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MICHIGAN'S DAIRY PROFITABILITY AND ENTERPRISE ACCOUNTING ON DAIRY FARMS

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MICHIGAN'S DAIRY PROFITABILITY AND ENTERPRISE ACCOUNTING ON DAIRY FARMS

By

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A THESIS

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ABSTRACT

MICHIGAN'S DAIRY PROFITABILITY AND ENTERPRISE ACCOUNTING ON DAIRY FARMS

By

Eric John Wittenberg

This research focused on using enterprise accounting to evaluate the profitability of dairy farm operations. These farms generated the majority of their income from milk sales and cull animals sales during the project year. Participating managers used a detailed computerized accounting system that conformed to standard chart of accounts, recorded inventories changes and recorded supplemental physical data.

Enterprise analysis allows farm manager to understand the cost of production processes by each enterprise and how each enterprise related to the whole farm business. An estimated risk adjusted cost of capital was determined for allocating capital costs to various enterprises. Comparative analysis on three farms was conducted to illustrate the importance of enterprise analysis in making management decisions. The study finding was that mid-sized farms were profitable compared with small and large farms, contrary to expectations based on the theory of economies of scale.

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KEY TO ABBREVIATIONS

β_L:	**Risk adjustment factor for leveraged firm**
β_U:	**Risk adjustment factor for unleveraged firm**
CAPM:	**Capital asset pricing model**
CAR:	**Commodity Costs and Returns**
CSV:	**Comma spaced value**
CWT:	**Hundredweight**
D/E:	**Debt to equity ratio**
DHIA:	**Dairy Herd Improvement Association**
D_{LT}:	**Debt long term**
D_{ST}:	**Debt short term**
E/A:	**Equity to asset ratio**
E(k):	**Expected cost of capital leveraged**
$E(k_M)$:	**Expected rate of return**
E(r):	**Expected return**
$E(r_C)$:	**Crude Estimate of risk preimum**
(k_L):	**Cost of leveraged capital**
(k_{LTR}):	**Cost of long term debt capital**
(k_M):	**20 year average return of S&P 500 Index**
(k_{STR}):	**Cost of short term debt capital**
(k_W):	**WACC**

MM:	**Modigliani and Miller**
NFI:	**Net farm income**
OCC:	**Opportunity cost of capital**
ROA:	**Return on assets**
ROE:	**Return on equity**
(rp):	**Risk premium**
(r_{rf}):	**Risk-free rate of return**
SPDR:	**Supplemental physical data records**
(t_C):	**Tax portion**
V:	**Total value of business**
VFP:	**Value of farm production**
WACC:	**Weight average cost of capital**
$W_{E:}$	**Equity**
$W_{LTD:}$	**Debt long term**
$W_{STD:}$	**Debt short term**

Chapter 1

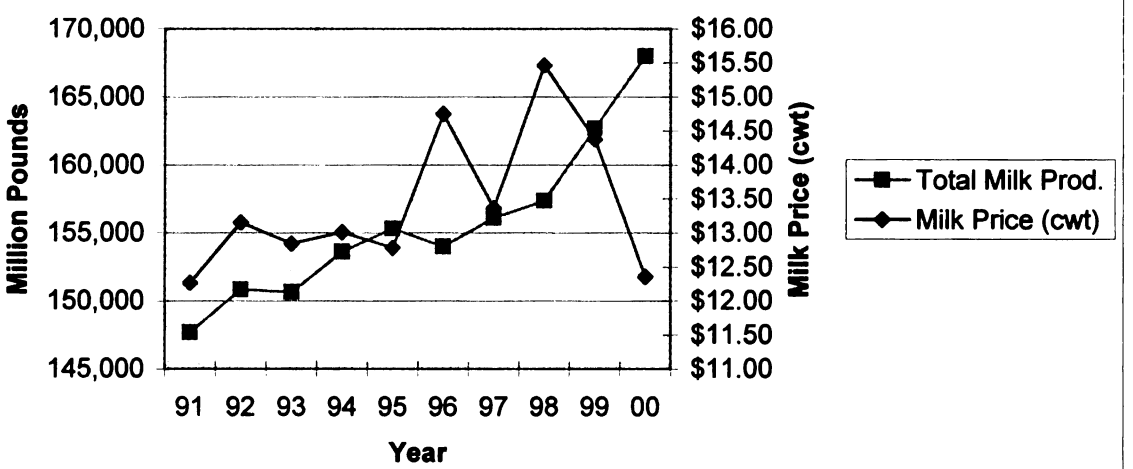
Introduction

The United States dairy industry is in a period of rapid change, which is affecting the profitability and competitiveness of dairy farmers. Current restructuring of the dairy industry has been accelerated by many factors including new technologies, improved management skills, changing milk pricing schemes, processor consolidation, and shifts in consumer demand. These factors have caused many dairy farm businesses to make adjustments in order to remain competitive and viable. According to the United States Department of Agriculture (USDA) and National Agricultural Statistics Service (NASS) data from 1991-2000, total milk production and milk production per cow increased. During this same period, cow numbers and per capita consumption of some dairy products have declined while milk price volatility has increased.

