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Vertical Integration for Long-Term Sustainability in the Dairy Industry

Bethany L. Gilles
Southern Illinois University Carbondale, bgilles26@siu.edu

VERTICAL INTEGRATION FOR LONG-TERM SUSTAINABILITY IN THE DAIRY INDUSTRY

By

Bethany Gilles

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A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
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RESEARCH PAPER APPROVAL

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The purpose of this study is to determine and analyze whether it is feasible for a milk processing facility to vertically integrate by establishing a dairy farm, and to determine the relationships of production variables to milk production costs. The results of this study will be used to help aid in working towards reducing the consumer's retail price for milk by utilizing a vertical integration strategy that involves the direct ownership of a dairy farm by a milk processing plant. Data utilized in this study was taken from the United States Department of Agriculture statistics from the years between 2000-2011, data from a dairy farm, Galliker Dairy Company, and many other sources. The variables for a regression model were national numbers for feed, fuel, animal, labor expenses, and milk production costs. The results suggest that more than just feed, fuel, labor, and animal expenses will affect the milk production costs although there is high correlation between these variables, which could be a result of multicollinearity.

Further studies could possibly indicate more data is needed or that there is some way in which to combine the variables. This would indicate and potentially reduce the effects of multicollinearity. A cost benefit analysis will be undertaken in order to determine possible outcomes of vertically integrating a dairy farm and a milk processing plant. Phase two of the planned project will involve the establishment or the addition of artisan cheese facility to be located on the farm. A detailed financial analysis of this project will also be undertaken and then consolidated with the farm financials to evaluate the operating concern.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

CONCEPTUAL FRAMEWORK

Throughout the course of this proposal I will make the argument that an existing milk processing plant can vertically integrate with a dairy farm to provide long-term sustainability in the dairy industry. I will be using the most current numbers available as provided by a milk processing facility, dairy farm, along with information from the USDA and other dairy websites to provide up to date prices on dairy farms. With this statistical information I will perform a cost budget analysis to determine how the milk produced and shipped from the farm will impact the existing milk processing facility's associated costs and how this relationship impacts the long-term viability of the farm itself. The study will involve the analysis of various sized dairy farms in order to determine the most economically feasible dairy farm for this particular processing plant.

The initial intent or belief is that vertical integration will reduce the transfer costs often associated with the procurement of milk. This will hopefully decrease the price the consumers will pay for the product and lead to increased consumption. By decreasing the input prices, the facility will be able to sell milk at a lower price, become more competitive, differentiate itself in the marketplace and help family farms survive. These results are what we hope will occur in the long-term. In the beginning, it is expected that the cost of production will be relatively high due to the initial purchase of the farm, milking equipment, cattle, and a manure pit.

Differentiating the facility will set the vertically integrated facility apart from other processing facilities, potentially increasing sales. The plan for vertical integration will happen in two phases. The first phase will involve the establishment of a new dairy farm and the second phase of that plan would be the establishment of an artisan cheese manufacturing facility at the farm itself. By performing a budget analysis, I will be able to determine whether the processing facility should start a new dairy farm and determine the number of cows needed to breakeven on the initial purchase. Once the dairy farm is established phase two will be implemented and the cheese factory will be evaluated and possibly established. The ability to purchase multiple small dairy farms will be an option. Starting with a small dairy farm and having the ability to purchase surrounding dairy farms or land is ideal. The use of futures prices will provide a timeline of paying off the dairy farm if it is not feasible to make a large purchase at this time.

I want to show that with the current trends in the dairy industry, it is important to vertically integrate an existing milk processing facility to provide sustainability. With the drastic changes, in particular low prices, that have occurred in the dairy industry it has become necessary for more changes and evolution to occur. This integration will provide the facility with the ability to produce and continue to process milk. This will increase the dairy and farm's ability to compete with other processing facilities. Because other successes have occurred with vertical integration within the agriculture industry, I am hoping to show that the dairy industry can also vertically integrate. Dairy farms are already vertically integrated as they also produce the food they feed the cows and the farm can raise the calves into milking cows and continue the cycle. Vertically integrating the facilities will provide the farm with more pricing power.

Vertical integration will be considered for this milk processing facility based upon the facility's current desire to continue to expand into different markets and products. The processing plant already has extended its product line by making other products such as ice cream, tea, juice, etc., and is currently exploring adding artisan cheese making in the future through vertical integration. The milk processing facility has been a family owned and operated business since 1914 and has strictly stayed in the processing side of the industry so the next step for the business is something, different and bold. The milk processing facility makes its own jugs, and distributes the milk and other dairy and nondairy products from its own fleet of vehicles. Other then developing its own milk hauling company, a logical step for the business is to begin producing and utilizing its own milk source as a supplement to its current supply. Current trends in the dairy industry have made it difficult for farmers to survive, which is why the purchase or the establishment of a dairy farm makes sense. Land and cows are available at reasonable prices and the financial position of the processing facility is such that it could support the operations of the farm for a while. The best time to purchase a farm is when the future prices are predicting an upswing in prices of cattle, milk, and etc.

Current trends in the dairy industry as well as with many industries make it imperative that companies maintain an economical competitive edge. The plant already is differentiated from other processing plants because of its processed milk is packaged in yellow milk jugs made at the plant. Because many processing plants nationwide buy their milk jugs, the plant already has established some differentiation through its packaging and labeling but continued differentiation will become a necessity as consolidation in the industry continues.

It is my intent to show how vertical integration in the dairy industry can benefit both the dairy farm and the processing facility through an example. The processing plant is currently looking into the possibility of purchasing a dairy farm. Through my example I will show that for long-term viability of both business entities that vertical integration will be both profitable and provide solutions for continuing differentiation through such initiatives becoming more green, artisan cheese making, organically produced milk or possibly powering the facilities with potential waste from the farm. This study will lead to a potential business venture between a dairy farm and our current family processing facility. After the dairy farm has been added, the milk processing facility will look to invest in an artisan cheese facility. This will create not only other marketing opportunities for the farm but also for the milk processing facility.

CHAPTER 2

LITERATURE REVIEW

The dairy industry has been faced with major changes. From a changing demand for conventional milk products to organic products, to the use of recombinant bovine somatotropin, to now the need for rBST free products. All these changes have had a large impact on the dairy industry today. Not only has the product changed, but also so has the number of available milking cows across states, and the amount of milk produced per animal. The number of farms has greatly decreased over the last 30 years, but the amount of animals per farm has greatly increased (Clark, Kendall and Flinn 2008). The number of processing facilities has also greatly decreased (Dobson and Paul 2000). Environmental, economic and consolidation issues have all had an adverse affect on the dairy industry and these trends are foreseeable in the long-term future.

The dairy industry has shifted from small family farms to large “factory farms.” This shift has caused many small conventional farms to go out of business because large farms are becoming more efficient and economical to operate. The large farms provide economies of scale to the milk processing facilities by providing for a “one stop shopping so to speak” decreasing the cost of fuel, stop charges, hauling charges and all the transaction costs that go along with more than one stop. Multiple stops are being eliminated because one stop equates to a full load of milk. These large farms are few in number but there has also been an increase in the amount of milk a cow can produce. The consolidation in the number of processing facilities has also greatly decreased, further straining the cost of transportation to the farmers.

Changes in the dairy industry are forcing firms and businesses to change their ways. Businesses are always searching for ways in which to improve efficiencies and profitability, which ultimately leads to long-term viability and sustainability. The low margins throughout the supply chain of the dairy industry make constant improvement and efficiencies necessary in order for an entity's survival. This notion is applicable to the farms, the processors and ultimately the retail chains that distribute the products.

Vertical coordination and vertical integration are key ways for some businesses to reduce transaction costs leading to greater efficiencies and the accomplishment of long-term goals. In vertically integrated firms, one firm will control the production and transaction costs will be reduced through integration (Martinez 2002). Uncertainties, supplier concentration, and scale economies can also be reduced through the integration. The higher the uncertainty in a firm there is, the more the firm will vertically integrate (Wolter and Veloso 2008). By having some fluid milk coming from the dairy farm to the processor, some transactional costs will be reduced because the farmers have some understanding of how the business is running (Frank and Henderson 1992). This also works in the opposite direction, as the processor will have some idea of how the dairy farm operates. Agriculture has had success with vertical integration with the poultry, pork, and egg industries (Martinez 2002).

The dairy industry can learn from these successful industries and has the potential to integrate dairy farms with milk processing facilities. The combination of firms can have potential benefits for both the dairy farm and processing facilities. Integration can reduce risks and uncertainties that develop with the combination of the two businesses. The success of vertical integration between the processor and the farmer relies upon the financial health and viability of each entity. Essentially, decisions that are made for one must also be good for the other. Each entity must "lookout" for the other's best interest.

The demand for milk changes weekly and processing facilities need the ability to sell or purchase milk from cooperative associations. There are very few milk processors that have an independent milk supply so most rely on the cooperative associations for the milk needs. Buying milk on the spot market during high demand times can be a risk that must be taken. This not only applies to milk but also the cream needed for ice cream. To reduce the need to buy on the spot market, contracting milk prices with farms can reduce some of the uncertainty of price (United States Department of Agriculture n.d.). Contracting prices can spread the risk between the firms and provide more control of the production (Martinez 2002). This will also allow for the evening out of the price fluctuations often involved in monthly milk prices.

The addition of a dairy farm to help supply a processing facility can, and most likely will, involve huge initial start-up expenses in the short-run. Dairy farms are in and of themselves already vertically integrated when replacements and crops are grown on the farm. To reduce some of the risk associated with the purchase of a dairy farm, some of the issues firms should consider include contracting commodities, transportation, milk prices, and growing feed on the farm (Sumner and Wolf 2002). Herd size on a dairy farm can be adjusted to increase the amount of milk being provided to the processing facility. While costs increase or decrease depending on the amount of milk needed, having contracted prices can reduce the anxiety of needing to use the spot market.

