powder) product is preferred. Several methods may be used to manufacture commercial evaporated and dehydrated milk products. A detailed description of the processing steps can be found in the University of Guelph's Dairy Science and Technology eBook series (2016).

Ice Cream

Ice cream is made of milkfat (cream) greater than 10 percent up to 16 percent, NFDM, sweeteners, stabilizers, water, color, flavor and inclusions. The base ice cream mix consisting of milkfat, NFDM, sweeteners, stabilizers and water are pasteurized and homogenized. Once cool, the flavor and color are incorporated and then the product is frozen. As the freezing process occurs, the base mix has air incorporated. The amount of air incorporated is termed overrun. Once frozen, any inclusions (candy, nuts or fruit) can be added to the mix and it is packaged and hardened to a completely solid state.

Milk used for producing ice cream on a large scale is generally moved through the following six steps, with transportation involved between each step:

- Farm
- Receiving/Transfer Station[1]
- Condensing/Drying Plant[2]
- Ice Cream Manufacturing Plant (condensed milk and cream, packaging)
- Distribution
- Retail

Conclusion

Understanding the movement of milk from farm to consumer can be complicated given the many factors that influence how and why milk is used in the manufacturing of different products. The ultimate end use of milk, and therefore the route it takes from farm to consumer, depends on a variety of factors, including the price paid for milk at the farm level, overall industry supply factors, overall industry demand factors, how it will be used, shelf life, and transportation factors. It may seem logical that a dairy farm should be located within close proximity to a yogurt or ice cream manufacturing plant to reduce transportation costs for delivering fluid milk from the farm to the plant. However, because of the multifaceted nature of the dairy manufacturing industry and the fact that the primary dairy ingredient for yogurt and ice cream manufacturing is not fluid milk, many other manufacturing and transportation considerations impact the transportation of milk from the farm. Therefore, at least a general understanding of the steps involved in the processing of various dairy products is important when considering new dairy manufacturing facilities.

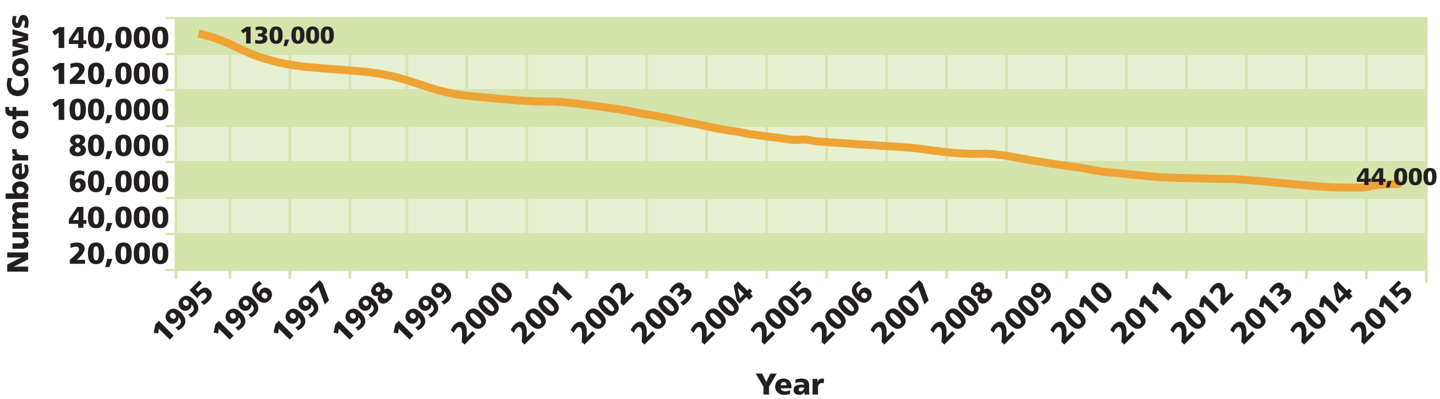
[2]Condensing plants develop dairy products that are essential to most ice cream and yogurt manufacturing plants, depending on the exact recipe of ingredients used in the ice cream and yogurt manufacturing process. In a very general sense, condensing plants make lower value products from a higher value product. In this case, the lower value products have a longer shelf life and are often developed when the higher value products are at a market surplus. That is, when the demand for fluid milk is met but the dairy processing company still has fluid milk available, they may decide to condense the fluid milk into longer shelf-life products such as condensed milk and dry milk powder. Condensing plants are normally located in milk surplus areas and or in areas with higher volumes of Class II, Class III and Class IV milk. The milk condensing/drying plants nearest to Tennessee are in Glasgow, Kentucky (approximately 90 miles from Nashville), and Goshen, Indiana (approx. 435 miles from Nashville).

Chapter III. Analysis of Trends and Survey of Tennessee Dairy Producers

Introduction

Milk cow inventory values for Tennessee have shown an almost steady decline on an annual basis from 1995 through 2016. The size of the state dairy herd was 131,000 cattle in 1995 and 44,000 in 2016 (a decline of 66.2 percent) (Figure 3.1). From 1997 to 2012, the Census of Agriculture reported that the number of Tennessee dairies decreased from 2,096 to 463, a decrease of 78 percent. The value and level of milk production has also declined over the same period, although in a much less dramatic fashion. From 2008 to 2015, the value of milk production in Tennessee declined from $191,496,000 to $139,496,000 (a 27 percent decrease) (Figure 3.2). However, if we adjust these estimates for inflation, the 2015 milk production value was $126,124,541.10 (in 2008 dollars), a 34 percent decrease. As delineated by the U.S. Department of Agriculture National Agricultural Statistical Service, the five production regions in Tennessee shown in Figure 3.3 have experienced a decline in number of milk cows similar to that found at the state level.[3, 4] Over time, fewer farmers are producing larger amounts of milk both nationally and in Tennessee (Miller and Blayney, 2006) as the industry is characterized by economies of size. While historically farm-level milk prices have trended upward in nominal terms, so have input costs, especially feed cost (Burdine et al., 2014). A review of data provided by the USDA Economic Research Service (2016) at the state level indicates that in general Tennessee is a high cost of production state primarily due to the small average size of operations.

Figure 3.1. Number of Dairy Cows in Tennessee, 1995-2015.
Source: U.S. Department of Agriculture, National Agricultural Statistical Service, 2016.



[3]The five production regions are area 20 (15 counties in West Tennessee), area 30 (12 counties primarily in Middle Tennessee), area 40 (19 counties in Middle Tennessee), area 50 (17 counties primarily in Middle Tennessee), and area 60 (26 counties in East Tennessee). No data were listed for area 10 (comprised by six counties bordering the Mississippi River).

[4]According to industry experts, Tennessee is a milk deficit state where consumption of milk exceeds production by a marked amount. Given the various types of processing in the state (ice cream, yogurt, cheese and fluid milk), several of which have national markets, the level of the deficit in terms of milk produced versus milk consumed in the production of a variety of products would be at best extremely difficult to estimate. A prior study (Moss et al., 2012) did estimate a fluid milk deficit (based on production versus household-based consumption of fluid milk) of several hundred million pounds for 2008.

Figure 3.2. Value of Milk Produced in Tennessee, 2008-2015.
Source: U.S. Department of Agriculture, National Agricultural Statistical Service, 2016.

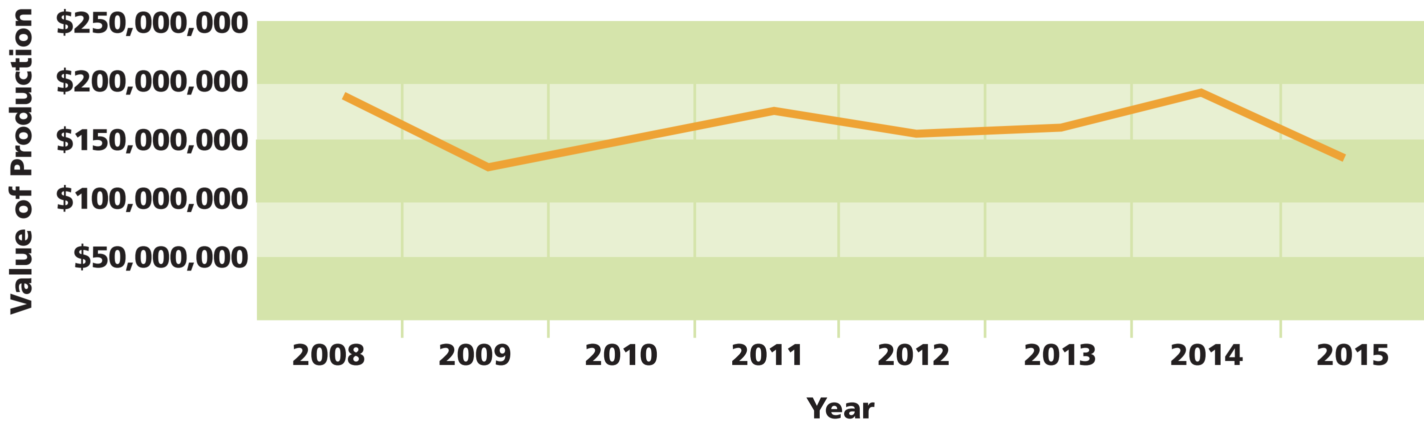
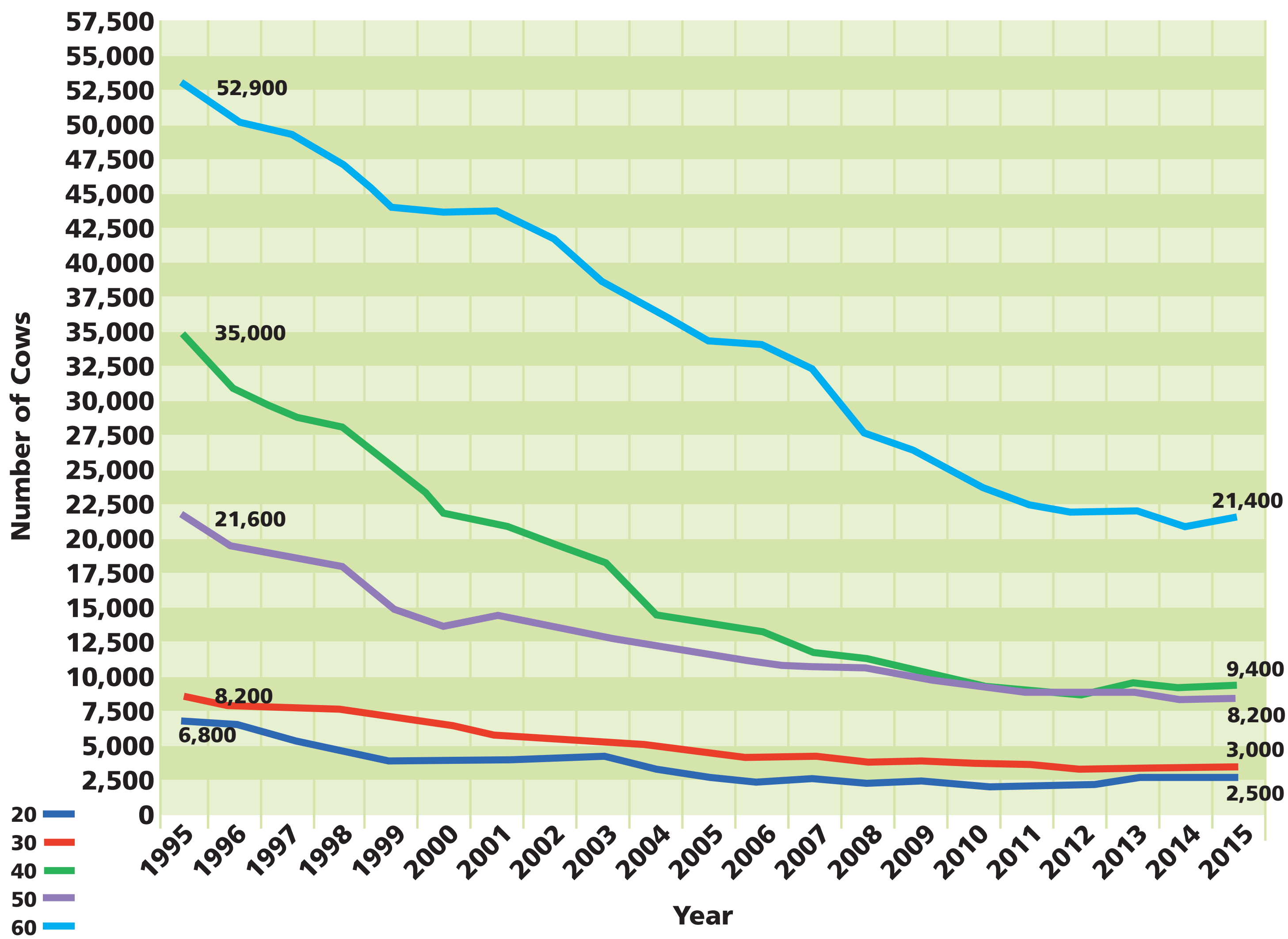