U.S. milk production and milk prices in nominal dollars for the period 1991-2000 are shown in Figure 1.1. In 1991, 147.7 million pounds of milk were produced. By 2000, this amount had grown to 168.0 million pounds of milk, a 14 percent increase in total milk production. The farm gate price of milk, which is the price received by dairy farmers, did not increase proportionate to production, but did increase in volatility. The farm gate milk price in 1991 averaged $12.27 per hundredweight. The farm gate price peaked at $15.46 per hundredweight in 1998 and declined to $12.36 per hundredweight in 2000. In real dollars this was a decline in price.

The price received by dairy producers is influenced by many factors, with the most important factor being the supply of milk. As the supply of milk increases, it puts downward pressure on the price of milk.

Figure 1.1: Milk Production and Milk Price (U.S.)
USDA

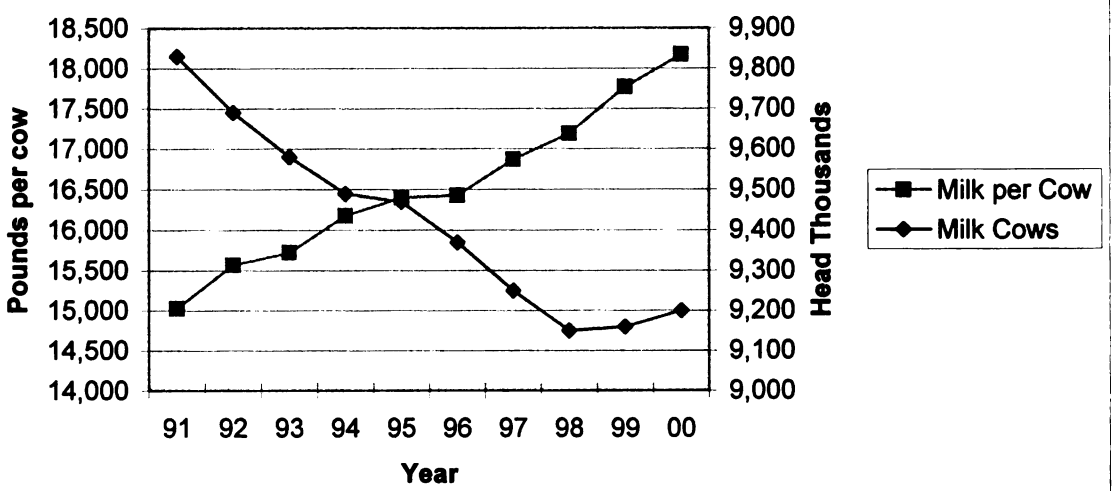


U.S. milk production per cow and total cow numbers from 1991 to 2000 are shown in Figure 1.2. The graph shows the average milk production per cow in 1991 which was 15,030 pounds. In 2000, average milk production per cow reached 18,170 pounds of milk, a 21 percent increase over the 10-year period. In 1991, total cows in the United States were 9.83 million head and by 2000 the total decreased by six percent to 9.20 million head, USDA.

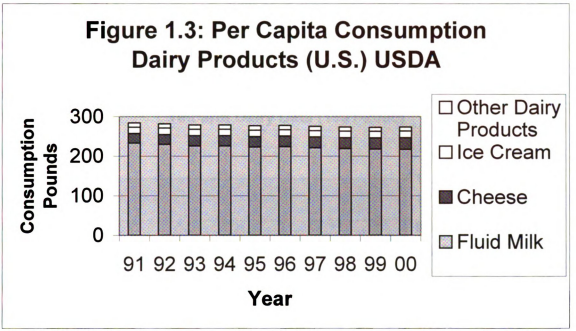
Per capita milk consumption in the U.S. for the period 1991-2000 declined slightly (Figure 1.3). Over this 10-year period, per capita fluid milk consumption decreased 7 percent, per capita cheese consumption increased 21 percent, per capita ice

cream consumption increased 6 percent, and per capita consumption of all other types of dairy products decreased 6 percent. The outcome of these changes is that total per capita consumption for all dairy products decreased by 4 percent. If not for population growth, there would have been even greater pressure for downward movement in milk prices as a result of decreasing demand.

Figure 1.2: Production per Cow & Cow Numbers (U.S.)
USDA



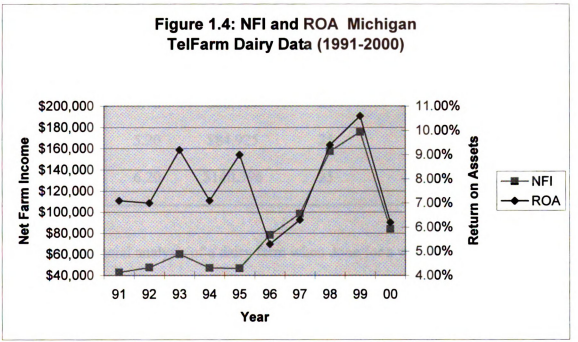
In summary, the U.S. dairy industry has experienced growth in total milk production coupled with fluctuating milk prices. Fewer cows are producing more milk, however, per capita consumption of all dairy products has declined. These trends have impacted the U.S. dairy industry and producers in particular. In order to remain competitive in this changing environment, dairy producers must explore ways to control costs and become more efficient.