The price associated with fluid milk changes constantly. The demand and supply for dairy products will drive the price of fluid milk. Cooperative prices of milk depend on factors such as transportation, the service price of going through the cooperative and bargaining powers of the cooperative (United States Government Accountability Office 2004). Transportation for both farms and processing facilities limits the area in which facilities can be located. Expenses will be reduced by locating the facilities near the purchasing population (Sumner and Wolf 2002).

This type of vertical integration can also help to differentiate the firm from a marketing standpoint. The firm can control quality, quantity, costs and even possibly the distribution of the final product. Vertical integration has the potential to both help the farmers and the dairy processing facilities survive in a complex and ever changing industry. The differentiation of the current milk processing facility will allow the firm to stand out and increase the chances of stability in the future. The firm will have the potential to add other dairy products. The facility could expand within using the milk that is already coming from the dairy farm.

Vertically integrating is done by firms to increase profits and/or to have more control in the supply chain. Firms decide to integrate if they can produce the same products together but cheaper then producing the products separately, in other words to establish economies of scope. While the integration in the dairy industry will be a little different, concepts in other agricultural industries can be used. The firm will need to produce raw milk at a price that is cheaper then what the existing processing facility is paying for it. The processing facility will then have the ability to bottle milk cheaper then previously which provides for a competitive advantage.

Williamson's transaction-cost economics (TCE) paradigm describes the basis of this project. While Williamson's TCE theory is based upon asset specificity for the justification of vertical integration, another evaluation process will need to be considered for this project. One specific asset cannot be determined in this example evaluation based upon Williamson's TCE theory. There are other ways for vertical integration to be justified. Scale and transaction costs are also another way in which to justify vertical integration (Altman, Klein and Johnson 2007). It is important to note that with the initial purchase and start-up of the dairy farm; it will be a somewhat vertically integrated facility to begin with. Vertical integration in a dairy farm would include raising replacements, feed, and etc. (Sumner and Wolf 2002).

Site specificity is very hard to determine for a vertically integrated dairy farm and milk processing plant. For example, one milk processing facility is located within the city limits and the other is located in an industrial park with little property available for expansion. Therefore, establishing a dairy farm within reasonable proximity to either dairy processing facility is out of the question. The location of the new dairy farm will be at a midway point somewhere between the two milk-processing facilities. This will alleviate some hauling costs. Unless the milk processing facility moves to the location of the dairy farm, there will still be hauling costs. According to Altman et al., they determined with biopower plants that the farther away the facility is from the supplies the less likely it is for them to vertically integrate (Altman, Klein and Johnson 2007).

The future of the dairy industry is slowly moving towards fewer but larger farms. This means there will be an increase in long-term contracts and vertical integration with dairy farmers. The demand for milk will either increase or remain the same. It is my assumption that many of the farms currently supplying milk to the milk processing facility will not survive in the future due to high land values, low milk prices and the lack of future generations returning to the farms.

From an economic standpoint, vertical integration is necessary. Spot-market purchasing is acceptable when there is little or no risk. However, for a business to sustain itself, spot-markets are very risky and have high uncertainties. The quantity and quality of the milk on the spot-market is unknown and not really in control of the purchaser. Milk processing facilities basically process milk twenty-four hours per day and based upon the season will need more milk than their current supply allows for. When there is an increase in demand from the milk processing facility, the spot-market is a means in which to fulfill or balance this short-term problem. In the long-run spot-market purchasing is too risky for the sustainability of a milk processing facility due to the quality and at times the limited availability of milk and cream. Of course the price facilities will have to pay on the spot-market can be also be variable depending upon market conditions but in most cases if the dairy is spot purchasing then milk is usually in short supply which means the milk processing facility most likely will be paying more on the spot-market than they would if they had contracts.

Short-term contracts are like the spot-market as far as risk and uncertainty. With short-term contracts, obviously the processing facility would know how long the contract will last, etc. but once the short-term contract has expired, the facility must either renew, purchase from the spot-market, or find another farm for their supply of milk. When there is an expiration of a short-term contract, the milk processing facility still has to fulfill the demand for milk.

Long-term contracts and vertical integration are the best options for the sustainability of a milk processing facility with the current trend in the industry. Long-term contracts add a predictable and stable flow of milk to the facility. They also provide the facility with a stable cost which in turn will allow for the accurate prediction of profitability. These contracts help reduce the risk and uncertainty of whether or not there will be enough milk to supply the market. When the milk processing facility becomes integrated with a dairy farm, it will still need long-term contracts to obtain enough milk to supply the market. The dairy farm purchased, will not be able to supply all the milk, but will help provide some of the balancing milk that the processing facility needs. The milk processing facility will have a better idea with long-term contracts and vertical integration as to how much milk will be supplied on a regular basis. The spot-market will potentially have to be used in rare cases when the demand for milk far exceeds supply.

Future dairy farms will be far and few between according to recent trends. This means something will have to drastically change in order for milk processing facilities to continue supplying milk or pay the higher costs associated with obtaining the milk from far away places. The current milk processing facility has its milk supply located within a four to six county region but if farms continue to close, the distance needed for the milk supply will continue to grow. When this happens, the hauling rates are going to increase which will eventually trickle down to the consumers and result in higher prices. Fuel prices are most likely not going to be decreasing any time soon making the need for close proximity essential. It is not feasible for the facility to purchase milk any farther away than it currently does, which is why it is so important to start looking toward vertical integration as means through which to control costs (Altman, Klein and Johnson 2007).

Vertically integrating the milk processing facility with a dairy farm with allow for flexibility. Assuming the bulk tank is full at the dairy farm, the milk processing facility can look to obtaining that supply as soon as it is needed in order to reduce shut down time while waiting for other trucks to enter the facility. If the facility can reduce shut down time, it will decrease overtime labor and operating costs in these rare occasions.

Altman et al. determined through the biopower industry that the larger the scale, the less probable it is to integrate (Altman, Klein and Johnson 2007). The milk processing facilities in this project are relatively small in size compared to the mega plants. Since the facilities are smaller vertical integration for the milk processing facility produces a higher probability for vertical integration. The milk processing facility in the beginning will have a combination of long-term contracts and vertical integration. The goal is not to put current producers out of business; it is to continue to supply the market when the current producers no longer wish to supply the market or exit the industry.

CHAPTER 3

REAL WORLD PROBLEM

The general real world problem is the reduction of transaction costs of the facilities using transaction cost economics. The real world problem is the reduction in the number of dairy farms and how supply has begun to affect milk-processing plants. The lack of interest in future generations of dairy farmers and hard economic times are causing family farms to go out of business. The times when the local processor relied upon nearby farms for the milk is fading fast. The small farm is being replaced by mega-farms and milk is being shipped further and further away. Quality and freshness are issues that become suspect in the system that is currently evolving and can eventually lead to reduced consumer consumption, further exacerbating the problem.

Vertical integration will allow or provide for the opportunity for milk processing plants to once again rely on these small local farms to buy the farm's milk to process, bottle, and sell in stores. Because milk has a limited shelf life and requires cold storage, the location of these farms is important. The closer to the plant these farms can be located to the processor the better. Timing factors are important to consider when the goods being produced are perishable. Raw milk must be maintained within the appropriate temperature range in order to produce quality milk. The distance between firms should be close to prevent any range in temperatures. The location of the dairy farm will be essential for the business. Bedford County, where the dairy farm would be located, is halfway between the two milk processing facilities. Not only will proximity to the facilities be important, but also it provides for some unique potential for advertising. The Pennsylvania turnpike runs through Bedford County and the town of Bedford, which again will provide for potential advertising avenues for the dairy products. It is also hoped that in the future, agritourism can be developed at the farm and attract people from the turnpike traveling through the area to the farm.

The vertical integration has the potential to eliminate the costs in purchasing milk from farmers but will also have the potential short-term downside of increasing the overall consumer prices with the addition of a dairy farm. Because many dairy farms are going out of business especially in the economic times of the last few years, milk processing plants are struggling to keep local farmers viable and maintain the local supply of raw milk.

Transportation costs are one of largest hurdles that dairy farms face and vertical integration could be essential in helping to solve this problem. The costs of transportation also trickle down to the processor and ultimately the consumer. Limiting traveling distance is essential in order to reduce costs. When the facilities are within a closer range, they tend to develop relationship-specific transactions. Vertically integrating the facility will allow the firms to not have to rely on contracting and potential problems with the closest producing facilities (Martinez 2002). Milk processing plants must have a steady schedule of milk coming into the plant in order to fulfill the orders of the customers. The dairy farm will take a few years, especially a start-up farm, to reduce costs but has limitless potential in terms of the ultimate marketability of the final product.

Once the dairy farm has been added to the milk processing facility, the next step would be to look further into diversification of the farm. This phase will include the addition of a small artisan cheese facility. In a time where local foods are becoming the fad this is a great opportunity for the milk processing facility. At this time, there is not a local artisan cheese processing facility anywhere near either facility.

CHAPTER 4

JUSTIFICATION

Through this analysis, my goal is to provide an example to economically prove that the dairy industry can vertically integrate and to reduce the cost of production in the long-run. Reduced costs and diversification can lead to potential new markets in the industry. I will analyze the data to determine dairy farm profitability and size, and which scenario provides for the best economies of scale. Utilizing various scenarios, I will be able to determine the number of cows needed to break-even along with the number of replacement cattle needed to sustain a viable dairy operation. I will also determine utilizing the break-even number of hundredweights, whether the dairy farm will be profitable at the lowest milk price in 10 years and also its profitability at the highest price as well. After the initial addition of the dairy farm, the potential for an artisan cheese facility will be considered utilizing financial projects and a cost-benefit analysis.

CHAPTER 5

OBJECTIVES

The objective of this research is to determine how to make an existing milk processing plant more efficient and show the potential benefits by vertically integrating a dairy farm in the short-run and long-run. In order to accomplish this objective the size of the dairy farm most beneficial to the processing facility will be determined by analyzing different scenarios varying the number of cows, and the milk prices, and observing the affects these variables have on the corresponding economies of scale. The price of milk per hundredweight will be varied to determine how the operational costs and profits or losses of the dairy farm are affected by changes in the price of milk. Phase II's objective is to determine if it would be feasible to add an artisan cheese facility after the initial introduction of the dairy farm.