Figure 3.3. Number of Dairy Cows per Major Agricultural Statistical Areas in Tennessee, 1995-2015.
Source: U.S. Department of Agriculture, National Agricultural Statistical Service, 2016.



Area 20 includes 15 counties in West Tennessee, area 30 includes 12 counties primarily in Middle Tennessee, area 40 includes 19 counties in Middle Tennessee, area 50 includes 17 counties primarily in Middle Tennessee, and area 60 includes 26 counties in East Tennessee. No data were listed for area 10 (comprised by six counties bordering the Mississippi River).

The dairy industry in the bordering state of Kentucky has experienced a similar decline. From 1997 to 2012, the number of Kentucky dairies decreased from 3,393 to 951 (a 72 percent decline) (Census of Agriculture, 1997, 2012). The number of milk cows in Kentucky declined from 145,557 in 1997 to 71,783 in 2012, a 51 percent decrease (NASS, various years). The value of milk production from 2008 to 2015 declined from $242,000,000 in 2008 to $201,912,000 in 2015 (17 percent decrease) (NASS, various years). Adjusting for inflation, the 2015 milk production value was $182,557,624.18 (in 2008 dollars), a 25 percent decrease.

The decline in the size of the Alabama dairy industry has been more pronounced. The number of dairies has declined from 608 in 1997 to 73 in 2012 (an 87 percent decrease) (Census of Agriculture, 1997, 2012). The number of milk cows in the state declined from 27,848 to 9,116, (a 67 percent decrease over the same period) (NASS, various years). The value of milk production in Alabama decreased from $39,928,000 in 2008 to $19,695,000 in 2015, a 51 percent decline (NASS, various years). Adjusting for inflation, we see an even more pronounced decline in the value of 2015 Alabama milk sales of $17,807,125.92 (in 2008 dollars), a 55 percent decrease.

Nationally, milk production has also undergone significant changes. From 1997 to 2012, the number of dairies has decreased from 116,874 to 64,098, an 82 percent decrease. Yet milk cow inventory has increased slightly from 9,095,439 to 9,252,272 cows (by 2 percent). The value of milk production in the United States from 2008 to 2015 increased from $35,048,242,000 to $35,910,597,000, a 2 percent increase (NASS, various years). Adjusting for inflation, the 2015 value is $32,468,368,751 (in 2008 dollars), a decrease of 7 percent from 2008.

Survey Instruments and Use

A survey instrument (Appendix A) is employed to determine the degree of interest by Tennessee dairy farmers in supplying a new milk processing plant. To make such a determination, questions centered on current behavior and possible future behavior with respect to supplying such a plant. In terms of current activities, survey respondents were asked to indicate the location (county) of their operation and their annual level of production (in pounds of milk). They were also asked to indicate the breakdown of their milk production by class and to whom they sold (cooperative, processor, or own-farm use). In terms of possible future behavior, survey respondents were asked to indicate the price premium that they would require to ship to a new processor and the distance over which they would consider shipping their milk. The question regarding shipping distance is necessary because supplying the facility with local milk (milk from the state of Tennessee) will increase the distance in which most milk is hauled since most of the milk in Tennessee is transported to fluid milk processors in the state that are fairly localized. In theory, the increased hauling distance should increase transportation costs, which are borne by the dairy producer. These costs could grow even more depending on the size of the dairy (milk production) and the distance from other dairy producers where milk will be picked up. The question regarding price premium is necessary primarily because switching to a new market carries implicit risks (especially if the new market is perceived as temporary). Farmers may also have to pay for increases in milk hauling costs with a new plant.

Finally, they were asked about the degree of importance regarding five possible attributes (quantity purchase guarantee, explicit quality, right of termination, right of notification, and price-forward contracting) of a contract that they would sign with a new processor.

The survey instrument was administered to dairy farmers at five different training meetings of Master Dairy Farmers across Tennessee in January 2016. Copies were also provided at the Tennessee Dairy Producers Association annual meeting for individuals who did not have an opportunity to respond to the survey at any of the earlier meetings. Based on the number of responses and the level of production covered in the survey, as discussed in the results section, the analysis of survey results provide a baseline analysis and appropriate inferences can be drawn from our analysis.

Survey Results

The distribution of survey respondents by county is provided in Table 3.1. Producers from 31 of the 95 Tennessee counties responded to this survey. Responses by county follow the expected pattern in terms of where dairy production is located in Tennessee. Eleven Greene County producers responded (14.9 percent of the 74 respondents answering the question) followed by six producers each in Marshall and Maury counties (8.1 percent) responses. Four other counties each had four respondents. In terms of the three regions of the state as defined by the University of Tennessee Institute of Agriculture, seven respondents were from western Tennessee, 28 from central Tennessee, and 34 from eastern Tennessee.[5]

Among the survey respondents, total annual milk production across all operations was 225.2 million pounds. Based on this value, the survey captures an estimated 34 percent of all milk produced in Tennessee (750 million pounds in 2014 according to the Economic Research Service, U.S. Department of Agriculture). Among the three regions of the state, 154.3 million pounds (60.5 percent of the total) are produced in the eastern region, 87.7 million pounds (34.3 percent) are produced in the central region, and 12.2 million pounds (5.2 percent) are produced in the western region. Across all survey respondents, average annual milk production was 3.698 million pounds. Average annual milk production was highest in the eastern Tennessee at 4.539 million pounds, followed by central Tennessee at 3.130 million pounds, and western Tennessee at 1.886 million pounds.

Table 3.1.
Survey Respondents by Tennessee County.

Tennessee County	Responses	Percentage of Responses
Bedford	1	1.4%
Bradley	2	2.7%
Cannon	1	1.4%
Carter	1	1.4%
Cocke	1	1.4%
Dickson	1	1.4%
Franklin	1	1.4%
Giles	1	1.4%
Greene	11	14.9%
Hamblen	4	5.4%
Hawkins	1	1.4%
Henry	4	5.4%
Lawrence	1	1.4%
Lincoln	1	1.4%
Loudon	3	4.1%
Marshall	6	8.1%
Maury	6	8.1%
McMinn	4	5.4%
Meigs	1	1.4%
Monroe	1	1.4%
Overton	1	1.4%
Polk	4	5.4%
Robertson	1	1.4%
Sequatchie	2	2.7%
Sullivan	2	2.7%
Warren	2	2.7%
Washington	2	2.7%
Weakley	2	2.7%
White	3	4.1%
Williamson	1	1.4%
Wilson	2	2.7%
Total	**74**	**100%**

Table 3.2.
Milk Marketing Channels Indicated by Survey Respondents.