1.1: TelFarm Accounting System

TelFarm is a computerized accounting system developed by Michigan State University for Michigan's agricultural industries. The accounting software is a financial record keeping system that provides producers with accurate financial information for management and tax purposes. This financial information is also used to generate annual reports of Michigan's production costs for various types of farms, including dairy. Average net farm income and return on assets from the TelFarm dairy reports are shown in Figure 1.4. Data shown in this figure are from dairy farms ranging in size from 20 to 1,400 cows. For these farms, net farm income was fairly constant for the years 1991 to 1995. Net farm income trended strongly upward from 1996 to 1999 and then plummeted in 2000. Net farm income is heavily impacted by the price of milk. In 1996 the ROA dropped to 5.3 percent and in 1999 hit a peak of 10.6 percent; this increase was driven by

an increase in net farm income. In 2000, the return on assets dropped off sharply, due to an increased milk supplies.



1.2: Problem Statement

A major concern for Michigan dairy farmers is long-term economic health. The 1996 Michigan State University Business Analysis Dairy Summary suggests that farm size influences profitability. The data suggest that as farm size increases so does the ability to achieve a higher return on assets (ROA), higher management income, higher net farm income (NFI) and higher earning potential for management. Table 1.1 shows herd sizes in four groups from small herds (10 to 75 cows) to large herds (176 to 1200 cows) from TelFarm Data. The data in this table show higher performance for ROA, NFI, and management for the larger herds. It should be noted, however, that some small farms did well and some large farms did not. This thesis identifies the characteristics of farms that achieved higher economic returns.

Table 1.1: TelFarm 1998 Business Analysis for Michigan Dairy Farms

Herd Size	Return on Assets	Net Farm Income	Percentage of All Herds	Labor Analysis	Management Income
(Cows)	(%)	($)	(%)	($/hour)	($)
10 - 75	0.70	$20,660	27	$3.69	-$2,648
76 - 120	5.70	$66,104	23	$8.75	-$4,165
121 - 175	5.20	$84,925	25	$9.48	$32,052
176 – 1200	6.20	$140,396	25	$21.13	$56,347

The financial analysis of a dairy farm when done for a whole business still leaves many unanswered questions. For example, a farm with a low ROA, what is the source of the low return? On the other side, for a farm with a high ROA, what is this farm doing different that make it so successful? A dairy farm business is made up of several enterprises. In a whole farm analysis all the enterprises of the operation are combined to report its business profitability. Is the low ROA due to problems with the milking herd (e.g., low labor efficiency), or the cropping program (e.g., high machinery costs), or both? To answer these questions, enterprise accounting may be used. Enterprise analyses can identity profitable and non-profitable enterprises. Enterprise accounting is a means to focus on each profit center or cost center. It can provide a clear picture of what successful farms are doing right and where unsuccessful farms can improve.

In *How to Farm for Profits*, Donald Fedie presents a formula for understanding how a business works and how one can improve future operations. He states that each

part of the management process must focus on financial linkages between the individual parts. Fedie writes,

"These principles are embodied in the following four major analytical and forecasting functions; (1) Financial and enterprise analysis: The analysis of past operations, in terms of both financial history and operating performance. (2) A business forecast: Use of the operating factors analyzed to perform sensitivity analysis and to properly and effectively forecast a plan of operations for the future. (3) A marketing plan: Use of the forecast and sensitivity analysis to formulate and substantiate a plan for marketing, including the use of marketing futures to aid in protecting profits. (4) An accounting system: Use of an accounting system to acutely document and demonstrate what is happening to the business during the course of an operating year and to facilitate year-end operational analysis."

Enterprise analysis used over time can be helpful in evaluating past performance and can be used as a planning tool for the future. Also, comparison among similar businesses can be an effective way to identify an operations strengths and weaknesses. Comparisons among similar operations are more meaningful when done at the enterprise level. For example, a small dairy farm may have higher costs allocated with raising field corn per bushel versus a large dairy farm. The larger farm can spread his costs over more units of production. It is not enough to simply understand financial ratios and factors in financial analysis to survive in production agriculture. But, enterprise analysis allows the farm manager to understand the cost of production processes by each segment or enterprise, of the whole operation and how each segment or enterprise, relates to the whole farm business. Enterprise analysis in this thesis means that inventories, labor,

harvest, variable and fixed costs are assigned to specific enterprises. The general objective of this study is to assess the feasibility and profitability of using enterprise accounting for all farms.