CHAPTER 6

RESEARCH QUESTION

To determine the feasibility of an existing milk processing facility purchasing a dairy farm and in the future whether or not to add an artisan cheese processing facility and the financial implications for both the short-run and the long-run viability of the operation. While there will be an increase in price in the short-run due to the purchase of a dairy farm, the purchase of the farm will ultimately prove to be beneficial, profitable and help enhance the company's long-term viability in the long-run.

I assume that a larger dairy farm will provide for greater ability to reduce on farm costs, which will ultimately result in reduced costs to consumers. Purchasing a dairy farm most likely is the best option but distance to the processing facility will need to be addressed as well as the potential farms for sale in the region in which the processing facility is located. Limiting the distance between the dairy farm and the processing facility will create issues.

The analysis of establishing dairy farm will help to identify and solve the issues associated with making the additional facility feasible for the milk processing plant. I will assume the initial purchase, in the short-term, will not be of much benefit to the vertical integration because if the start-up costs but my concern is with the long-term viability. The long-term benefits generated through vertical integration will outweigh the initial cost of the dairy farm. I will assume consumers will respond by purchasing more milk with decreased prices and their general utility will be increased.

In the additional analysis there will be an option to establish an artisan cheese facility. This facility will further expand the business into more local markets. With the addition of an artisan cheese facility, there will be another entity to the business. Artisan cheese will be sold locally thus increasing the market size for the dairy's products. Right now, cheese is one of the few products the milk processing facility has yet to explore. The way the economy is driving locally produced foods, this is an area in which the milk processing facility can become somewhat of a pioneer in and differentiate itself from the other dairies by offering a product that is locally grown, manufactured and distributed.

CHAPTER 7

METHODS

The data collected will be put through a cost analysis to determine the most beneficial option for the milk processing facility. The information will be based on current farms that are for sale, along with current prices taken from varied sources. In the cost benefit analysis, feed prices will remain constant with the varying milk prices. The milk prices will be based upon the Pennsylvania historical data between the years of 2001-2011. There will be three scenarios based upon the data: best case, worst case, and break-even. The best-case scenario will utilize the December 2011 price of milk at $22.15. The worst- case scenario will use the 2002 average price received for milk at $13.80. The break-even scenario will use the average price for the year 2010 at $17.98. The decision to add a dairy farm to the existing processing facility will be projected for seven years to determine the feasibility.

To ultimately determine the farm feasibility, options will be varied. The processing plant will create a financial projection or a rough estimate of how the future dairy farm would benefit the dairy utilizing a cost benefit analysis. Because the distance between the farm and the processing facility needs to be within a reasonable range between two co-existing milk processing facilities, the area of interest would be the Bedford, Pennsylvania. Bedford, Pennsylvania is halfway between the current milk processing plants. The existing milk processing facility used in this study consists of two separate facilities: one located in Maryland, and a larger facility in Pennsylvania. The current milk processing facilities work together supplying each other with products, sharing personnel and services, and expanding sales territories whenever possible.

The farm I based the purchase cost off of is located in Bedford, PA. The farm currently has two barns located on site along with two houses. Both houses will not be used therefore; one of them will be sold. There are currently 175 acres of cropland that is already in use. The current price of the farm is $1.2 million. Milking facilities will need to be added to one of the barns. A 2,500-gallon bulk tank with agitation and cooling properties will cost approximately $22,000 used (eBay n.d.). At this point, it will be most beneficial to purchase used equipment. Purchasing used equipment will enable the farm to purchase equipment larger than needed, which will provide for the potential for expansion. This also allows for the purchase of a milking parlor that is much larger than is needed at this time.

The parlor that will be purchased is a used double ten remanufactured Original Germania herringbone. The price of the parlor included instillation, shipping, crowd gates, pumps, and etc. (Technology For Agriculture LLC n.d.). The purchase of a milking parlor at $222,807 and a bulk tank will total $244,807.

The funding plan, which will include the borrowed money for the original purchase of the farm, cattle, manure pit, and milking equipment will be shown in loan amortization schedules. The loan amortization schedules were based upon the useful lives of the equipment, animals and land and are pretty much industry standards. The useful life is a 10-year loan period for the milking equipment and 30-year loan period for the farm and manure pit. The money for the cattle will be based on a 5-year loan period. The Daily Profit Weekly was used to determine the price of cattle. The prices used in the analysis were $900 for the replacement cattle and $1,500 for fresh and dry cows. These prices were based upon average sale prices at the New Holland, Pennsylvania auction (Dairy Business 2011). One of the two houses on the farm will be sold to cover most of the cost of purchasing cattle. The asking price for the house will be set low at $325,000.

It is assumed the dairy farm will be able to internally grow after the initial purchase of the cattle. It will also be assumed the milk processing facility will initially agree to invest $500,000 towards the purchase of the farm and that this money is an investment which will not have to be repaid until some time in the future if at all. It is also assumed the farm will do it is own breeding using artificial insemination.

The price of a manure pit again will be another large initial cash outlay in the short-run but is necessary for the dairy farm. The cost of the pit is estimated to be approximately $60,000. The cost is all-inclusive for the construction, excavation, pumps, and concrete, and is being built large enough for future expansion. Excavation costs for the manure pit would range between $1-$3.50 per cubic yard (Fulhage, Pfost and Feistner n.d.). Concrete will cost $75 per cubic yard (The Concrete Network n.d.). The manure pit will have a six-month storage capacity for 400 milking cows, which will be 5,500 cubic yards in size. Finally, a used agitator and pump will cost $33,020 (Fastline n.d.). To determine the total cost of the manure pit, multiple sources were used to calculate the cost of excavation, agitators, and concrete.

The data utilized to determine the operating costs of the dairy farm is modeled after one of Galliker Dairy Company's actual dairy farms. This farm is actually located in Maryland so some modification of the data to fit the proposed farm in Pennsylvania will occur. In making the projections for the new farm, assumptions had to be made about inflation rates, efficiency rates, and many other issues that may or may not occur. The first major assumption made is that the new farm would be able to run close to the same efficiency rate as the Maryland farm. The actual dairy farm currently has 125 milking cows and based upon the efficiency rate and the cash outlay needed to purchase the new farm a break-even calculation (Table 1 in Appendix A), determined that the number of milking cows needed was at least 173.

It will be assumed the dairy farm will increase in efficiencies after the first year. The dairy farm will increase in production by eight percent from year two to year four. In years five and six, the milk production will decrease to only a two percent increase, and finally year seven will be at a zero percent increase. This will increase the average pounds per cow to 21,500 in seven years. With advances in dairy genetics, nutrition, and management issues this will be a very reasonable goal to reach in seven years. The cheese processing facility will be added to the business in year three.

In order to be cautious and conservative in the projections, adjustments to the actual farm data were made. This was necessary in order to allow for a close but lower efficiency rate for the new farm since it is a start-up. Utilizing a conservative approach, the actual Maryland farm's operating cost numbers have been inflated by a minimum of 10%. Even though the herd size is going to be larger, by approximately 63 cows or 50.4% there will be some advantages and efficiencies that can be achieved through some differences in operations, which will explain why operating costs will only rise 10%. The data will be projected to show the difference in profitability between having and not having a cattle loan to pay off. The data will also be projected over the course of seven years, to show profitability without the cattle loan. (See Table 3 in Appendix A)

Utilizing the milk processing facilities financials, a determination will be made as to whether or not the processing facility can safely invest the $500,000 needed to purchase the dairy farm. The intent is that the businesses will be run separately and the farm will have to perform and stand on its own but the initial investment will be needed in order for the farm to be purchased. The dairy farm itself will have to borrow the rest of the money in order to get the farm operating based upon the land value of the farm. Keeping the businesses separate will be important for the simple fact that the farm is a risky venture and the processing facility cannot be hampered by the farm's operation. Essentially the farm is a stand-alone entity while the milk processing facility is the primary investor which will eventually be looking for a return on it's investment.

Many assumptions were made in the calculations based upon the information that was available. Various scenarios utilizing combinations of numbers will be employed in order evaluate business conditions that may occur. The worst-case scenario will be based on the lowest milk price occurring within the last ten years. The break-even scenario for the new farm will be based upon the actual dairy farm's average milk price for the year of 2010. The best-case scenario will based upon the projected December 2011's milk price (United States Department of Agriculture n.d.).

I will also look at the necessary size of the facility needed to ultimately reduce costs to the consumers by analyzing the economies of scales of various facilities. Current published data will be used to provide this analysis. I will look at the least cost option for running the facility. The least cost option will also be used in order for the processing plant to determine if a start-up facility will provide for a reduction in costs to the consumer.

The ability to expand the processing plants will be assessed as well. In order for the addition of a dairy farm to be feasible, the processing plants may have to add other dairy products. Potential products to be added are a small artisan cheese plant, coffee creamer, and yogurt. Differentiating and expanding the firm continually will set the firm apart from other processing plants.

Current processing plants and dairy farms are not vertically integrated, and only specialize in serving certain set markets. The processing plants are mainly producing milk and have added addition products but do virtually nothing in terms of utilizing the local farm supply to sell products. The dairy farms on the other hand are focused solely on producing milk and rely upon the processor to market the milk. The integration through an example will bring about new ways for dairy farms and processing plants to differentiate through a combined cooperative collaboration. There are very few if any dairy farms that are producing other dairy products, other than raw milk, at this point. This example will show the farms and other processing plants that it is possible to make vertical integration beneficial for the facilities and consumers.

While this project is formulated on assumptions, the data utilized was based upon very conservative numbers. There is plenty of risk involved with a start venture and vertically integrating the dairy farm with the milk processing plant is no exception, which is why maximum costs, average costs, and even the lowest price for milk in the last ten years were all utilized in combinations in order to make this evaluation.