Category	Unweighted by size of operation	Weighted by size of operation
Class I Fluid Direct to Processor	57.7%	72.3%
Class I Fluid through Cooperative	33.9%	20.6%
Class I Fluid Through Spot Market	0.0%	0.0%
Class II Fluid Direct to Processor	0.6%	0.3%
Class II Fluid through Cooperative	2.2%	0.3%
Class III Fluid Direct to Processor	2.7%	5.2%
Class III Fluid through Cooperative	0.0%	0.0%
Class IV Fluid Direct to Processor	0.1%	0.1%
Class IV Fluid through Cooperative	2.8%	1.2%
Fluid Milk to On-Farm Value-Added	0.0%	0.0%

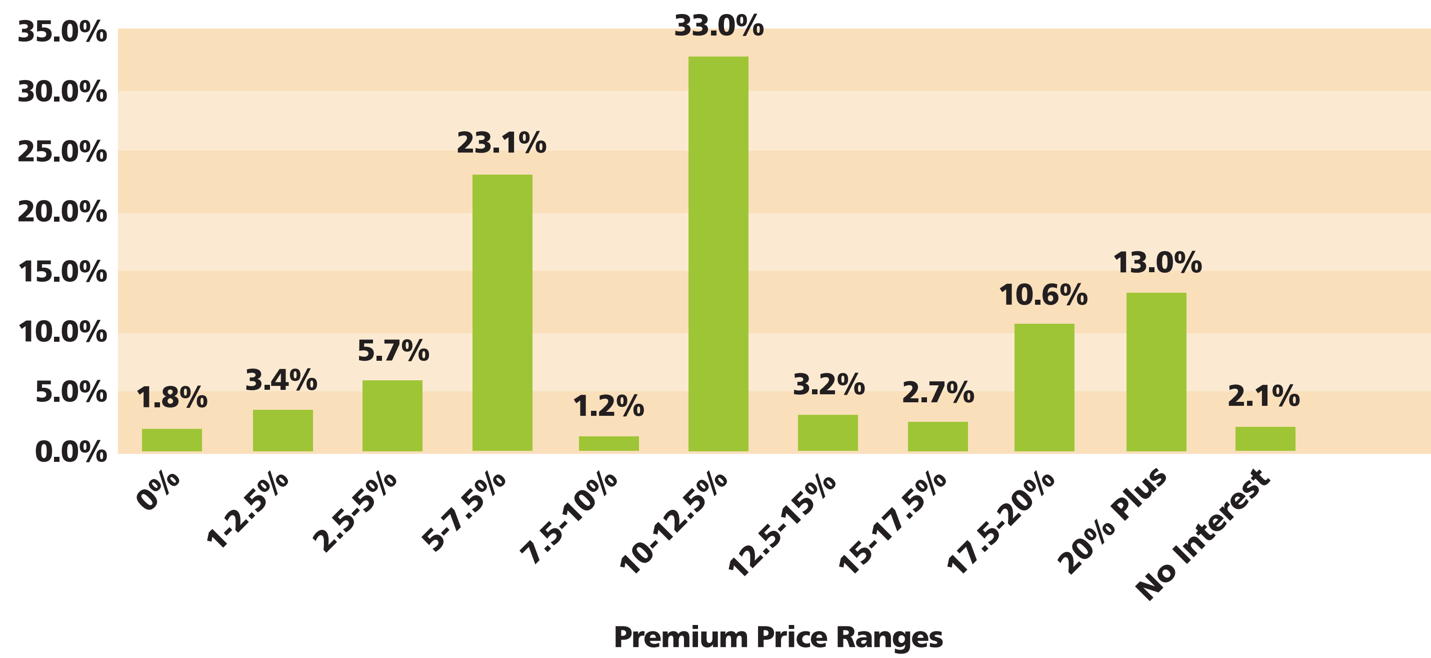
[5]The western region is comprised by Benton, Carroll, Chester, Crockett, Decatur, Dickson, Dyer, Fayette, Gibson, Hardeman, Hardin, Haywood, Henderson, Henry, Hickman, Houston, Humphreys, Lake, Lauderdale, Lawrence, Lewis, Madison, McNairy, Montgomery, Obion, Perry, Shelby, Stewart, Tipton, Wayne and Weakley counties; the central region is comprised by Bedford, Cannon, Cheatham, Clay, Coffee, Davidson, DeKalb, Franklin, Giles, Grundy, Jackson, Lincoln, Macon, Marion, Marshall, Maury, Moore, Overton, Pickett, Putnam, Robertson, Rutherford, Sequatchie, Smith, Sumner, Trousdale, Van Buren, Warren, White, Williamson and Wilson counties; and the eastern region is comprised by Anderson, Bledsoe, Blount, Bradley, Campbell, Carter, Claiborne, Cocke, Cumberland, Fentress, Grainger, Greene, Hamblen, Hamilton, Hancock, Hawkins, Jefferson, Johnson, Knox, Loudon, McMinn, Meigs, Monroe, Morgan, Polk, Rhea, Roane, Scott, Sevier, Sullivan, Unicoi, Union and Washington counties.

[6] Level of annual production as indicated by producer was summed across all respondents; the producer's share (percentage) of that total was then used to weight the response to the question concerning marketing channel. As discussed further, responses to other questions were weighted in the same manner.
[7] The 72.3 percent plus 20.6 percent values in Table 3.2 form the former value and the 57.7 percent plus 33.9 percent values in Table 3.2 form the latter value.
[8] That is, the 33.9 percent value divided by the 20.6 percent value and expressed in percentage terms.

Survey respondents were asked to indicate the distribution of their milk production in terms of marketing channel (cooperative, processing or on-farm value-added) and class (I through IV). The distribution of responses by milk producers (unweighted and weighted by size of operation) is provided in Table 3.2.[6] Class 1 fluid production is dominant, with 92.9 percent of the total size of production and 91.6 percent of surveyed farms.[7] In terms of marketing channels, 72.3 percent of all production by size goes directly to processors as Class I fluid milk, while 20.6 percent is marketed through cooperatives as Class I fluid milk. When responses are not weighted by size, 33.9 percent of the unweighted responses are marketed through a cooperative, a markedly larger value (64.9 percent greater [8]) than when size is taken into account. This result indicates that smaller-size (or volume) producers tend to rely much more on cooperatives for marketing than do larger producers. In terms of size, Class III fluid milk sold to processors is the next largest category at 5.2 percent of all reported milk sold. Overall, 78 percent of all production is marketed directly to processors, while 22 percent is marked through cooperatives. Across the other two classes, only 1.2 percent of milk is sold as Class IV milk and only 0.7 percent is sold as Class II milk.

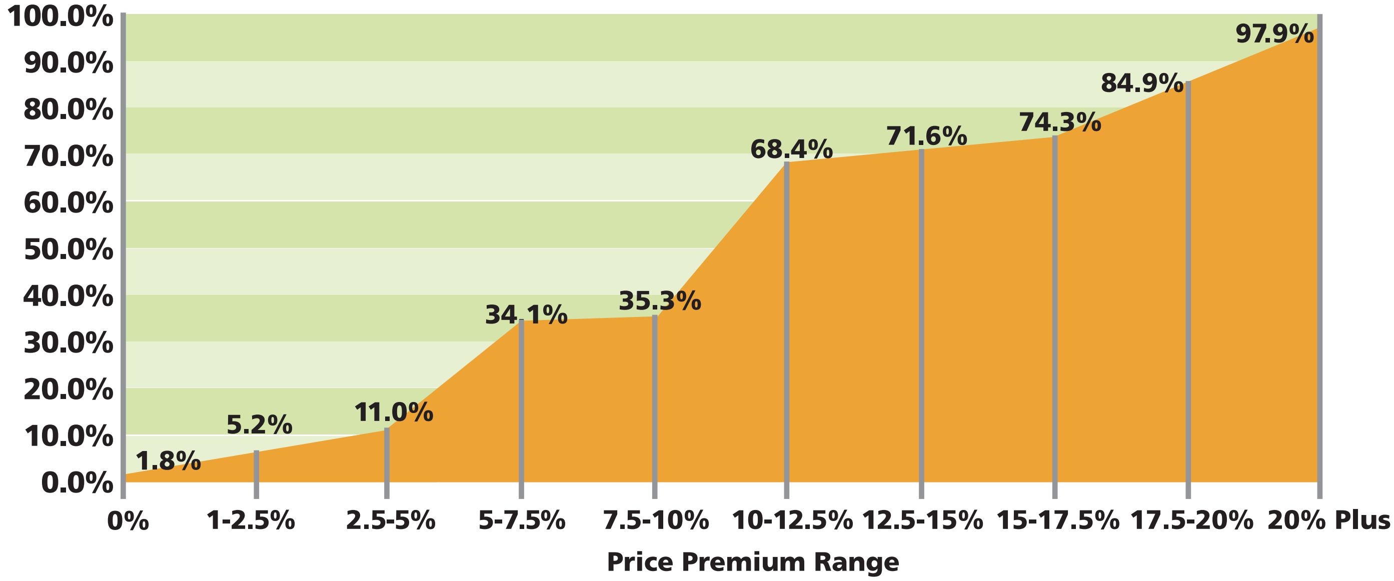
Survey respondents were asked to consider how much of a premium (across 11 separate price ranges) over currently received prices would be required to sell to a new processor. The indicated price premiums ranged from no interest in participating at any premium, to the 1-2.5 percent level and finally to the over 20 percent level (Figure 3.4). Among survey respondents (weighted by the size of their production), providers of 33 percent of volume indicate that they would require a 10-12.5 percent range price premium to supply a new processor. The 5-7.5 percent range price premium has the second largest level of responses (weighted by size of production) at 23.1 percent of responses, followed by the above 20 percent (13.0 percent) and 17.5-20 percent range (10.6 percent) categories. The percentage of production in each of the price premium ranges is multiplied by the midpoint value for the price premium range in the question to calculate a production-level weighted price premium average. Across all responses, the average price premium calculated in this manner is 11.7 percent.

Figure 3.4. Price Premium Range for Supplying a New Milk Plant as Indicated by Survey Respondents.



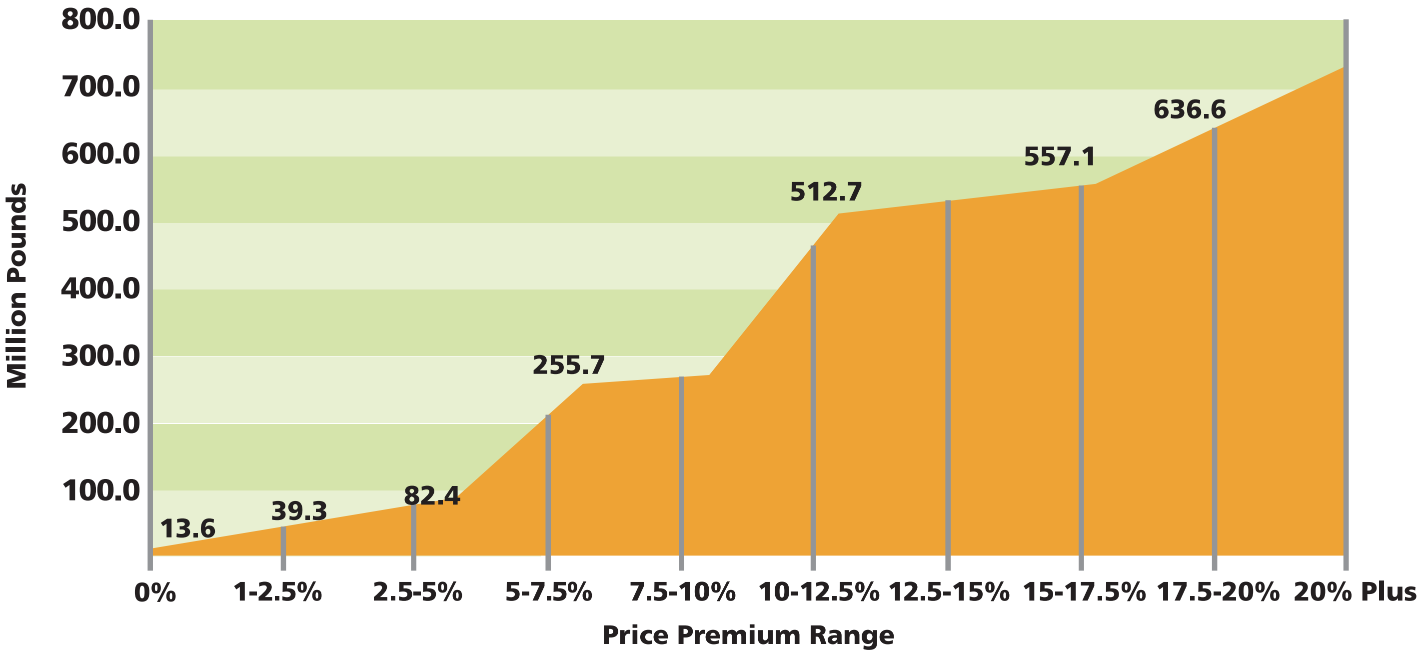
Responses are also assessed from a cumulative viewpoint to determine how much production could be expected at a given price premium (that is, the highest value in a range plus all lower price premium ranges). As shown in Figure 3.5, a 2.5 percent price premium (the upper range for the 1-2.5 percent category) would bring forth 5.2 percent of production, while a 5 percent price premium is expected to elicit commitment from producers with 11 percent of production. A 10 percent price premium would bring a positive response from producers with 35.3 percent of production while the 12.5 percent price premium would elicit supply from producers with 68.4 percent of production.