1.3: Project Background and Objectives

In the 1997 Issues and Opportunities Survey of the Michigan Dairy Industry ranked among the highest priorities for Michigan's dairy farms was "profitability, determining costs of production, developing and learning to use enterprise accounting analysis and improving financial management skills." To address this need for more pertinent financial information on Michigan's dairy farm operations, the Dairy Profitability and Efficiency Project was initiated. This project was funded by Animal Industry Initiative Funds and for the purpose of this thesis the project duration was from January 1, 1998 to December 31, 1998. The objectives of this project are:

1) To develop cost accounting methods to determine the profitability of various business centers in Michigan dairy operations (e.g., milk production, raising dairy replacements, grain and forage production and other overhead accounts).
2) To use comprehensive cost accounting methods on selected dairy farms to evaluate the economic performance of the various profit centers, analyze costs and revenue data of individual farms.
3) To collect and merge comprehensive production and financial data as a means to monitor efficiency and improve production efficiency on Michigan dairy farms.

4) To select participating farms that are geographically dispersed across the state and to reflect different sized operations, which utilize different technology options.

Chapter 2

Literature Review

One objective of this research project is to determine the costs and returns of dairy farm enterprises, particularly the costs and returns of producing milk. One method for achieving this objective is through enterprise accounting. This type of accounting is not new, but rather a more intensive use of accounting to calculate the cost of production for specific enterprises (e.g., dairy cow enterprise where costs and returns are expressed in hundredweight of milk). In 1927, J.S. King wrote in his book *Cost Accounting Applied to Agriculture*,

"The functions of cost accounting in the agricultural industry are distinguished from the keeping of ordinary financial books of account, which is the main emphasis has been laid upon the determination of the individual product cost, and the separation of the profits and losses on several branches of the farm activities. This particular form of accounting which we term "cost accounting" are designed to show, not only the profit and loss resulting on the whole farm from the year's operation, but also the separate results, in the way of cost and also profit and loss, of each department of the farm."

This chapter focuses on other studies which determined the returns and costs of business profit or cost centers. Breakdown of financial information into its various subparts or enterprises from these studies varies from the very simple, using spreadsheet and federal tax statements (Schedule 1040-F) to calculate a cost of production, to very intensive, using whole farm cost accounting. The advantages and disadvantages gained by review of other studies are noted here to highlight the methods used in this project to determine the costs and returns of profit centers and their related efficiencies.

2.1: Business Cost Accounting, Planning and Control

Cost accounting enhances an operation's ability to determine successes and failures, so as to better solve its problems. Planning is a decision-making activity and "control" ensures the realization of the plan. The information or data needed to apply control can be obtained from a cost accounting system. In *Cost Accounting* (Planning and Control) by Matz and Usry write,

"Cost accounting or management accounting should be considered the key managerial partner, furnishing management with the necessary accounting tools to plan and control activities. It helps management to budget the future or predetermined materials costs and other costs of production and marketing. This cost information provides aid to management with problems such as capital expenditure decisions, expansion of facilities for production, make-or-buy decision or purchase-or-lease decision."

2.2: Use of Spreadsheets for Cost of Production for Milk

Several spreadsheets have been developed with the goal to reduce the amount of work and time required to compute the cost of milk production. These spreadsheets allow users to estimate milk production costs using whole farm data.

The University of Wisconsin's Center for Dairy Profitability developed a spreadsheet to calculate the cost of milk production. This spreadsheet uses the dairy farm's Schedule 1040-F tax statement and makes adjustments for changes in feed inventory, livestock inventory, and accounts receivable. This spreadsheet divides the farm's cost of milk production between fixed and variable costs, based on "hundredweight

milk equivalents." "Hundredweight milk equivalents" is defined as total farm revenue divided by the U.S. average price received per hundredweight of milk.

The "hundredweight equivalent" method attempts to address non-milk returns generated by the farm. Non-milk returns include the sale of cull cows, deacon calves, government program payments, crop sales, and refunds. These joint enterprises have costs that are not separated from the overall costs of the farm. Thus, it is assumed that all costs not associated with milk production will be offset by these non-milk returns. For example, on most dairy farms the cost of producing corn is not readily separated from the other costs. Because corn is fed to dairy animals it is assumed that these costs are part of the cost of producing milk. If there is excess corn and it is sold, then the value is converted to milk equivalents.

The primary advantage of the hundredweight equivalent approach is its simplicity. When doing farm comparisons, if all farms in the study are using the same method and are similar in structure (e.g., mainly raise feed for farm use), then the comparison data can be used to identify good and poor cost control.