Phase II of the project involves determining the cost and potential benefits of establishing an artisan cheese plant. The development of the cheese facility will be established at the farm to eliminate costs. The main expense will be in purchasing the necessary equipment for making the cheese. The farm facility already has the space to add the cheese making area and the milk is already there. Processing of the cheese will take place at the farm in one of the newly renovated barns, which will also allow for a retail outlet to be established right on the farm.

The goal of the cheese plant is to provide quality cheeses using a combination of Artisan and Farmstead Cheese making processes to create the best tasting, locally produced cheese. We will guarantee that the cheeses will be handmade from the freshest ingredients and aged with care. The cheese style will be unique to this region since it will be produced using local milk from the dairy farm and local ingredients.

Artisan cheese producers purchase milk from other dairy farms whereas Farmstead cheese producers use milk from the farm's own animals. The Artisan and Farmstead Cheese making styles will be combined in the initial start phase of the business due to the infrastructure in place at Potomac Farms Dairy. Costs will be minimized by initially making the cheese on the farm and then transporting it to the dairies or the storage facility thus, the main expenditure is for the equipment used in the making of the cheese. The milk processing facility also has the ability to store the finished product once the cheese making process is completed. Its fleet of refrigerated trucks coupled with its current customer base also makes for an opportunistic avenue through which the distribution of the product can take place.

The farm will need the milk processing facility to invest in a cheese vat, press, molds, cheesecloths, and any ingredients necessary. The cheese vat to be purchased is a stainless steel cheese vat made in Holland. Size of the vat will be 1000L or 265 gals, which will allow for expansion. The vat will be, as Glengarry Cheese-making and Dairy Supply Ltd states, "a triple wall, circular, on casters with manual or pneumatic lift" (Glengarry Cheesemaking and Dairy Supply Ltd. n.d.). It will also have automatic curd cutters and a milk agitator on a variable speed reversible motor. The vat will also include vat lids, a whey screen, dipstick, and a product thermometer. The vat selection was based upon a Lancaster County cheese production plant, September Farms (September Farm n.d.). The cheese vat will be $25,000 (C.van't Riet n.d.).

The milk processing facility will need to purchase a cheese press. The cheese press will need to be a two-cylinder press in order to press the whey from the cheese curd. The cost of the press will be around $5,000 (Cheese Supply n.d.). This size press will allow for the cheese to be made every other day if necessary. Cheese molds will also need to be purchased. The molds will be plastic for easy cleaning and the sizing will be $3^{1/2}$ by $3^{1/4}$. The cost of the molds is $78.48 for ten and the intention is to purchase 50 (Cheese Supply n.d.). The cheesecloths are not a capital outlay because they are inexpensive.

The plan for the cheese facility would be to distribute the cheese locally. This again will be a separate entity from the milk processing facility. Because there are many local restaurants in the area of the milk processing facility, the intention is to sell mainly to these restaurants and local farmers' markets. Once production has increased, there is a possibility of adding a small store off the dairy farm and/or adding another small cheese processing facility. A small store off the dairy farm again can be advertised from the road thus increasing traffic to the dairy farm.

CHAPTER 8

DATA

The data was found on the United States Department of Agriculture's website. (See Table 2 in Appendix) (United States Department of Agriculture n.d.). The numbers contained in the data are the national averages for the years 2000-2009. The milk column was calculated using the average price per hundredweight, average pounds per head, and the average number of cows per year. The Feed, Fuel, Labor, and Animal columns indicated the national expenses per year. All of these factors affect the cost to produce milk and ultimately profitability and sustainability; therefore, I will employ the above data to perform a regression analysis.

The total cost of milk production includes many variables. I chose to look at how total milk production is affected by feed prices, fuel prices, labor prices, and animal expenses. Due to unavailability of data for Pennsylvania farms currently supplying the milk processing plants at this time, I used the national average prices. It should be noted that Pennsylvania controls it production and pricing of raw milk through the Pennsylvania Milk Marketing Board. The Board was established to help determine costs of production, raw milk pricing, set premiums, determine retail pricing and provide a fair rate of return to both the processor and the dairy farmer. The Board, in theory, was established in order to help the dairy farmer and the processor stay in business (Center for Dairy Excellence- Pennsylvania Milk Marketing Board 2011). Pennsylvania will either have higher or lower figures than the national averages, which, adds a degree of error to the model.

Feed prices will vary from farm to farm, and even day to day, which will also cause some error in these averages. Farms feed prices will be different because farms have the option to buy feed or grow their own feed, and they can determine whether or not a low cost feed is efficient for their cows. Fuel prices will change depending on the economy, year, and transportation distance. Labor prices vary based off the states' minimum wages from year to year and also from state to state. Farms have their own pay scale, which will lead to variation in labor prices. The milk price per hundredweight will vary from farm to farm because some are offered premiums, and others are organic. In this model, organic farms are not separated from conventional farms. The price of expenses for animals will change based off the number of cows involved, and all of the expenses that were included in the USDA data (United States Department of Agriculture n.d.).

I assume feed, fuel, labor, and animal expenses will have an affect on milk production costs. The regression model I will perform will be based on the USDA data from the years 2000-2009. There have been significant changes in the in the dairy industry and major price fluctuations since 2000, which will increase the volatility of error in this model. This regression will have some error and possibly multicollinearity but will show that there is a relationship between feed, fuel, labor, animal expenses, and milk production costs (United States Department of Agriculture n.d.).

The data for the milk processing facility and the cheese facility are best shown in table form (See Appendix A). The data was pulled from outside sources such as the milk processing plant, one of our producers, NASS, and USDA data, and formulated to into a cost-benefit analysis (NASS 2010) (United States Department of Agriculture n.d.). The cheese facility uses data and numbers from various sources as well.

Table 1. Adjusted National Average of Costs Data

Year	Feed (dollars)	Fuel (dollars)	Animal (dollars)	Labor (dollars)	Milk (dollars)
2000	245	70	180	207	20.589
2001	248	67	185	217	24.799
2002	249	65	183	215	20.577
2003	275	67	185	218	21.298
2004	297	80	192	233	27.504
2005	280	101	216	240	26.731
2006	314	111	261	245	23.465
2007	419	135	330	286	35.472
2008	469	160	283	297	34.781
2009	450	124	259	280	24.235

(NASS 2010).

The linear regression model was utilized to indicate the correlation between milk production costs and the national average costs of feed, fuel, labor, and animal expenses. The regression results are shown below in the empirical results and in Appendix B. The above data was used to run the regression model. I divided the data by 100,000,000 for simplicity of the results. (For original data; see Table 1 in Appendix A.) Below is the equation utilized in the performance of the regression model:

$$Y_i = \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\mu_i$$

Y_i= Milk Production Cost

X_1= National Average Feed Expenses

X_2= National Average Fuel Expenses

X_3= National Average Labor Expenses

X_4= National Average Animal Expenses

CHAPTER 9

EMPIRICAL RESULTS

Milk production costs is a function of feed, fuel, labor, and animal expenses. I performed five equations within my regression model to show how each variable is related to milk production costs, and then together how they impact milk production costs. I used the program SPSS to perform a regression analysis on the adjusted data. Multicollinearity did play a role in this study, which suggests that there is a high correlation between the variables used. When multicollinearity is present, it will have significant effects on coefficient estimates when there is a small change in the regression model. This evidence can be seen when looking at the regression model statistics in Appendix B.

The regression model suggests that 78% of the variation in milk production costs was explained by feed, fuel, animal, and labor expenses, leaving 22% of the variation unexplained by these variables in the regression model. The effect each variable had on milk production cost was statistically significant. But together, the model suggests there are other more important variables that are affecting milk production costs. With the regression model data, the processing facility can look at how to farther reduce costs by coming up with the least cost of variables to still produce milk. Data specifically for Pennsylvania will be more beneficial in further looking at individual variables on milk production costs for the desired farm.

A regression model was performed to indicate how each of these important variables has the potential to affect milk production costs. Utilizing the results of the regression model, it becomes clear what areas the processing facility will need to improve upon so that the new efficiencies will make-up for any unexpected changes in costs. For example, if the dairy farm can make the employees more efficient in their abilities to handle more cows per person, this will reduce the number of people working on the dairy farm, which will result in reduced labor costs. Another example would be the fuel expenses, by locating the dairy farm within closer proximity to the milk processing facilities; automatically fuel prices can be reduced to an extent depending on the economy and the cost for fuel. This regression model is showing milk production costs are affected by more than feed, fuel, animal, and labor costs. It is also showing multicollinearity plays a role in this model. But for the purposes of this paper, multicollinearity will not play a role in the results of whether or not this is a feasible plan.

The results of the regression model indicate that the addition of a dairy farm within close proximity to the milk processing facility, which, results in lowering fuel expenses, is in fact a viable business venture. Feed, animal, and labor expenses can be reduced by the management of the dairy farm. These are areas in which changes would need to be addressed form the onset in order to obtain maximum efficiencies and return on investment. Increasing feed efficiency for the animals and increasing production or quality through seed changes can reduce feed expenses. Many of these management changes will be addressed and are assumed will occur with the addition of a dairy farm.

Individually, each variable was compared to milk production costs, and then combined to determine what affects these variables will have on milk production costs. In reviewing the t-values for the regression model of all the variables, it was found that all of the t-values were less than the t critical value, which means the null hypothesis cannot be rejected. This indicates that together these variables are impacting 78% of the milk production costs with 95% confidence. When looking each variable individually, there are significant differences in the data.

The regression model with the variables milk production costs and feed, had t-values that were greater than the t critical value. This suggests that the null hypothesis should be rejected because of the variation in the impact feed expenses had on milk production costs. The same was true for milk production costs and fuel expenses. When it came to animal expenses and labor expenses, the null hypothesis again was rejected for individually affecting the milk production costs. This is suggesting that they do play a role in milk production costs. Fuel and labor expenses are playing the largest role of the variables in milk production costs. Each of the variables was statistically significant and they are all playing a role in total milk production costs. However, there are other variables that could be playing a larger role in milk production costs that were not included in the model.