Figure 3.5.
Cumulative Willingness to Supply a New Milk Plant Based on Price Premium Range, as Indicated by Survey Respondents.



The percentages shown in Figure 3.5 are applied to the most recent estimate of total milk production in Tennessee (i.e., 750 million pounds) based on the assumption that responses are representative of the entire industry. At a price premium of 2.5 percent, the estimated supply to a new processor would be 39.3 million pounds (Figure 3.6). At the 5 percent price premium level, the estimated supply to a new processor would be 82.4 million pounds. The projected supply commitment increases to 255.7 million pounds at the 7.5 percent price premium level and shows a large increase to 512.7 million pounds at the 12.5 percent price premium level. The rate of increase levels off after that point, resulting in a projected supply of 557.1 million pounds at the 17.5 percent price point and 636.6 million pounds at the 20 percent price premium level.

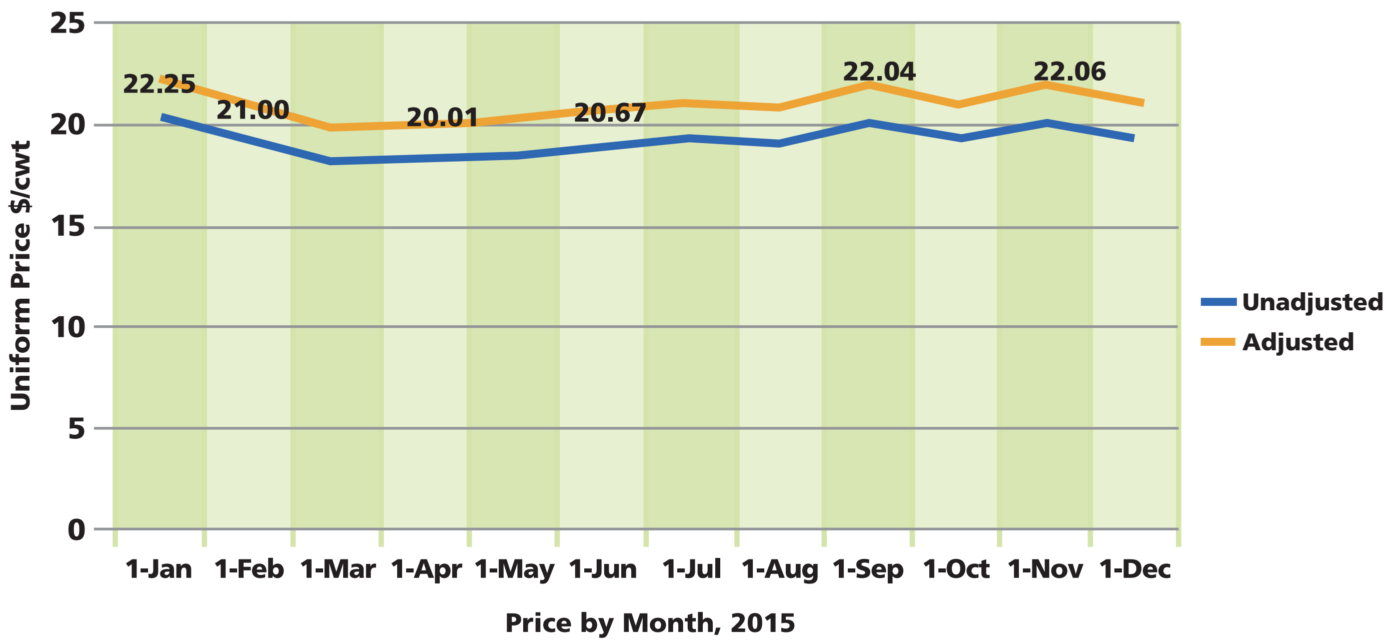
Figure 3.6. Cumulative Willingness to Supply as Applied to Tennessee Milk Supply by Price Premium Range as Indicated by Survey Respondents.



The percentage price premium increase is also translated into projected or adjusted prices based on the uniform price received (per hundredweight) for the two milk marketing orders (Appalachian and Southeast) that operate in Tennessee. To calculate these values, the price premium midpoint range values are weighted by the level of production as indicated by responding producers in the two milk marketing order areas.[9] A weighted average price premium of 12.9 percent is calculated for the Appalachian milk order region and a weighted average price premium of 9.1 percent is calculated for the Southeastern milk order region. These percentages are then applied to the monthly reported uniform prices received in the two regions (Griffith, 2016, Griffith, 2015). The resulting values provide prospective processors with an estimate of the prices they could expect to pay for Tennessee milk by marketing order.

As shown in Figure 3.7, for the Southeast milk marketing order region counties, the estimated adjusted monthly price (i.e., with the premium) ranges from a minimum of $19.97 per hundredweight to a high of $22.25 per hundredweight, with an average across all months of $21.05 per hundredweight. The unadjusted monthly price (i.e., without the premium) ranges from $18.30 per hundredweight to a maximum of $20.39 per hundredweight in the Southeast marketing area counties, with an average across all months of $19.29 per hundredweight. Across each month, the difference in the unadjusted monthly price versus the adjusted monthly price ranges from $1.86 per hundredweight (in January) to a minimum of $1.67 per hundredweight (in March), with an average difference of $1.86 per hundredweight.

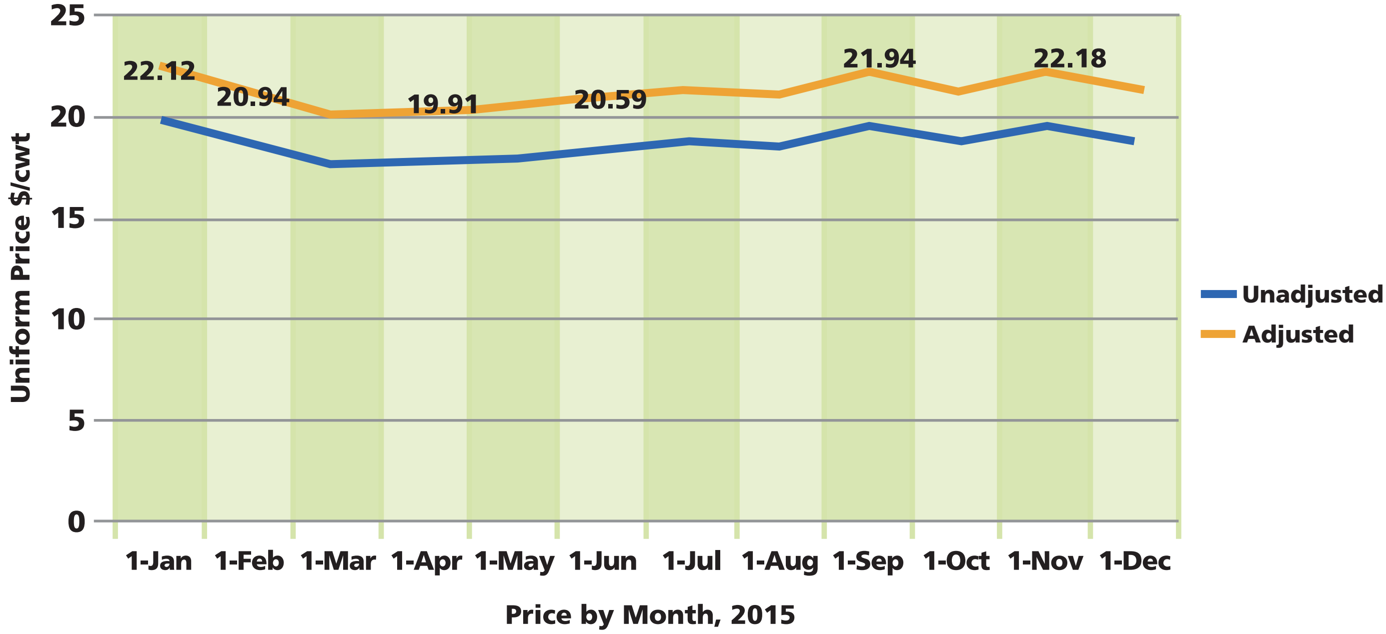
Figure 3.7.
Adjusted Monthly Price (2015) for Milk as indicated by Survey Respondents in the Southeast Marketing Order Area.



As shown in Figure 3.8, for the Appalachian milk marketing order region counties, the estimated adjusted monthly price (i.e., with the premium) ranges from a minimum of $19.90 per hundredweight to a maximum of $22.18 per hundredweight with an average across all months of $20.97 per hundredweight. The unadjusted monthly price (i.e., without the premium) ranges from $17.63 per hundredweight to a high of $19.65 per hundredweight in the Appalachian marketing area counties with an average across all months of $18.58 per hundredweight. Across each month, the difference in the unadjusted price versus the adjusted price range from a maximum of $2.53 per hundredweight (in November) to a minimum of $2.27 per hundredweight (in March) with an average difference of $2.39 per hundredweight.