One disadvantage of the equivalent approach is that the profit or loss determined cannot be attributed to a particular enterprise. A second disadvantage of the equivalent approach is the possibility that two farms could have the same "equivalent" costs of milk production but on one of the farms, profits are generated by the milking herd and losses are generated by the corn enterprise. On the other farm the opposite situation could be occurring. A third disadvantage is additional calculations may be required if the income from non-dairy enterprises exceeds 20% of the total income and the associated issue of how to correctly make these adjustments. Dairy farms producing milk have other income

sources unrelated to dairy enterprise such as: crop sales, cooperative dividends, property tax credits, income tax refunds, government payments, and more. A farm's total income (including cash sales of crops and changes in the value of feed and cattle inventories) must be included when calculating the output hundredweight equivalents. On most dairy farms the cost of producing crops (e.g., sales of corn) sold for cash cannot be separated from the cost of producing crops (e.g., alfalfa and corn silage) fed to the dairy animals. This larger income reduces the basic cost per hundredweight equivalent. The 20 percent threshold of total income is considered the average level of income by which most dairy farms vary from each other. The hundredweight equivalent method compares your dairy farm's basic costs with the "average" farm's costs.

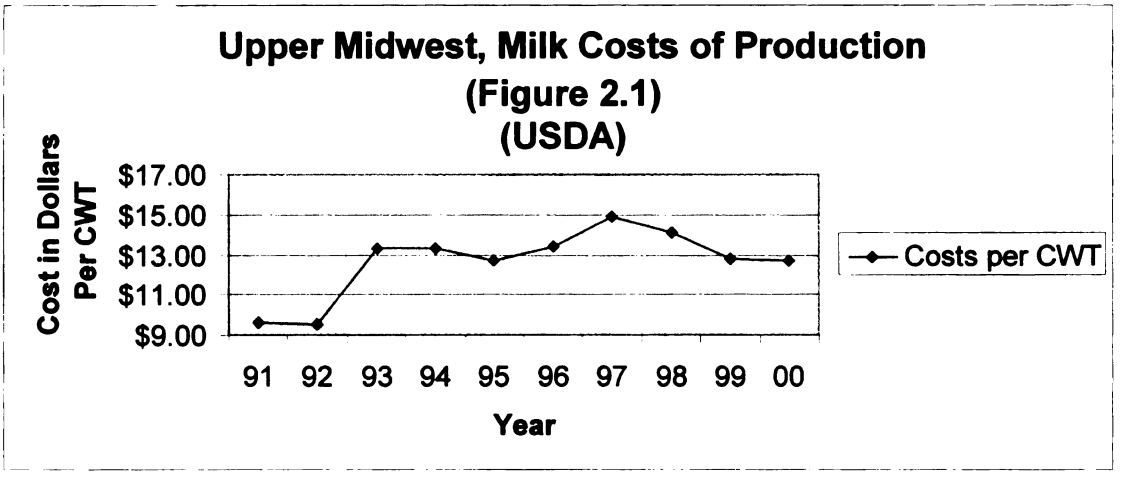
Michigan State University's Department of Agricultural Economics developed a spreadsheet to calculate the cost of production for milk. This spreadsheet uses Federal tax statements (Schedule 1040-F), and makes adjustments for feed inventory changes, livestock inventory changes, and accounts receivable. It estimates the farm's variable cost of production and total cost of production for milk. This spreadsheet uses actual hundredweights of milk sold divided into total farm income to arrive at the average price of milk sold. This average price of milk used in this spreadsheet is specific to the farm. Therefore, this analysis could have a higher return per hundredweight of milk. This spreadsheet has essentially the same strengths as the University of Wisconsin model and the advantage of simplicity when comparing farms of similar structure. A weakness or disadvantage of this spreadsheet is determining where profits are coming from and that additional calculation may be required if income from non-dairy sources exceeds 20 percent.

The University of Missouri developed a dairy producer manual for using QuickBooks to manage a dairy farm. This manual was designed for dairy producers who want to better understand production costs and finances. All that is required to use this manual is QuickBooks by Intuit, an accounting package and Excel by Microsoft, spreadsheet. This manual introduces the fundamentals of using QuickBooks for enterprise accounting in dairy production and spreadsheet files for dairy enterprise budgeting. This accounting spreadsheet package provides a very detailed manual for using QuickBooks with enterprising detail. The spreadsheet provides enterprise reports with quantity detail (e.g., bushels of corn harvested or sold). A disadvantage of this package is the data from QuickBooks must be manually inputted into the spreadsheet. Another disadvantage is this package does not track labor and equipment hours.

2.3: Commodity Costs and Returns for Milk from Surveys

The Economic Research Service of the United States Department of Agriculture (USDA) calculates the cost of producing milk in the U.S. The milk costs and returns estimates for the Upper Midwest from 1991 to 2000 are based on a survey of dairy producers' production practices and costs in 1993, 1996 and 2000. These surveys were used to project the cost of producing milk by adjusting the inputs costs and outputs prices annual using price changes reported. The reliability of the estimates in the non-survey years is influenced by the degree of technical and structure changes adopted by producers. As the number of years away from the survey year increases the reliability of the estimates decreases. Survey results are reported for the industry and made no distinction with respect to size of the dairy operation and the technologies utilized.