When the individual variables are compared to milk production costs, the model indicates the impact that each variable has on milk production costs. Labor expenses are playing the biggest role in the impact on milk production costs, followed by fuel expenses. Feed and animal expenses have less of an impact on the milk production costs. The dairy farm can use these results to lower labor, feed, and animal expenses. As noted earlier it is assumed that labor expenses will be reduced to gain better efficiency in the employee to cow ratio and the animal expenses will be reduced through internal herd growth. This is simply suggesting that all of the growth that will occur on the farm will come from animals already on the farm. Not only will this eliminate the expense of buying animals but it also can help reduce potential veterinary expenses due to buying animals.

Efficiency and changes in management are going to be the key factors in reducing the impact these individual variables play on milk production costs. Through this regression model, it is obvious that there are other potentially more important variables influencing milk production costs on the farm. Again, multicollinearity is to blame for some of these results but even without it, all of these expenses will be reduced through the vertical integration of the dairy farm and the milk processing plant. Vertical integration will reduce fuel expenses but through management decisions, all of the expenses caused by these variables can be reduced.

Based upon the cost-benefit analysis of multiple milk prices, it is apparent that the best-case scenario with a milk price of $22.15 per cwt. will produce profits immediately. The lowest price of $13.80 per cwt. was used to see if the business could maintain and weather financial difficulties at the lowest producer price in ten years. The analysis done for the varying milk prices again, utilized the break-even projections. Based on the break-even projection, the number of hundredweights needed to break even was 29,714.34. Therefore, this number of hundredweights was used to calculate whether the dairy farm would still be profitable. In both scenarios, the dairy farm would be profitable. The dairy farm would loose money the first two years with the $13.80 per cwt. but would be profitable from the start using the $22.15 per cwt. See tables 4 and 5 in Appendix A.

CHAPTER 10

CONCLUSION

In order for this regression model to accurately describe the farms currently producing milk for the milk processing plant, the data should come from Pennsylvania farms. Pennsylvania data will help determine how the processing plant can reduce the price of milk sold to consumers. A cost benefit analysis will be necessary along with data from a regression model to ultimately determine ways to reduce the price of milk sold to consumers. Additional variables could be added to the regression model such as transportation costs to see if these have any affect on the milk production costs.

While the cost benefit analysis looks somewhat discouraging unless the artisan cheese facility is added, the numbers used were very conservative and did not include the full benefits from vertical integration. As with any start-up, capitalization and weathering the first five years of business will be crucial to its success. The benefits of adding the dairy farm outweigh the potential hardships the farm will undergo in the first years. Vertically integrating the dairy farm with give the company the ability to market the freshest milk because of the close proximity the farm will be to either milk processing facility.

The newly formed company will provide for the ability to further diversify products such as organic, artisan cheeses, sour cream, beef, show cows, embryonic transfer, agritourism, and etc. As can be seen in Table 3 in the appendix A, phase two of the farm project, a full financial analysis was undertaken utilizing the farm and the dairy assets and the results were encouraging. The potential to market and distribute a unique cheese that is locally produced and distributed has unlimited possibilities for both the farm and the dairy.

Adding the dairy farm will open up the family business to more entities. With the dairy farm, there will be better control of the quality of milk such as somatic cell counts, temperatures, fat content, and solid contents. The dairy farm will allow the farm to reduce reliance on outside sources for milk. Since the newly purchased farm is not currently in use, the company will be able to supply more jobs to the community. The company will be able to act quicker to the market, and increase their marketing potential within the geographic region. In the initial phase of the project, the processing facility will benefit the most from the concern and the ability to capitalize on the advertising opportunities that the vertical integration will present. It should also be noted in the cost benefit analysis provided that the farm and the equipment have provided for growth with added milking equipment, and manure pit being built to handle larger volumes than what will originally be on the farm.

In the future, it will be critical for the farm to grow, but for analysis purposes there was no growth included in the scenarios. The reason being is it was felt that paying off debt and establishing efficiencies would be important for future success rather than growing to increase cash flow and possibly putting the whole venture at risk. Therefore, these numbers will not exactly show the potential of the dairy farm. The numbers will show the dairy farm's expenses and income without any growth in purchased cattle numbers. The hope is that growth will happen through sound breeding philosophies during the initial years of the farm start-up. This is an important fact to consider because growth is inevitable. Growth is needed in the dairy industry to allow for the long-term viability of the farm. The increase in milk production will help reduce some of the expenses. The dairy farm will also need to consider reducing feed costs or making the feed ration more efficient for the cattle. If the feed rations are made more efficient, the dairy will be able to feed less to the cattle and thus reduce some of the costs.

The actual dairy farm, which helped form the basis for the analysis, was not operating at peak efficiencies and maximizing the potential output of the operation. The cost of the operation per cow is currently running significantly higher than the average farm. Therefore, the data utilized in the analysis for the new farm will produce a cost per cow that is higher than average but erring on the side of caution is preferable to making a large investment in a losing venture. With the use of more modern farm techniques, growing the herd and the farm internally, cow production and farm efficiencies will continually improve.

In the future, the dairy farm can explore the potential of adding methane digesters, or bedding recovery in the development of the dairy farm. Growth will be necessary which means in the future, more barns will need to be built, land will need to be purchased, the amount of labor needed will increase, more seed will be needed, and all the incidentals that will occur with increased production. To further analyze the decision as to whether or not a new dairy farm should be added to the business will require a more in depth long-term cost benefit analysis utilizing various scenarios and different variables. For example, milk prices were assumed to remain somewhat constant in this analysis but wide fluctuations in pricing have and will continue to occur. Government regulations and their impact on both the processing and farming side should also be taken into consideration as the farm programs are constantly changing and under scrutiny. And finally global markets have made the dairy industry much more volatile than it has ever been.

Once the milk processing facility makes the initial purchase of the farm and the farm is up and running, there will be many benefits involved with the integration. The farm provides for the possibilities and advancements for the milk processing facility in such areas as possibly generating the power for the plant from a methane digester, incorporating windmills or solar panels to reduce costs, the ability to produce artisan cheese on site, and the ability to exploit the advertising side of the business through agritourism and the promotion of the freshest milk around. The farm will also teach the processing facility the complexities of producing the milk and that it should not be taken for granted. The value and potential of vertically integrating a dairy farm with the milk processing facility far outweighs the initial economic hardships endured in the short-run.

The dairy farm will provide the milk processing facility with stability. With the continual decline in the number of dairy farms, the vertically integrated business will have stability in the fact that it will be able to continue to provide to the milk processing facility with locally produced fresh milk. The intention is not to eliminate the current dairy farms that supply milk to the processing facility; it is to build stability and sustainability when these farms are no longer able to keep up with production or if they choose to exit the dairy industry.

The integration of the dairy farm and cheese facility will allow the family business to continue into future generations with confidence. The business will be better informed of the raw milk market because it will be a new entity with the addition of the dairy farm. While unexpected and miscellaneous costs will arise, the facilities will be able to make adjustments within to prevent these costs from becoming a determent. The facilities are built for expansion, and will need to expand in the future in order to continue to be on the cutting edge in the markets they a re involved with. The decision to add a dairy farm will be beneficial for the milk processing facility in the long-run. The addition of a cheese facility will expand the business even farther. The benefits that will occur from the addition of both entities provide for sustainability and stability for future generations. As a family member and part owner of the current processing facilities, there is no better time to buy a dairy farm. It is my hope and dream that I will able utilize this paper to help plot the course for the future of our company and our family.

REFERENCES

Altman, Ira J., Peter G. Klein, and Thomas G. Johnson. "Scale and Transaction Costs in the U.S. Biopower Industry." *Journal of Agricultural & Food Industrial Organization* 5, no. 10 (2007).

C.van't Riet. *C.van't Riet Dairy Equipment/ USA.* http://www.schuller.us/Cheese-vats-DoubleO.html (accessed August 2011).

Center for Dairy Excellence. *Overview of Pennsylvania's Dairy Industry.* http://www.centerfordairyexcellence.org/index.php/pennsylvania-dairy-industry-overview.html (accessed November 2011).

Center for Dairy Excellence- Pennsylvania Milk Marketing Board. "Summary of Program Activities and Initiatives to Increase Dairy Farm Income and Security in the Northeast." December 2011.

Cheese Supply. *Gourmet Cheeses, Books, Kits, Cheese Parties, and Cheese Supplies.* http://www.cheesesupply.com/product_info.php/products_id/352 (accessed August 2011).

Clark, Jill, Holli Kendall, and William Flinn. "Ohio's Dairy Industry: The Geography and Impact of a Key Sector." *Social Responsibility Initiative* (The Ohio State University), September 2008.

Dairy Business. "Dairy Profit Weekly." XXII, no. 48 (December 2011).

Dobson, W. D., and Christ Paul. "Structural Change in the U.S. Dairy Industry: Growth in Scale, Regional Shifts in Milk Production and Processing, and Internationalism." *Agricultural and Applied Economics Staff Paper Series* (University of Wisconsin-Madison) 438 (December 2000).

eBay. *Electronics, Cars, Fashion, Collectibles, Coupouns and More Online Shopping.* www.ebay.com (accessed 2012).

Economic Research Service/USDA. "Farmers' Use of Marketing and Production Contracts." *Agricultural Economics Report*, December 1996.

Fastline. *Used Tractors and Farm Machinery for Sale by Fastline.* http://www.fastline.com/ (accessed 2012).

Frank, Stuart D, and Dennis R Henderson. "Transaction Costs as Determinants of Vertical Coordination in the U.S. Food Industries." *American Journal of Agricultural Economics* 74, no. 4 (1992): 941-950.

Fulhage, Charles D., Donald L. Pfost, and John Feistner. "Storage Tanks for Liquid Livestock Manure." *Environmental Quality, Nutrients and Bacteria Waste - MU Guide* (MU Extension, University of Missouri-Columbia).

Glengarry Cheesemaking and Dairy Supply Ltd. *Glengarry Cheesemaking, mold, ingredients, and Dairy Supplies.* http://glengarrycheesemaking.on.ca/equipment.htm (accessed August 2011).