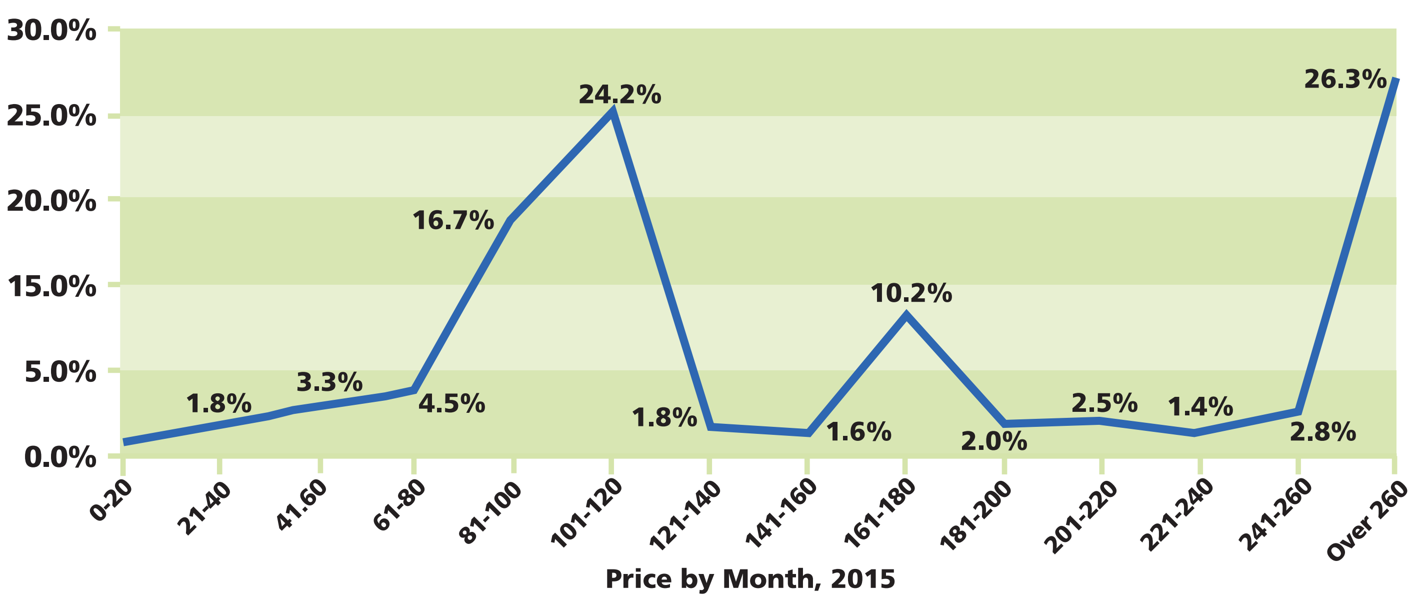
[9] Thirty-three Tennessee counties comprise the Appalachian milk order region: Anderson, Blount, Bradley, Campbell, Carter, Claiborne, Cocke, Cumberland, Grainger, Greene, Hamblen, Hamilton, Hancock, Hawkins, Jefferson, Johnson, Knox, Loudon, Marion, McMinn, Meigs, Monroe, Morgan, Polk, Rhea, Roane, Scott, Sequatchie, Sevier, Sullivan, Unicoi, Union, and Washington (U.S. National Archives and Records Administration, 2014). All other Tennessee counties are in the Southeastern milk order region.

Figure 3. 8.
Adjusted Monthly Price (2015) for Milk as indicated by Survey Respondents in the Appalachian Marketing Order Area.



The willingness of survey respondents to haul their milk (either directly or indirectly by paying hauling cost) to a new processing facility is also assessed. Survey respondents were provided with 14 categories, 13 of which had ranges of 20 miles, starting with 0-20 miles and ending with over 260 miles. The over 260 mile shipping distance category has the largest share of output indicated by responding producers (26.3 percent) followed by the 101-120 mile shipping category (24.2 percent) (Figure 3.9).

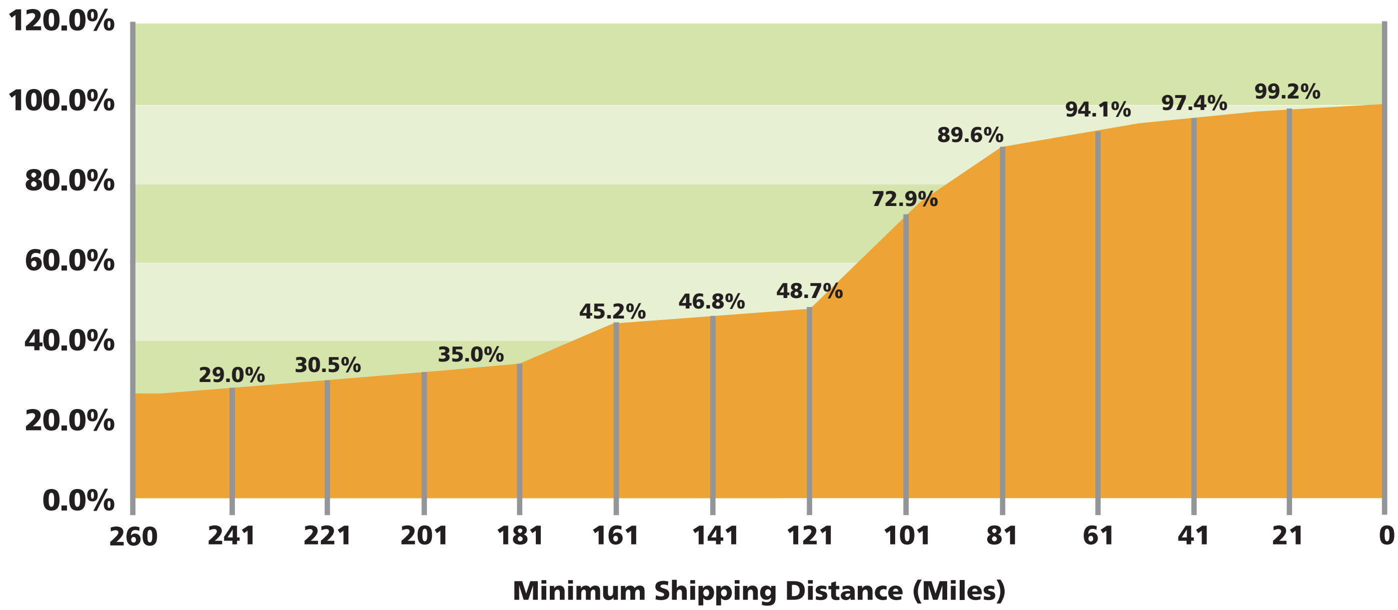
Figure 3.9. Willingness to Ship Milk as Indicated by Survey Respondents.



The percentage of production in each of the shipping distances is multiplied by the midpoint value for the shipping distance range in question (e.g., 30.5 miles for the 21-40 mile category to calculate a production-level weighted willing-to-ship average. Across all responses, the average shipping distance calculated in this manner is 163.3 miles.

The responses are also examined from a cumulative viewpoint to determine how much production would be expected to be forthcoming at a given distance from a processing plant. The minimum of the range as indicated by the producers (e.g., 181 miles for the 181-200 mile category) is used in this evaluation. At a minimum distance of 260 miles, producers with an estimated 26.3 percent of production would be willing to supply the processing plant as shown in Figure 3.10. At 221 miles from the facility, producers representing 30.5 percent of surveyed production would be willing to supply a processor, while at 181 miles an estimated 35 percent of production would be forthcoming, at 161 miles 45.2 percent of production would be forthcoming, and at 121 miles 48.7 percent of production is expected to be shipped to the plant. At a distance of 101 miles from the plant, producers with 72.9 percent of total production would ship to the processing plant, while at a distance of 81 miles, producers with 89.6 percent of the total production in our survey would make such shipments.

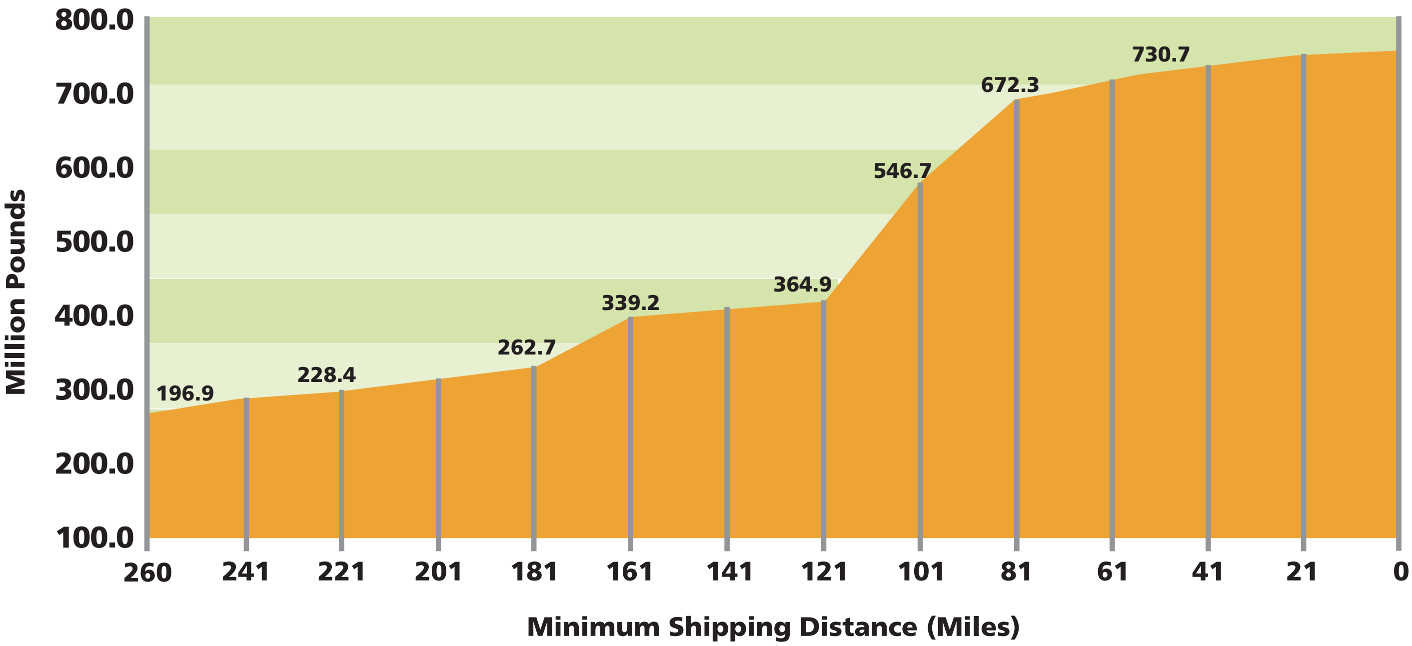
Figure 3.10. Cumulative Distribution of Survey Respondents Based on Willingness to Ship Milk.