Over a ten year period, 1991 to 2000, the U.S. Upper Midwest cost of milk production per hundredweight increased by 43 percent (Figure 2.1). In 1991 and 1992, the cost to produce milk was approximately $9.50. In 1993, costs rose to $13.34, a 40 percent increase over previous years. From 1993 to 2000, the cost to produce milk remained relatively constant, in $13.50 to $14.00 range. In 1998, the year of this research study the cost of milk production was estimated to be $14.07.

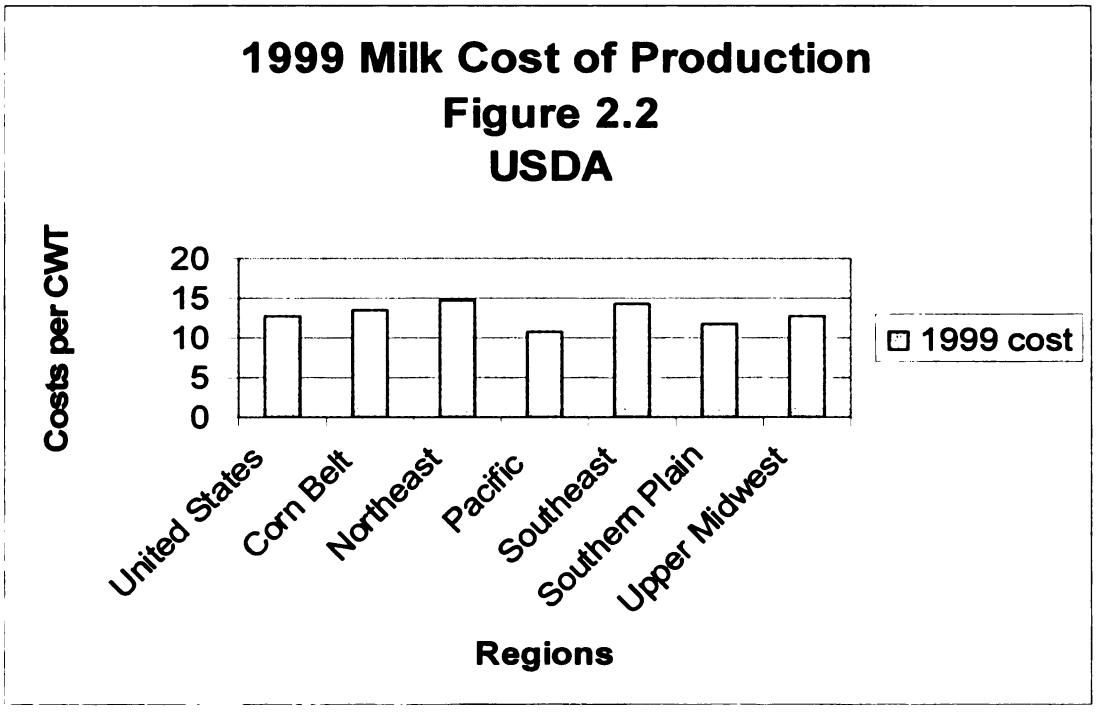


The Economic Research Service also calculates the cost of producing milk in the major regions of the U.S. (Figure 2.2). The milk costs and returns estimates for each of the six regions and for the U.S. are based on a voluntary survey of dairy producers' production practices and costs. The costs are reported for the industry and make a distinction with respect to size of dairy operation and technologies utilized. The Midwest region and the U.S. cost of production were similar in the $12.70 per cwt.

2.4: Cornell Project

Enterprise accounting entails the separating of revenue, expenses and returns for a single livestock or cropping operation (e.g., cost of production of corn) from the whole farm accounts. An enterprise is any coherent segment of the whole structure of the farm

business that can be separated out and analyzed as a distinct entity. The base units for enterprise budgets are commonly one acre or one unit of output (e.g., bushel) for



crops and one head or one unit of output (e.g., hundredweight) for livestock. Enterprise accounting permits easy comparisons across different farm operations. Several enterprising projects have been applied to agricultural operations.

The Cornell Cost Accounting Project was a long-term research project (nearly a 40-year period) to determine the annual cost of production for milk (Kearl, 1997). The project examined nearly 400 farms in New York State and reported the results of individual enterprises, including enterprise costs and returns to each farm. The project tracked the value of inventories and annual value of inventory change, prices received for milk, cattle, and other commodities, yields and annual rainfall. Some advantages of this research are: tracking of labor used per enterprise, enterprise rates of return, and the calculation of cost of production for milk per hundredweight and per cow. Some

disadvantages are that all costs are averaged and no distinction is made for the size of operations. Also, the project required costly and labor-intensive data collection. The project has been discontinued, due in part to its costly data needs and over concerns that the project participants did not reflect the dairy industry.

2.5: Conclusions

Enterprise accounting is a useful tool for calculating direct and indirect costs for an agricultural business. This type of analysis approach is not new and has been used extensively in the past in other industries. In today's modern high tech agriculture it may seem that this type of accounting is old fashion. However, by adding special enterprise components to existing accounting programs and collecting hourly usage of equipment data this type of accounting can extend management's reach into all aspects of the agricultural operation.