Martinez, Steve W. "A Comparison of Vertical Coordination in the U.S. Poultry, Egg, and Pork Industries." *Current Issues in Economics of Food Markets* (USDA) 747, no. 5 (2002).

NASS. "Agriculture Counts- PA Dairy." PowerPoint, 2010.

Pfost, Donald L., Charles D. Fulhage, and David Rastorfer. "Anaerobic Lagoons for Storage/Treatment of Livestock Manure." *Environmental Quality, Nutrients and Bacterial Waste- MU Guide* (MU Extension, University of Missouri-Columbia).

September Farm. *September Farm Cheese- Handcrafted Farmstead Cheese.* http://www.septemberfarmcheese.com/ (accessed August 2011).

Sumner, Daniel A., and Christopher A. Wolf. "Diversification, Vertical Integration, and the Regional Pattern of Dairy Farm Size." *Review of Agricultural Economics* 24, no. 2 (2002): 442-457.

Technology For Agriculture LLC. *Milking Parlors- Used Germania milking parlors reconditioned to as new. New Dairy equipment from TFA.* http://www.techforag.com/ (accessed January 2012).

The Concrete Network. *Concrete Prices - How much does concrete cost?* http://www.concretenetwork.com/concrete-prices.html (accessed January 2012).

The Penn State University. *What are some common conversion or equivalent factors for manure?* http://www.das.psu.edu/frequently-asked-questions/common-manure-conversions (accessed January 2012).

United States Department of Agriculture. *Commodity Costs and Returns: U.S. Regional Cost and Return Data.* http://www.ers.usda.gov/Data/CostsAndReturns/TestPick.htm (accessed January 8, 2012).

—. *National Agricultural Statistics Service- Ad- hoc Query Tool.* http://quickstats.nass.usda.gov/ (accessed January 2012).

—. *National Agricultural Statistics Service- Statistics By Subject.* http://www.nass.usda.gov/Statistics_by_Subject/index.php?sector=CROPS (accessed October 2011).

United States Environmental Protection Agency. *Common Manure Handling Systems.* http://www.epa.gov/agriculture/ag101/dairymanure.html (accessed January 2012).

United States Government Accountability Office. "Information on Milk Prices, Factors Affecting Prices, and Dairy Policy Options." *Report to Congressional Requesters*, December 2004.

Wolter, Claudio, and Francisco M. Veloso. "The Effects of Innovation on Vertical Structure: Perspectives on Transaction Costs and Competences." *The Academy of Management Review* (Academy of Management) 33, no. 3 (July 2008): 586-605.

Zering, Kelly. "Anaerobic Lagoon and Sprayfield." Technology, Department of Agricultural and Resource Economics, North Carolina State University, Raleigh, 2005.

APPENDICIES

APPENDIX A

Table 1. Break- even Projection.

Assumptions:	
1) Assume milk production is 17,126.86 lbs milk/year/cow	
2) Assume fresh cows and dry cows cost $1500	
3) Assume price received per cwt is $17.98	
4) Assume 188 milking cows will be needed and 19 dry cows	
5) Assume 25% cull rate, 12% noncompletion rate, 24 age of first calving, 13 month calving interval	
6) Assume operations costs remain constant throughout the year	
7) Assume price of heifer replacements $900 -need 97	
8) Assume total amount of cows to be 304	
9) Assume 10% of milking cows will be dry	
Yearly Cost of Operation	$534,263.80
Loan Payments	$89,170.32
Total Operational Cost	$588,098.99
Number of cwt needed to break-even	29,714.34
Lbs of milk to break-even	2,971,434.00
Fresh Cows to Break-even	173

Sources: Dairy Business 2011, Actual Dairy Farm

Table 2. Potential Benefits of Additional Milking Cows.

	Actual Farm	Break-even Farm
Average Milking Cows	125	188
Average price/cwt	$17.98	$17.98
Average lbs milk/day	5,257	8,213
Cwt for the year	21,409	29,977
Total Income from Milk	$384,926.09	$538,991.93

Sources: Actual Dairy Farm

Table 3. Cost- Benefit Analysis.

Key Assumptions in the Generation of Financials:

Dairy Farm Assumptions:

1.) Assume milk production is 17,126.86 lbs/year/cow
2.) Fresh cows and dry cows cost $1,500
3.) Price of heifers replacements will be $900 and 97 will be needed
4.) Milk price received per cwt is $17.98

5.) Assume 188 milk cows will be needed and 19 dry cows
6.) 10% of milking cows will be dry
7.) Assume 25% cull rate, 12% noncompletion rate, 24 months of age at first calving, 13 month calving interval
8.) Operation costs will remain constant throughout the year
9.) Total amount of cows will be 304
10.) Assume no increase in milk production in year one but an 8% increase in years 2,3, and 4. 2% increase in years 5, and 6. By year seven, 0% increase and the cows will be producing 21,500 lbs/year/cow
11.) 2.44% inflation rate starting in year 2
12.) 10% increase in all farm income and expenses from farm's original data
13.) Dairy farm will cost $1.2 million. It will include 170 acres, 2 barns, and 2 houses
14.) Milk processing facility will initially pay $500,000 down on the purchase of the dairy farm
15.) One of the two houses will be sold at $325,000 to pay for majority of cows
16.) Cow loan will be $72,800 for 5 years at a 3.65% interest rate
17.) Farm purchase loan will be $700,000 for 30 years at a 3.65% interest rate
18.) 2,500 gallon bulk tank will be $22,000
19.) Remanufactured Original Germania double 10 herringbone milking parlor costs $222,807
20.) Loan for the milking equipment will be $250,000 for 10 years at a 3.65% interest rate
21.) Manure pit loan will be $60,000 for 30 years at a 3.65% interest rate
22.) Total manure pit will be 5,500 cubic yards
23.) Excavation costs for the manure pit will run at $2.50 cubic yard
24.) Concrete cost is $75 cubic yard for the manure pit
25.) Used agitator for the manure pit is $33,020

Farm Side of Cheese Making Facility Assumptions:

1.) The cows will be located on the new facility
2.) The cow will be fed a balanced diet
3.) Milk will be pulled from the bulk tank
4.) Initial costs will be determined based off USDA published cost of milk for PA
5.) Initial start up will require 75,000 pounds of milk on a yearly basis
6.) Approximately 412 pounds of milk will be used
7.) There will be no transportation costs as everything will be produced on farm
8.) Milk will be needed based upon every other day which equates to 182 milkings
9.) Cost to produce a hundredweight of milking according to USDA is $23.27
10.) Finished cheese product will be transported to the dairy for aging, storage, and distribution on current transport trucks that run between plants

Dairy Assumptions for Cheese Making Facility:

1.) The dairy will purchase a cheese vat at $25,000 depreciable over 8 years
2.) Dairy will purchase the press at approximately $5,000 depreciable over 8 years
3.) Assume 10% lost product due to inefficiencies
4.) Piping for tanking will be minimally expensed in first year (approximately $2,000)

5.) Cheese molds will be expensed in the first year at $500
6.) From start to finish, a batch of cheese including dipping the cheese in wax will take approximately 17 hours over two days to complete at a rate of $15.75 per hour
7.) Outside refrigeration space will be needed for storage. This can be rented currently for $25.00 per square foot but we have a minimum of 500 square feet per month
8.) Yield factor on cheese normally is 1 pound for 10 gallons of milk but with a 10% loss factor we will assume it will take 11 gallons of milk to yield a pound of cheese
9.) Each load of milk will produce 322 pounds of cheese (412lbs of milk x 8.6 lbs/11 lbs of cheese)
10.) Transportation costs are $1.85 per mile and $15.00 per hour for driver
11.) Initially limited distribution to a 50 mile radius
12.) Very modest advertising budget of approximately $20,000 per year
13.) Total pounds of cheese produced per year will be 58,604 (322*182)
14.) Establish a high price point to begin with. One can always go down in price but raising them is difficult. State with a 40% mark-up
15.) There will be four types of cheddar cheese made, milk taking 1-2 months to age, medium taking over 60 days, sharp taking over 9 months to age, and extra sharp will take over 15 months to age
16.) Product mix will be 20,511 pounds of mild (35% * 58,604), 11,720 pounds of medium (20% * 58,604), 11,720 pounds of sharp (20% * 58,604), and 11,720 pounds of extra sharp (20% * 58,604)
17.) Whey collected will be hauled away by a swine farmer to avoid surcharges for high BOD levels in the dairy's sewage discharge

CONSOLIDATED FARM AND CHEESE OPERATIONS IN VERTICAL INTEGRATION PROJECT

$17.98

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7
INCOME	0	8	8	8	2	2	0
Calves	$647.11	$698.88	$754.79	$815.17	$831.47	$848.10	$848.10
Cattle	$5,391.90	$5,823.26	$6,289.12	$6,792.25	$6,928.09	$7,066.65	$7,066.65
Milk	$390,981.42	$422,259.93	$468,708.53	$520,266.47	$530,671.79	$541,285.23	$541,285.23
Pat. Dividend	$1,444.52	$1,560.08	$1,684.89	$1,819.68	$1,856.08	$1,893.20	$1,893.20
Federal Tax Refund	$1,195.53	$1,291.17	$1,394.46	$1,506.02	$1,536.14	$1,566.86	$1,566.86
MD St Tax Return	$607.28	$655.87	$708.34	$765.00	$780.30	$795.91	$795.91
DCP-Government	$6,028.42	$6,510.69	$7,031.55	$7,594.07	$7,745.95	$7,900.87	$7,900.87
MILC-Government	$395.22	$426.83	$460.98	$497.86	$507.81	$517.97	$517.97
MD Gas Tax Refund	$979.67	$1,058.04	$1,142.69	$1,234.10	$1,258.78	$1,283.96	$1,283.96
Grain	$23,973.01	$25,890.85	$27,962.12	$30,199.09	$30,803.07	$31,419.13	$31,419.13
Interest	$26.62	$28.75	$31.05	$33.53	$34.20	$34.88	$34.88