The relationship among the three regions of the state (eastern, central and western) and the willingness to ship to a processing facility is also examined. As compared to producers in western Tennessee, eastern producers on average were willing to ship 59.8 miles farther and 29.9 miles farther than producers in the central region. Central region producers are estimated, on average, to ship 29.9 miles farther than producers from the western region of the state.

Analogous to the examination of the price premium data, the distributions for shipping distance (as shown in Figure 3.10) are applied to the most recent estimate of total milk production in Tennessee (i.e., the 750 million pounds), assuming our responses are representative of the entire industry. At a distance of 260 miles, the estimated supply to a new processor would be 196.9 million pounds (Figure 3.11). At the 221 mile shipping distance, the estimated supply to a new processor would be 228.4 million pounds. The projected supply commitment increases to 262.7 million pounds at the 181 mile shipping distance and increases to 339.2 million pounds at the 161 mile shipping distance level. After increasing to 364.9 million pound level at the 121 mile distance, the projected supply increases markedly to 546.7 million pounds at the 101 mile distance and then to 672.3 million pounds at the 81 mile distance.

Figure 3.11.
Cumulative Distribution of Survey Respondents Based on Willingness to Ship Milk as Applied to Tennessee Milk Supply.



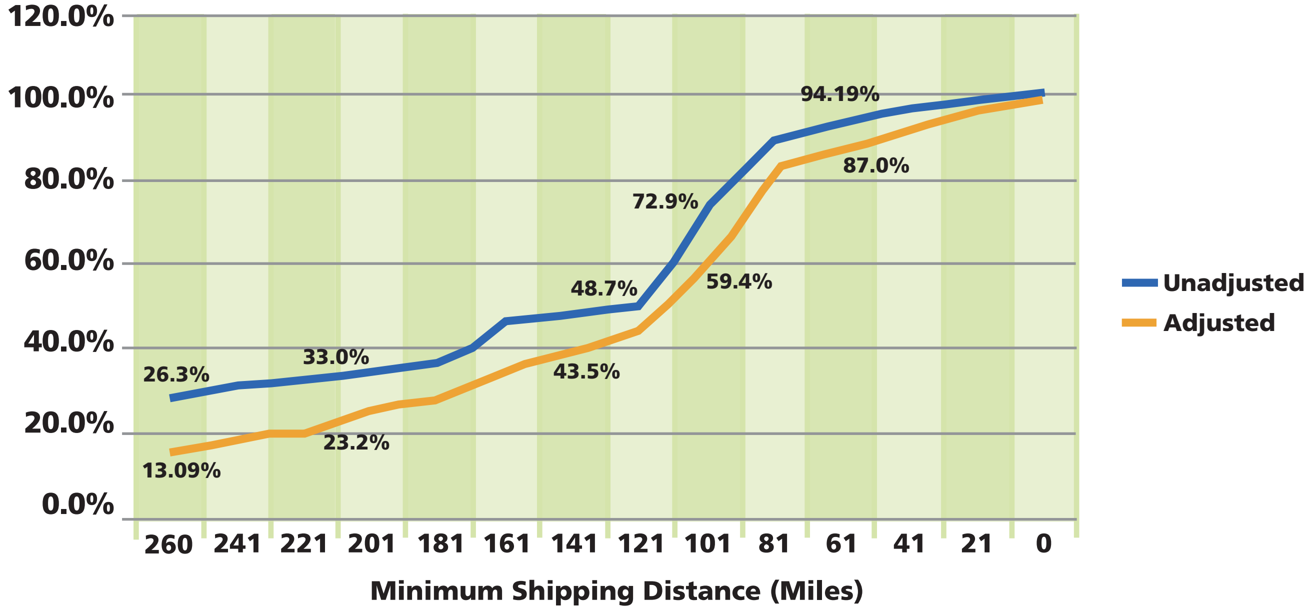
The relationship between the unweighted and weighted by output responses in terms of the willingness to ship to the plant (by minimum distance) is also examined. As shown in Figure 3.12, this analysis indicates that, on average, larger producers were willing to ship farther, especially for the longer shipping distances (such as 260 miles or over). For example, producers with an estimated 26.3 percent of output were willing to ship at least 260 miles one way to the plant, while in terms of number of producers, only 13.0 percent were willing to make such shipments. The gap between the production-level weighted and unweighted values narrows to some degree at the 201 mile minimum shipping distance (33 percent for the weighted value versus 23.2 percent for the unweighted value) and narrows even more at the 121 mile distance (48.7 percent weighted versus 43.5 percent unweighted) before diverging at the 101 mile minimum shipping distance (72.9 percent weighted versus 59.4 percent unweighted) and finally converging again at the shorter shipping distances.

The relationship between price premium and willingness to ship is evaluated. We hypothesized that producers willing to ship farther distances would also tend to require greater price premiums (i.e., the two variables would be positively related ("move together") or be statistically correlated in a statistically significant fashion). However, a simple regression analysis of the two variables showed no such relationship.

Survey respondents were also asked to evaluate the importance of various aspects of a contract that they would be willing to sign with a processor requiring supplying a dairy processing plant. The evaluated aspects were quantity purchase guarantee, explicit quality, right of termination, right of notification, and price forward contracting. Survey respondents were asked to evaluate attributes as ranging from not important (1), to somewhat important (3), to very important (5).

From 1997 to 2012, the number of dairies has decreased from 116,874 to 64,098, an 82 percent decrease.

Figure 3.12.
Differences in Weighted by Size Versus Unweighted Cumulative Responses by Tennessee Survey Respondents.



As shown in Figure 3.13, quantity purchase guarantee is very important to a large number of surveyed producers (53 or 73.6 percent of the 72 respondents to the question) and between somewhat important and very important for six more producers (8.3 percent). Only a total of four survey respondents (5.6 percent) see this aspect as either not important or only slightly important, while nine respondents felt it was somewhat important (12.5 percent). The average response with respect to a quantity guarantee across all survey respondents is 4.47 (approximately halfway between important and very important). With respect to this guarantee, in informal discussions producers strongly emphasized the need for a long-term commitment (such as 5 or 10 years) by a processor relating to a quantity guarantee. Market outlets are limited for many Tennessee dairy farms. Producers highlighted the risk of switching from their current marketing channel to a new market and that the processor must be sustainable to incur such a risk.[10]

Right of notification regarding any changes in the contract is seen as very important to a large number of surveyed producers (52 or 73.2 percent of the 71 respondents to the question) and important for eight more producers (11.3 percent) (Figure 3.14). The average response with respect to a right of notification clause across all survey respondents is 4.55 (slightly more than halfway between important and very important). Likewise, right of termination by the producer is seen as very important to a large number of surveyed producers (51 or 71.8 percent of the 71 respondents to the question) and important for seven more producers (9.9 percent) (Figure 3.15). The average response with respect to a quantity guarantee across all survey respondents is 4.45 (slightly less than halfway between important and very important).

[10] A statistically significant relationship was not found between size of operation and responses to any of the five questions regarding contract attributes.

Figure 3.13.
Importance of Quantity Purchase Guarantee as a Contract Attribute for Survey Respondents.

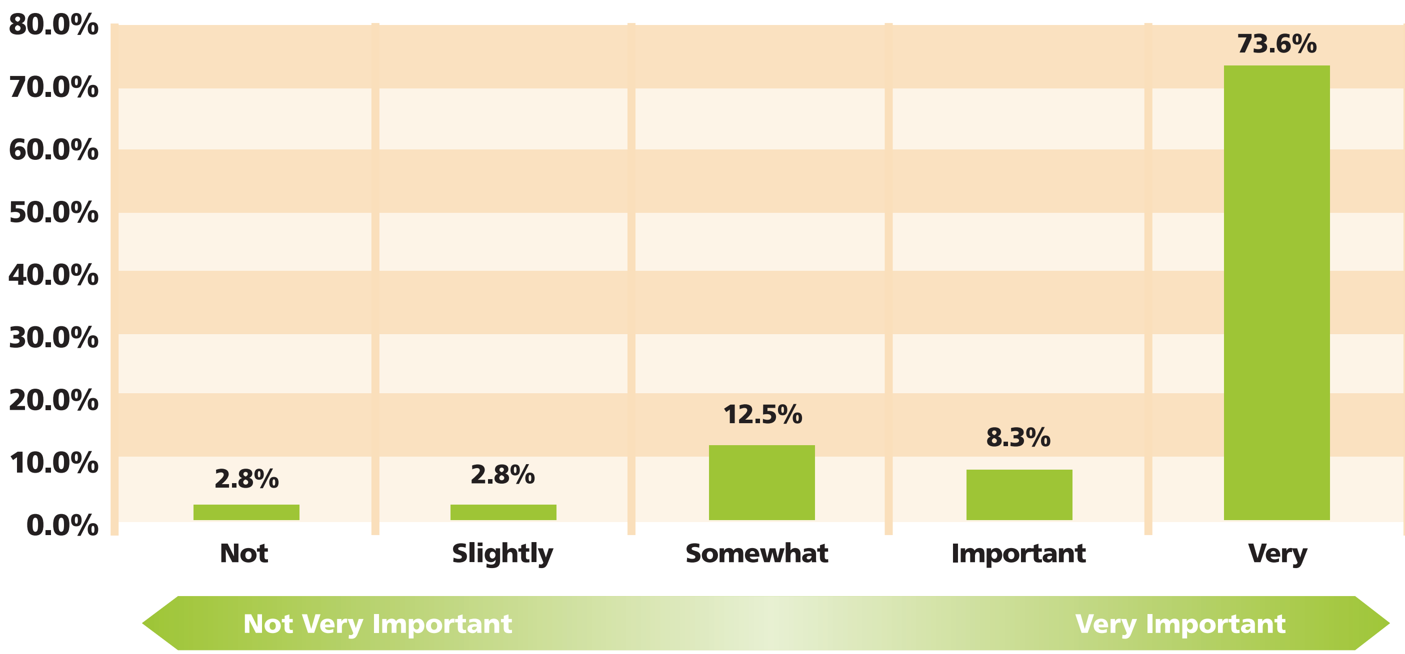


Figure 3.14.
Importance of Right of Notification Regarding Contract Changes as a Contract Attribute for Survey Respondents.