Other studies have shown that calculating the costs and returns for various profit centers can be done with similar results. The studies highlight the fact that enterprise accounting is time consuming. But, they also provide this research project with benchmarks and direction for approaching enterprise accounting. This project draws on the findings of previous enterprise accounting research.

Chapter 3

Data Collection and Analysis

3.1: General Description of the Farms in this Study

To be considered for this study several criteria were utilized. First, farms in the study must have generated the majority of their income from milk sales and cull animal sales. Second, the farms had to be geographically dispersed across the state of Michigan. Third, the participating farms had to agree to use an electronic accounting system compatible with the Michigan State University's TelFarm project. Fourth, participating farms must be willing to keep detailed labor usage, equipment usage, and crop harvest records. Finally, participating farm operations had to express a motivation to participate in the project.

The farms participating in this study were distributed across Lower Michigan, from the thumb region to the western counties along Lake Michigan. Nine farms were selected to participate in the project in 1998. However, one farm dropped from the project halfway through the data collection process. The remaining eight farms supplied complete data for 1998.

Dairy production was the primary source of income for the eight participating farms. The milking herds consisted of all Holstein cattle, a popular breed in Michigan. Milk produced on these farms was shipped to local producers' cooperatives. All of the farms raised crops and, except for two farms, most of the farms feed crops were fed to the livestock. As a rule, the farms used a crop rotation program to reduce pest problems. Field crops raised on these farms did not greatly vary from an alfalfa-corn rotation.

Several farms had small acreages of other crops such as wheat and two farms had large acreages of beans.

The type of farm ownership of the farms in the study consisted of two farms in a sole proprietorship, five farms in partnership (2 to 5 owners), and the remaining farm was held in a family corporation.

Prior to this study, all of the participating farms were using whole farm accounting with two using a limited amount of enterprise accounting. Those using enterprise accounting did so only for a couple of enterprises (e.g., the milking herd or a crop) and mainly enterprised direct cash revenues and expenses.

All farms in this study were participating members of the Dairy Herd Improvement Association (DHIA), a service that provides production and management reports on dairy animals for Michigan's dairy farmers. DHIA data were used by this study to account for dairy animal movement between groups (e.g., when heifer calves move into the milking herd, or when dairy animals were culled, calves were born, and cows died). The DHIA figures were used in this study to calculate the milking herd size and number of "heifer-months."

Facilities for those participating in this study consisted of one farm using a tie stall barn for the milking animals. The remaining seven farms used herringbone-type milking parlors and free-stall barns for housing. All the farm operations housed heifers in free-stall barns. Most of the farms housed dry cows and bred heifers in separate facilities.

As a manure handling strategy, one half of the farms used dry stacking with hauling/spreading two to six times per year. The remaining farms used lagoons with hauling/spreading twice a year.

Some characteristics of the farms participating in the project in 1998 are shown in Table 3.1. The minimum and maximum information in this table is not related to a specific farm, but reflect the minimum or maximum for that characteristic across farms in

Table 3.1 1998 Farm Statistics

Size Factors	Average	Minimum	Maximum
Dairy			
Milking Herd Number	195	44	463
Milk Production (lbs)	22,468	17,831	25,500
Number of Heifers	171	35	365
Land			
Acres Owned	490	121	1,258
Acres Tillable	422	116	1,189
Acres Rented	306	0	980
Acres Farmed	728	116	1,943
Employees			
Salary Employees	2	0	4
Seasonal Employees	5	2	12
Financial Positions			
Debt to Assets Ratio	30%	1%	57%

this research project. The smallest herd in this study was 44 cows and the largest was 463 cows. The average herd size was 195 cows. Milk production ranged from 17,831 pounds to 25,500 pounds, with an average of 22,468 pounds. The debt to assets ratio ranged from a minimum of one percent to a maximum of 57 percent, with an average debt to asset ratio of 30 percent. Acreage farmed ranged from 116 acres to 1,943 acres, with an average of 728 acres. Employees ranged from two laborers to 12 laborers, with an average of five.

3.2 Farm Data Collected from Participating Farms

The process for collecting farm level data for enterprise accounting follows the approach used by the Cornell Cost Accounting Project with some modifications. The enterprise data collected included financial, supplemental physical data (e.g., labor usage by enterprise), inventory changes, harvest or production information, dairy herd information, and ration information.

3.3: Financial Information

The financial data was captured in the accounting system used by each of the farms and was a computer-based system. The data, when exported from the accounting software, had to have the capability of being converted into TelFarm type records. The accounting systems used in the project were Quicken, QuickBooks and TelFarm. The TelFarm accounting program was developed by Michigan State University for the farming sector of Michigan. Intuit Corporation of Mountain View, California developed the Quicken and QuickBooks accounting products and these exported records could be converted into the TelFarm record system. These computer based accounting packages had a financial transaction structure of such that accounting data would capture the dollar

amount, quantity units of measure (e.g., paid $1,300 for 650 bushels of corn), and the number of animals (e.g., sold 3 cull cows for $1,500).