Income From Farm milking	$431,670.69	$466,204.35	$516,168.50	$571,523.23	$582,953.70	$594,612.77	$594,612.77
Sales from cheese							
Mild			$146,041.17	$160,645.28	$176,709.81	$194,380.79	$213,818.87
Medium			$104,315.12	$114,746.63	$126,221.30	$138,843.42	$152,727.77
Sharp			$20,863.02	$22,949.33	$25,244.26	$27,768.68	$30,545.55
Extra Sharp			$-	$10,431.51	$11,474.66	$12,622.13	$13,884.34
Total Sales			$271,219.31	$308,772.76	$339,650.03	$373,615.03	$410,976.54
Total Income	**$431,670.69**	**$466,204.35**	**$787,387.81**	**$880,295.99**	**$922,603.73**	**$968,227.80**	**$1,005,589.31**
EXPENSES							
Loan Payments and Interest	$87,553.32	$87,553.32	$87,553.32	$87,553.32	$87,553.32	$71,602.20	$71,602.20
Rent	$960.34	$979.55	$999.14	$999.14	$999.14	$999.14	$999.14
Labor	$34,392.68	$35,080.53	$35,782.14	$35,782.14	$35,782.14	$35,782.14	$35,782.14
F2 Benefits	$15,535.02	$15,914.07	$16,232.36	$16,628.43	$17,034.16	$17,449.79	$17,875.57
Feed	$75,659.93	$77,506.03	$77,506.03	$77,506.03	$77,506.03	$77,506.03	$77,506.03
Seed	$49,377.69	$50,582.51	$51,816.72	$53,081.05	$54,376.22	$55,703.00	$57,062.16
Sprays	$3,593.29	$3,680.97	$3,770.78	$3,862.79	$3,957.04	$4,053.59	$4,152.50
Machinery	$6,985.34	$7,155.78	$7,330.38	$7,509.24	$7,692.47	$7,880.17	$8,072.44
Supplies	$23,402.10	$23,973.11	$24,558.06	$25,157.27	$25,771.11	$26,399.92	$27,044.08
Machine Repairs	$43,542.05	$44,604.48	$45,692.83	$46,807.73	$47,949.84	$49,119.81	$50,318.34
Building Repairs	$671.80	$688.19	$704.98	$722.19	$739.81	$757.86	$776.35
DHIA	$3,714.70	$3,805.34	$3,898.19	$3,993.30	$4,090.74	$4,190.56	$4,292.81
Fertilizer	$28,264.61	$28,954.27	$29,660.75	$30,384.47	$31,125.85	$31,885.32	$32,663.33
Fuel- Oil	$65,292.95	$66,886.10	$68,518.12	$70,189.96	$71,902.60	$73,657.02	$75,454.25
Real Estate Tax	$3,626.57	$3,715.06	$3,805.71	$3,898.56	$3,993.69	$4,091.14	$4,190.96
FICA Tax	$3,635.28	$3,723.98	$3,814.85	$3,907.93	$4,003.28	$4,100.96	$4,201.03
Utilities	$15,008.55	$15,374.76	$15,749.90	$16,134.20	$16,527.87	$16,931.15	$17,344.28
Insurance	$6,896.34	$7,064.61	$7,236.99	$7,413.57	$7,594.46	$7,779.77	$7,969.59
Crop Insurance	$660.00	$676.10	$692.60	$709.50	$726.81	$744.55	$762.71
Auto Upkeep	$1,905.18	$1,951.67	$1,999.29	$2,048.07	$2,098.04	$2,149.23	$2,201.68
Miscellaneous	$2,382.18	$2,440.31	$2,499.85	$2,560.84	$2,623.33	$2,687.34	$2,752.91
Breeding	$33.00	$33.81	$34.63	$35.48	$36.34	$37.23	$38.14
Dairy Supplies	$17,445.79	$17,871.47	$18,307.53	$18,754.23	$19,211.84	$19,680.61	$20,160.81
Workers Compensation	$2,988.42	$3,061.34	$3,136.03	$3,212.55	$3,290.94	$3,371.24	$3,453.50
Federal Tax	$3,242.79	$3,321.91	$3,402.97	$3,486.00	$3,571.06	$3,658.19	$3,747.45
Trucking	$16,166.96	$16,561.43	$16,965.53	$17,379.49	$17,803.55	$18,237.96	$18,682.96
Total Expenses from	$512,936.88	$523,160.69	$531,669.67	$539,717.50	$547,961.70	$540,455.93	$549,107.35

Milking							
Expenses from cheese operation							
Total Processing and Storage Costs			$298,294.36	$305,572.74	$313,028.72	$320,666.62	$328,490.88
TOTAL EXPENSES FROM OPERATIONS	**$512,936.88**	**$523,160.69**	**$829,964.03**	**$845,290.24**	**$860,990.41**	**$861,122.55**	**$877,598.23**
NET INCOME/(LOSS)	**$(81,266.19)**	**$(56,956.34)**	**$(42,576.22)**	**$35,005.74**	**$61,613.31**	**$107,105.26**	**$127,991.07**

Sources: Actual Dairy Farm, eBay n.d., Technology For Agriculture LLC n.d., Dairy Business 2011, Fulhage, Pfost and Feistner n.d., The Concrete Network n.d., Fastline n.d., United States Department of Agriculture n.d., Glengarry Cheesemaking and Dairy Supply Ltd. n.d., September Farm n.d., C. van't Riet n.d., Cheese Supply n.d.

Table 4. Break-even Cost-Benefit Analysis at $13.80

Key Assumptions:

1.) Assume milk production is 29,714.34lbs/year/cow
2.) Fresh cows and dry cows cost $1,500
3.) Price of heifers replacements will be $900 and 97 will be needed
4.) Milk price received per cwt is $13.80
5.) Assume 173 milk cows will be needed and 19 dry cows
6.) 10% of milking cows will be dry
7.) Assume 25% cull rate, 12% noncompletion rate, 24 months of age at first calving, 13 month calving interval
8.) Operation costs will remain constant throughout the year
9.) Total amount of cows will be 289
10.) Assume no increase in milk production in year one but an 8% increase in years 2,3, and 4. 2% increase in year 5.
11.) 2.44% inflation rate starting in year 2
12.) 10% increase in all farm income and expenses from farm's original data
13.) Dairy farm will cost $1.2 million. It will include 170 acres, 2 barns, and 2 houses
14.) Milk processing facility will initially pay $500,000 down on the purchase of the dairy farm
15.) One of the two houses will be sold at $325,000 to pay for majority of cows
16.) Cow loan will be $72,800 for 5 years at a 3.65% interest rate
17.) Farm purchase loan will be $700,000 for 30 years at a 3.65% interest rate
18.) 2,500 gallon bulk tank will be $22,000
19.) Remanufactured Original Germania double 10 herringbone milking parlor costs $222,807

20.) Loan for the milking equipment will be $250,000 for 10 years at a 3.65% interest rate
21.) Manure pit loan will be $60,000 for 30 years at a 3.65% interest rate
22.) Total manure pit will be 5,500 cubic yards
23.) Excavation costs for the manure pit will run at $2.50 cubic yard
24.) Concrete cost is $75 cubic yard for the manure pit
25.) Used agitator for the manure pit is $33,020

INCOME STATEMENT FOR THE FARM PORTION OF VERTICAL INTEGRATION
IF Price per CWT is 13.80

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
INCOME					
Calves	$647.11	$698.88	$754.79	$815.17	$831.47
Cattle	$5,391.90	$5,823.26	$6,289.12	$6,792.25	$6,928.09
Milk	$410,057.89	$442,862.52	$491,577.40	$545,650.92	$556,563.93
Pat. Dividend	$1,444.52	$1,560.08	$1,684.89	$1,819.68	$1,856.08
Federal Tax Refund	$1,195.53	$1,291.17	$1,394.46	$1,506.02	$1,536.14
MD St Tax Return	$607.28	$655.87	$708.34	$765.00	$780.30
DCP-Government	$6,028.42	$6,510.69	$7,031.55	$7,594.07	$7,745.95
MILC-Government	$395.22	$426.83	$460.98	$497.86	$507.81
MD Gas Tax Refund	$979.67	$1,058.04	$1,142.69	$1,234.10	$1,258.78
Grain	$23,973.01	$25,890.85	$27,962.12	$30,199.09	$30,803.07
Interest	$26.62	$28.75	$31.05	$33.53	$34.20
Total Income	**$450,747.17**	**$486,806.94**	**$539,037.37**	**$596,907.68**	**$608,845.83**
EXPENSES					
Loan Payments	$87,553.32	$87,553.32	$87,553.32	$87,553.32	$87,553.32
Rent	$960.34	$979.55	$999.14	$999.14	$999.14
Labor	$34,392.68	$35,080.53	$35,782.14	$35,782.14	$35,782.14
F2 Benefits	$15,535.02	$15,914.07	$16,232.36	$16,719.33	$17,220.91
Feed	$75,659.93	$77,506.03	$77,506.03	$77,506.03	$77,506.03
Seed	$49,377.69	$50,582.51	$51,816.72	$53,081.05	$54,376.22
Sprays	$3,593.29	$3,680.97	$3,770.78	$3,862.79	$3,957.04
Machinery	$6,985.34	$7,155.78	$7,330.38	$7,509.24	$7,692.47
Supplies	$23,402.10	$23,973.11	$24,558.06	$25,157.27	$25,771.11
Machine Repairs	$43,542.05	$44,604.48	$45,692.83	$46,807.73	$47,949.84
Building Repairs	$671.80	$688.19	$704.98	$722.19	$739.81
DHIA	$3,714.70	$3,805.34	$3,898.19	$3,993.30	$4,090.74
Fertilizer	$28,264.61	$28,954.27	$29,660.75	$30,384.47	$31,125.85