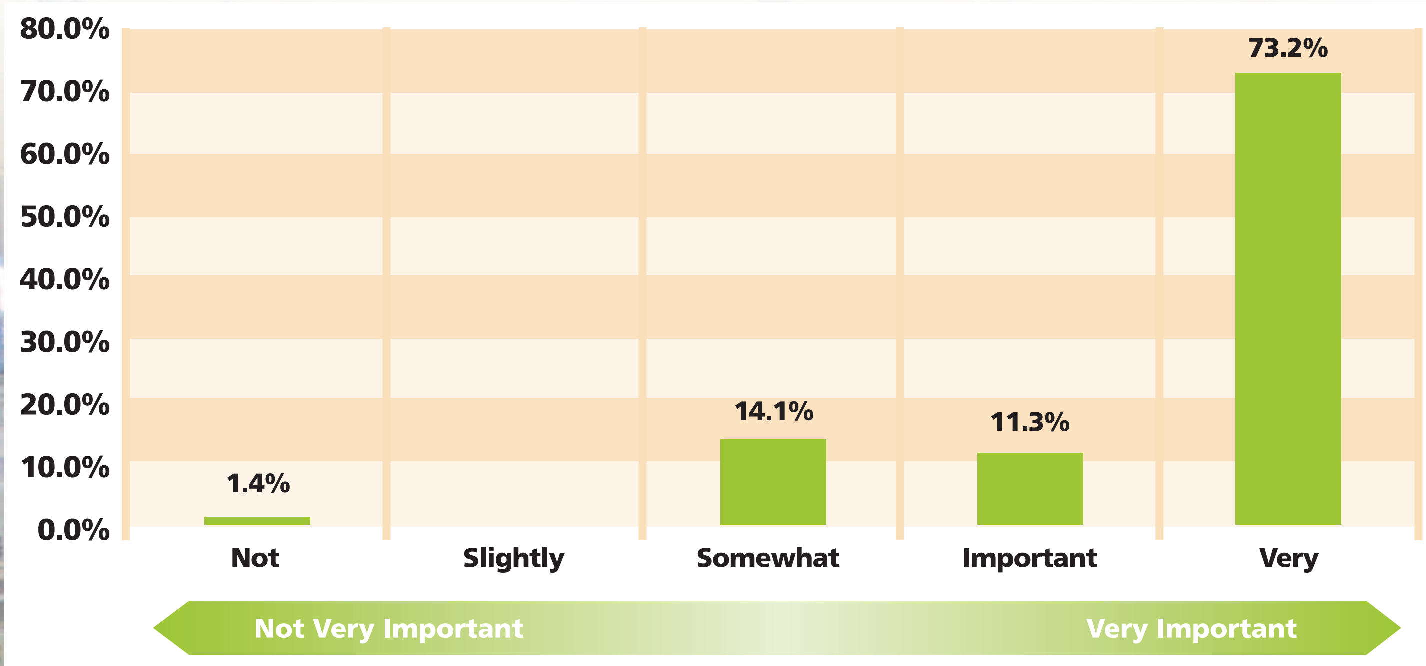
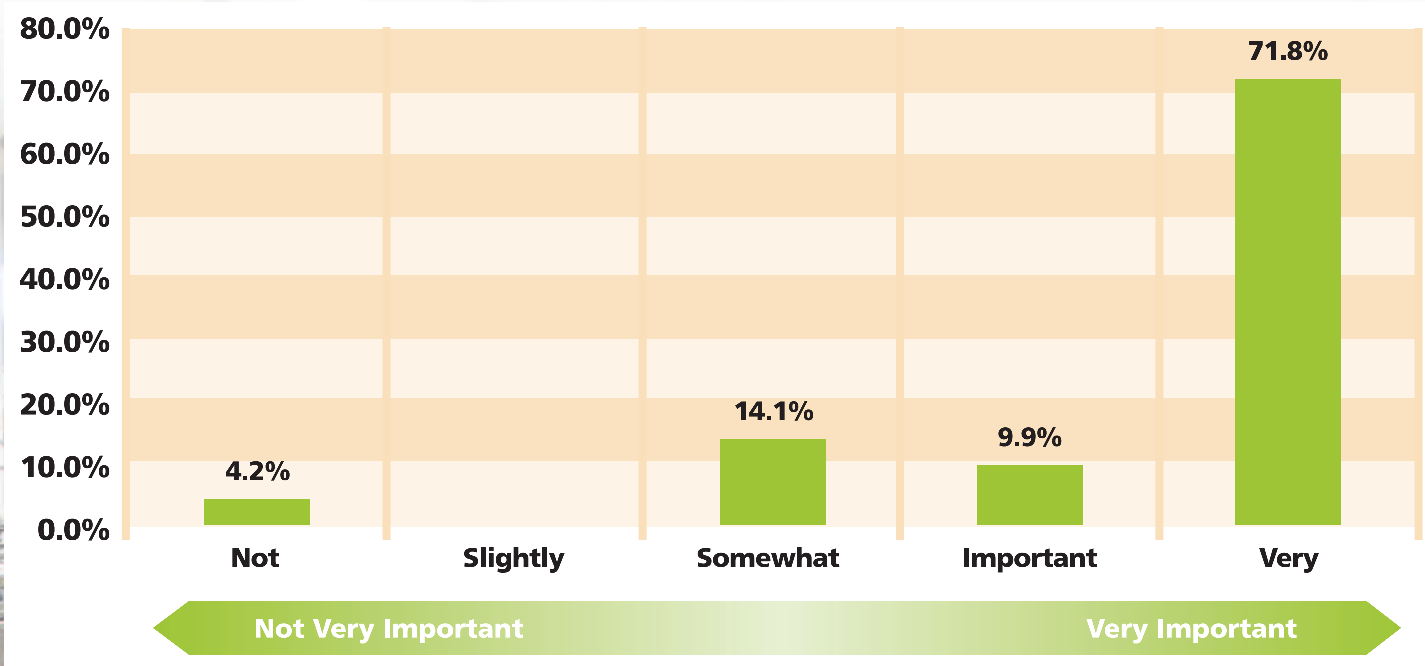


Figure 3.15.
Importance of Right of Termination as a Contract Attribute for Survey Respondents.



As shown in Figure 3.16, explicit quality requirements in a contract is seen by producers as somewhat less important than quantity purchase guarantee, right of notification and right of termination. Among the 67 respondents to that question, 46.3 percent of respondents (31) see this aspect as very important while 14.9 percent (10) see it as important and 24 respondents (35.8 percent) feel that it was somewhat important. The average response with respect to a quality guarantee across all survey respondents is 4.03 (slightly more than halfway between somewhat important and very important). Similarly, price forward contracting is seen as relatively less important than the other possible contract attributes. Among the 68 respondents to that question, 32.4 percent of respondents (22) see this aspect as very important while 11.8 percent (8) see it as important (Figure 3.17). Somewhat important is the category receiving the largest numbers of responses at 26 respondents (38.2 percent). The average response with respect to a price forward contracting across all survey respondents is 3.43 (slightly less than halfway between somewhat important and very important), which is the lowest average among the five evaluated contract attributes.

Figure 3.16. Importance of Explicit Quality Requirements as a Contract Attribute for Survey Respondents.