Fuel- Oil	$65,292.95	$66,886.10	$68,518.12	$70,189.96	$71,902.60
Real Estate Tax	$3,626.57	$3,715.06	$3,805.71	$3,898.56	$3,993.69
FICA Tax	$3,635.28	$3,723.98	$3,814.85	$3,907.93	$4,003.28
Utilities	$15,008.55	$15,374.76	$15,749.90	$16,134.20	$16,527.87
Insurance	$6,896.34	$7,064.61	$7,236.99	$7,413.57	$7,594.46
Crop Insurance	$660.00	$676.10	$692.60	$709.50	$726.81
Auto Upkeep	$1,905.18	$1,951.67	$1,999.29	$2,048.07	$2,098.04
Miscellaneous	$2,382.18	$2,440.31	$2,499.85	$2,560.84	$2,623.33
Breeding	$33.00	$33.81	$34.63	$35.48	$36.34
Dairy Supplies	$17,445.79	$17,871.47	$18,307.53	$18,754.23	$19,211.84
Workers Compensation	$2,988.42	$3,061.34	$3,136.03	$3,212.55	$3,290.94
Federal Tax	$3,242.79	$3,321.91	$3,402.97	$3,486.00	$3,571.06
Trucking	$16,166.96	$16,561.43	$16,965.53	$17,379.49	$17,803.55
Total Expenses	**$512,936.88**	**$523,160.69**	**$531,669.67**	**$539,808.40**	**$548,148.44**
NET INCOME/(LOSS)	**$(62,189.71)**	**$(36,353.75)**	**$7,367.70**	**$57,099.28**	**$60,697.39**

Sources: Actual Dairy Farm, eBay n.d., Technology For Agriculture LLC n.d., Dairy Business 2011, Fulhage, Pfost and Feistner n.d., The Concrete Network n.d., Fastline n.d.

Table 5. Break-even Cost-Benefit Analysis at $22.15

Key Assumptions:

1.) Assume milk production is 29,714.34lbs/year/cow
2.) Fresh cows and dry cows cost $1,500
3.) Price of heifers replacements will be $900 and 97 will be needed
4.) Milk price received per cwt is $13.80
5.) Assume 173 milk cows will be needed and 19 dry cows
6.) 10% of milking cows will be dry
7.) Assume 25% cull rate, 12% noncompletion rate, 24 months of age at first calving, 13 month calving interval
8.) Operation costs will remain constant throughout the year
9.) Total amount of cows will be 289
10.) Assume no increase in milk production in year one but an 8% increase in years 2,3, and 4. 2% increase in year 5.
11.) 2.44% inflation rate starting in year 2
12.) 10% increase in all farm income and expenses from farm's original data
13.) Dairy farm will cost $1.2 million. It will include 170 acres, 2 barns, and 2 houses
14.) Milk processing facility will initially pay $500,000 down on the purchase of the dairy farm
15.) One of the two houses will be sold at $325,000 to pay for majority of cows
16.) Cow loan will be $72,800 for 5 years at a 3.65% interest rate
17.) Farm purchase loan will be $700,000 for 30 years at a 3.65% interest rate
18.) 2,500 gallon bulk tank will be $22,000

19.) Remanufactured Original Germania double 10 herringbone milking parlor costs $222,807
20.) Loan for the milking equipment will be $250,000 for 10 years at a 3.65% interest rate
21.) Manure pit loan will be $60,000 for 30 years at a 3.65% interest rate
22.) Total manure pit will be 5,500 cubic yards
23.) Excavation costs for the manure pit will run at $2.50 cubic yard
24.) Concrete cost is $75 cubic yard for the manure pit
25.) Used agitator for the manure pit is $33,020

INCOME STATEMENT FOR THE FARM PORTION OF VERTICAL INTEGRATION
IF Price per CWT is 22.15

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
INCOME					
Calves	$647.11	$698.88	$754.79	$815.17	$831.47
Cattle	$5,391.90	$5,823.26	$6,289.12	$6,792.25	$6,928.09
Milk	$658,172.63	$658,172.63	$658,172.63	$658,172.63	$658,172.63
Pat. Dividend	$1,444.52	$1,560.08	$1,684.89	$1,819.68	$1,856.08
Federal Tax Refund	$1,195.53	$1,291.17	$1,394.46	$1,506.02	$1,536.14
MD St Tax Return	$607.28	$655.87	$708.34	$765.00	$780.30
DCP-Government	$6,028.42	$6,510.69	$7,031.55	$7,594.07	$7,745.95
MILC-Government	$395.22	$426.83	$460.98	$497.86	$507.81
MD Gas Tax Refund	$979.67	$1,058.04	$1,142.69	$1,234.10	$1,258.78
Grain	$23,973.01	$25,890.85	$27,962.12	$30,199.09	$30,803.07
Interest	$26.62	$28.75	$31.05	$33.53	$34.20
Total Income	**$698,861.90**	**$702,117.05**	**$705,632.60**	**$709,429.40**	**$710,454.53**
EXPENSES					
Loan Payments	$87,553.32	$87,553.32	$87,553.32	$87,553.32	$87,553.32
Rent	$960.34	$979.55	$999.14	$999.14	$999.14
Labor	$34,392.68	$35,080.53	$35,782.14	$35,782.14	$35,782.14
F2 Benefits	$15,535.02	$15,914.07	$16,232.36	$16,719.33	$17,220.91
Feed	$75,659.93	$77,506.03	$77,506.03	$77,506.03	$77,506.03
Seed	$49,377.69	$50,582.51	$51,816.72	$53,081.05	$54,376.22
Sprays	$3,593.29	$3,680.97	$3,770.78	$3,862.79	$3,957.04
Machinery	$6,985.34	$7,155.78	$7,330.38	$7,509.24	$7,692.47

Supplies	$23,402.10	$23,973.11	$24,558.06	$25,157.27	$25,771.11
Machine Repairs	$43,542.05	$44,604.48	$45,692.83	$46,807.73	$47,949.84
Building Repairs	$671.80	$688.19	$704.98	$722.19	$739.81
DHIA	$3,714.70	$3,805.34	$3,898.19	$3,993.30	$4,090.74
Fertilizer	$28,264.61	$28,954.27	$29,660.75	$30,384.47	$31,125.85
Fuel- Oil	$65,292.95	$66,886.10	$68,518.12	$70,189.96	$71,902.60
Real Estate Tax	$3,626.57	$3,715.06	$3,805.71	$3,898.56	$3,993.69
FICA Tax	$3,635.28	$3,723.98	$3,814.85	$3,907.93	$4,003.28
Utilities	$15,008.55	$15,374.76	$15,749.90	$16,134.20	$16,527.87
Insurance	$6,896.34	$7,064.61	$7,236.99	$7,413.57	$7,594.46
Crop Insurance	$660.00	$676.10	$692.60	$709.50	$726.81
Auto Upkeep	$1,905.18	$1,951.67	$1,999.29	$2,048.07	$2,098.04
Miscellaneous	$2,382.18	$2,440.31	$2,499.85	$2,560.84	$2,623.33
Breeding	$33.00	$33.81	$34.63	$35.48	$36.34
Dairy Supplies	$17,445.79	$17,871.47	$18,307.53	$18,754.23	$19,211.84
Workers Compensation	$2,988.42	$3,061.34	$3,136.03	$3,212.55	$3,290.94
Federal Tax	$3,242.79	$3,321.91	$3,402.97	$3,486.00	$3,571.06
Trucking	$16,166.96	$16,561.43	$16,965.53	$17,379.49	$17,803.55
Total Expenses	**$512,936.88**	**$523,160.69**	**$531,669.67**	**$539,808.40**	**$548,148.44**
NET INCOME/(LOSS)	**$185,925.02**	**$178,956.36**	**$173,962.93**	**$169,621.00**	**$162,306.09**

Sources: Actual Dairy Farm, eBay n.d., Technology For Agriculture LLC n.d., Dairy Business 2011, Fulhage, Pfost and Feistner n.d., The Concrete Network n.d., Fastline n.d.

APPENDIX B

Table 1. National Average of Costs of Variables from 2001-2009.

Year	Feed (dollars)	Fuel (dollars)	Animal (dollars)	Labor (dollars)	Milk Production Cost
2009	45,000,000,000	12,400,000,000	25,900,000,000	28,000,000,000	2,423,466,483
2008	46,900,000,000	16,000,000,000	28,300,000,000	29,700,000,000	3,478,116,392
2007	41,900,000,000	13,500,000,000	33,000,000,000	28,600,000,000	3,547,159,709
2006	31,400,000,000	11,100,000,000	26,100,000,000	24,500,000,000	2,346,509,807
2005	28,000,000,000	10,100,000,000	21,600,000,000	24,000,000,000	2,673,081,275
2004	29,700,000,000	8,000,000,000	19,200,000,000	23,300,000,000	2,750,356,560
2003	27,500,000,000	6,700,000,000	18,500,000,000	21,800,000,000	2,129,849,963
2002	24,900,000,000	6,500,000,000	18,300,000,000	21,500,000,000	2,057,707,995
2001	24,800,000,000	6,700,000,000	18,500,000,000	21,700,000,000	2,479,930,290
2000	24,500,000,000	7,000,000,000	18,000,000,000	20,700,000,000	2,058,948,697

Sources: NASS 2010.

Table 2. Milk Production Costs is a function of Feed, Fuel, Animal, and Labor Expenses

Model	T-test	Significance	R^2	F-test	Significance
Milk Production Cost	-1.315	0.246	0.779	4.416	0.067
Feed	-1.556	0.18	Confidence Level 95%		
Fuel	-0.382	0.718			
Animal	-0.184	0.861			
Labor	1.632	0.164			

Table 3. Individual Variable Regression. Milk Production Costs= f(x)

X	R^2	T-test	Significance
Feed	0.521	2.950	0.018
Fuel	0.639	3.766	0.006
Animal	0.617	3.588	0.007
Labor	0.661	3.953	0.004

VITA

Graduate School
Southern Illinois University

Bethany L. Gilles

bgilles26@gmail.com

Cornell University
Bachelor of Science, Animal Science, Dairy Concentration, May 2010

Research Paper Title:
Vertical Integration For Long-Term Sustainability In The Dairy Industry

Major Professor: Ira Altman