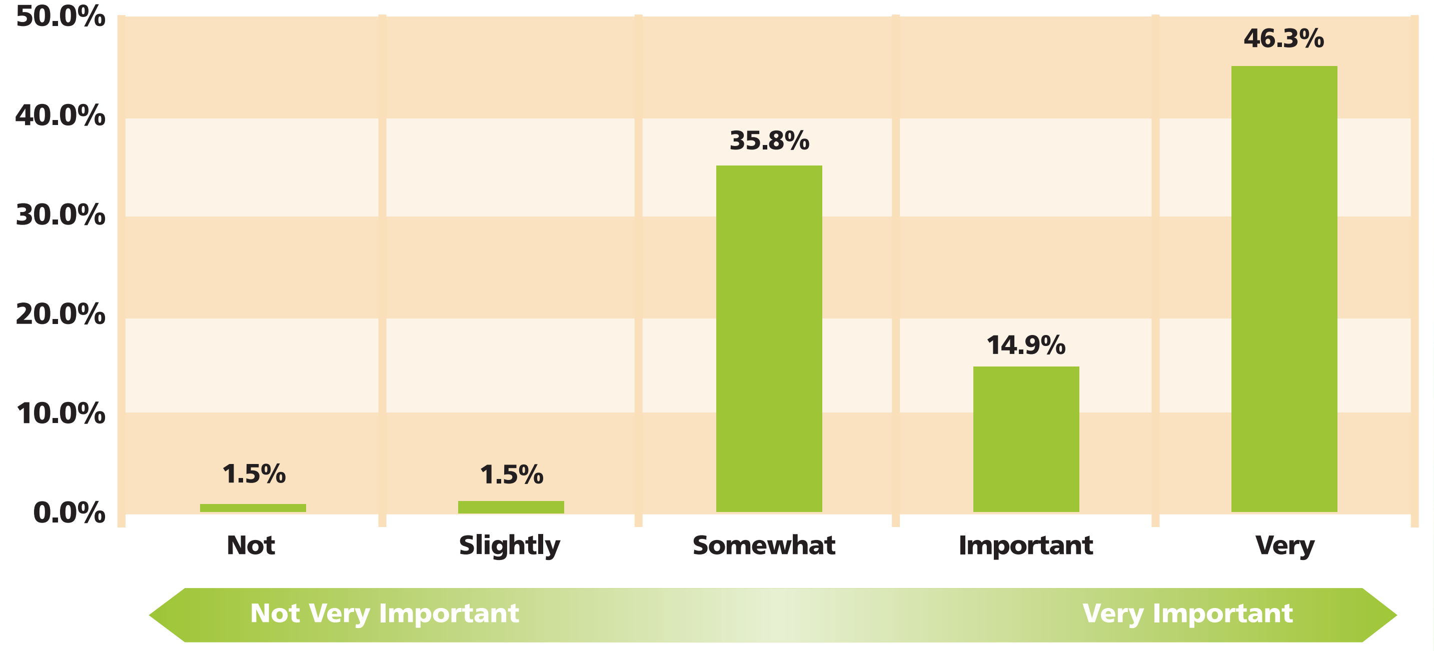
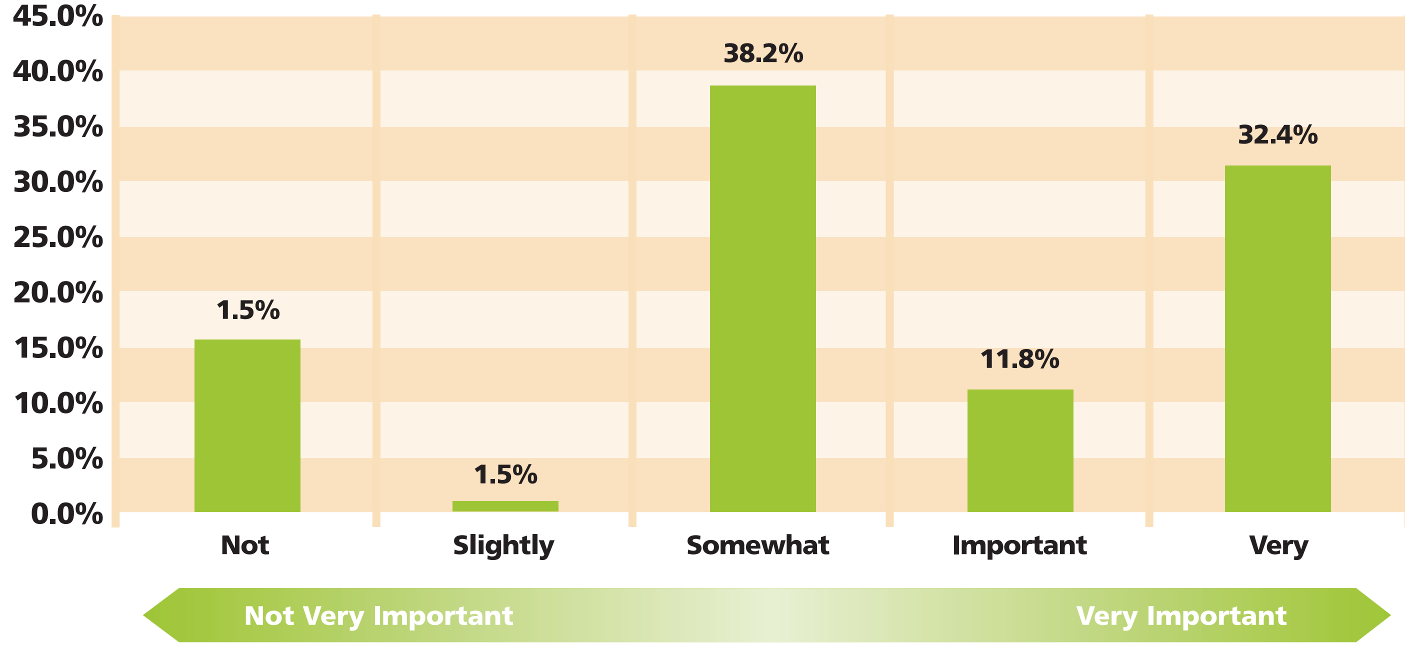
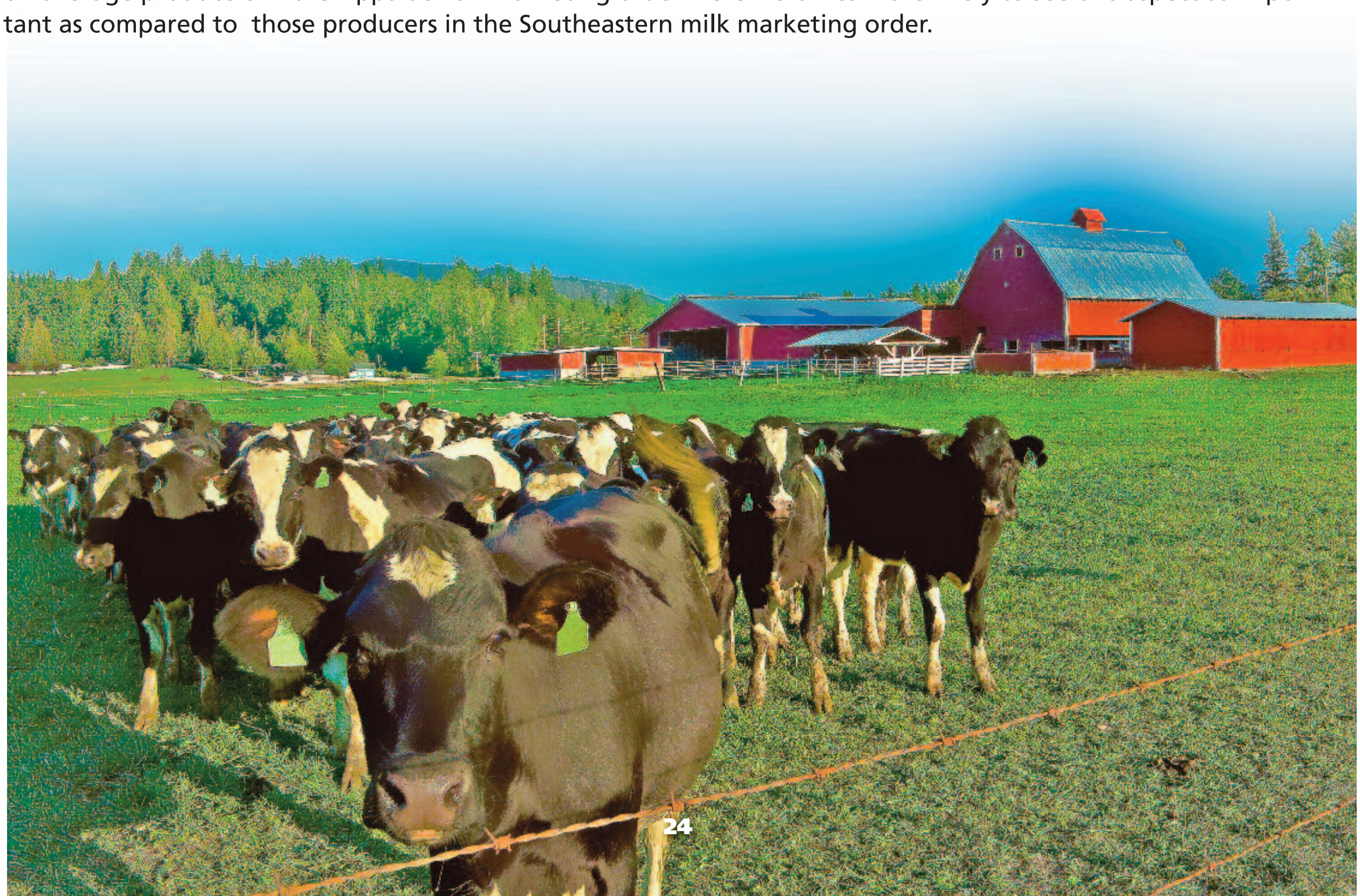


Figure 3.17. Importance of Price Forward Contracting as a Contract Attribute for Survey Respondents.



The relationship between various producer attributes and producer perceptions regarding contract aspects was also tested in a logistic regression model. Responses concerning most contract aspects did not appear to be influenced by any of the producer attributes. However, producers who belong to the Appalachian milk marketing order tended to see the quantity purchase guarantee as more important than producers in the Southeast milk marketing order. The odds ratio was 4.6, indicating that on average producers in the Appalachian marketing order were 4.6 times more likely to see the quantity purchase guarantee being important when compared to than those in the Southeast milk marketing order. Producers in the Appalachian milk marketing order also tended to see the right of termination as more important than their counterparts in the Southeastern milk marketing order, indicating that on average producers in the Appalachian marketing order were 2.9 times more likely to see this aspect as important as compared to those producers in the Southeastern milk marketing order.



Summary and Conclusions

Presented here are results from 74 surveyed Tennessee dairy farmers regarding the possibility of supplying a Tennessee milk processing plant. Surveyed farmers were responsible for 34 percent of the Tennessee produced milk supply, while the distribution of respondents was representative of the state industry. Survey respondents indicated an interest in supplying such a plant given a weighted (by level of production) premium of 11.7 percent over currently received prices. Applying our values to current annual milk production level in the state, 512.7 million pounds of Tennessee milk would be available for the plant at the 12.5 percent price premium. Producer willingness (as weighted by their level of production) to ship would be 163.3 miles. At this distance, an estimated 335.2 million pounds of Tennessee milk would be available for the plant.

In terms of contract attributes respondents saw quantity of purchase guarantee, right of notification regarding contract changes, and right of termination as the most important aspects of a possible contract with a milk processing plant. In summary, survey respondents indicated a willingness to supply a new milk processing plant given an adequate received price and with appropriate contract attributes.

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Appendix A
Survey Instrument

1. Estimated milk production per year __________ pounds

2. County in which your dairy operation is located

   ____

3. Please indicate the distribution of your sold milk (% terms; value should sum to 100%)

   _______ Class I Fluid milk through a dairy cooperative
   _______Class I Fluid milk direct to milk processor
   _______Class I Fluid milk through the spot market
   _______Class II Fluid milk to processor
   _______Class II Fluid milk to cooperative
   _______Class III Fluid milk to processor
   _______Class III Fluid milk to cooperative
   _______Class IV Fluid milk to processor
   _______Class IV Fluid milk to cooperative
   _______Fluid milk to on-farm value added
   100% Total

4. Please indicate the percentage markup above the price you currently receive required for you to switch to a new, regional milk processor.

   _______ 0% no premium required
   _______ 1-2.5% premium required
   _______ 2.5-5% premium required
   _______ 5-7.5% premium required
   _______ 7.5-10% premium required
   _______ 10-12.5% premium required
   _______ 12.5-15% premium required
   _______ 15-17.5% premium required
   _______ 17.5-20% premium required
   _______ above 20%
   _______ Not interested no matter what the premium

5. Please rate these other contract attributes that would be required for you to consider selling milk to a new, regional milk processor with 1 as not important and 5 as very important

Attribute	**1**	**2**	**3**	**4**	**5**
	Not important		Somewhat important		Very important
Quantity purchase guarantee					
Explicit quality					
Right of termination					
Right of Notification					
Price Forward Contracting					

6. Given the premium you have indicated and your re sponses regarding other contract attributes, how far would you be willing to haul milk to the processing plant (assuming that you are directly or indirectly pay ing hauling cost).

   _______ 0-20 miles (one way)
   _______ 21-40 miles (one way)
   _______ 41-60 miles (one way)
   _______ 61-80 miles (one way)
   _______ 81-100 miles (one way)
   _______ 101-120 miles (one way)
   _______ 121-140 miles (one way)
   _______ 141-160 miles (one way)
   _______ 161-180 miles (one way)
   _______ 181-200 miles (one way)
   _______ 201-220 miles (one way)
   _______ 221-240 miles (one way)
   _______ 241-260 miles (one way)
   _______ Over 260 miles (one way)

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