In the collection of financial transaction data, it was necessary to use a standard chart of accounts. Because each business would likely have its own unique chart of accounts, financial comparison between farms would not be easy. Therefore, a standard chart of accounts was developed to provide the organization framework for recording and reporting financial transaction. The TelFarm standard chart of accounts was used for the project and was the project's standard chart of accounts.

The accounting systems used in this project required that data had to be exportable to facilitate future analysis. QuickBooks and Quicken can export data using a comma-spaced-value (CSV) text format, TelFarm exported fixed field records. The QuickBooks and Quicken CSV files were loaded into a project developed conversion program that transferred data into TelFarm fixed field records.[2] This program mapped each participating farms' chart of accounts to the TelFarm standard chart of accounts and checked for errors. An additional requirement of the accounting system was the ability to attach an enterprise code to each financial transaction. The three systems used in this project had this capacity.

3.4: Supplemental Physical Data Records (SPDR)

Supplemental physical data records (SPDR) were used to record activities for each employer (including managers) and equipment used. The daily usage of labor, tractors, trucks, auto, and special equipment by each enterprise was recorded.

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[2] The special program or filters were developed by the project team and were used to sort the data into the correct enterprise. This program was written in FORTRAN for this project.

Additionally, any input-output relationship (e.g., fertilizer applied per acre or yield per acre) was recorded. Activities cards were used for collecting this data. Each farm was supplied cards that are specific to their operation (see Appendix A). Every person in the business was required to fill out a daily card of his or her own activities along with any usage of equipment. The labor and equipment usage was then credited to a specific enterprise.

3.5: Inventory Information

At the end of the year each farm in this study had a FINAN analysis completed. The FINAN analysis is part of the FINPACK financial package developed by the Center for Farm Financial Management at the University of Minnesota. The FINAN financial analysis evaluates the financial performance of the farm business during the past year. This analysis uses beginning and ending balance sheets and summarizes the whole farm. The beginning inventory values were collected at the beginning of the accounting year and the ending values were assigned at the end of the accounting year. The FINAN analysis provides managers with whole-farm profitability and solvency measures. The beginning and ending market balance sheets were used in this project to reflect changes in inventories (e.g., grains and forages in storage and purchased inputs such as fertilizers). The inventory information sheets supplied the needed listing of goods on hand (e.g., fertilizer, feed, and etc. in inventory) and tracked changes in value of assets such as buildings and machinery. All inventory items were assigned to an enterprise.

3.6: Harvest Information

Crops harvested were reported monthly by type of crop, moisture content of crop, acres harvested and total weight harvested. Yields were converted to a standard market

place dry matter (e.g., shelled corn at 84.5 percent dry matter). The only exception to this rule was haylage, which was converted to baled hay equivalent with a moisture content of 14 percent. Converting these yields to standard units simplified the analysis and made the comparisons more meaningful. Acres of each crop were reported and checked against total acres controlled by the farm.

3.7: Dairy Herd Improvement Association Records (DHIA)

All farms were participating members of the Dairy Herd Improvement Association (DHIA). This service provides production and management reports for Michigan's dairy farmers. DHIA records were used to inventory animal numbers and to track dairy animal movement into the milking herd from the heifer enterprise and calves born from the milking herd enterprise to the heifer enterprise.

3.8: Feed Ration Sheets

All feeds purchased were reported by type of feed and moisture content. Beginning and ending inventory were also used to determine the amount of feed available for animal use. Feed rations were used to report feed usage by each animal group. Feed rations were also used to check feed usage against inventory change.

3.9: Data External to the Business

The external data used in the study included commodity prices, financial market indexes, historical rates of returns for dairy farming, and available loans rates. These prices or values played a role in placing values on certain inputs used by each enterprise.

3.9.1: Commodity Prices

Commodity prices were used to credit and debit enterprises for usage of a particular commodity (e.g., corn prices were used to charge the livestock enterprise for corn usage). The value for any commodity harvested on the farm was given a harvest price adjusted to reflect the cost of transportation to the local grain elevators. In this analysis, all feeds grown on the participating farms were placed into a storage account and marketing account (e.g., grains storage and marketing). Each commodity was sold out to the using enterprise (e.g., corn grain was sold to market and/or fed to the cows) at the average price for the year after accounting for transportation costs or the actual value if sold on the market. This method allowed for separating crop production from feed usage or sales.

Market hay prices were available on a statewide basis (see Appendix B.) The hay price was adjusted to reflect the relative feed value based upon the relative feed value index found on the feed test analysis. Haylage prices were based on dry hay prices. Corn and soybean prices for the year were collected from local grain elevators across Michigan (see Appendix C and D). This data was used to price corn, soybeans and hay into and out of the storage and market accounts.

Corn silage pricing used for this analysis was obtained through a nutrient value calculation. The value of corn silage was determined by placing a nutritional value on the components in the corn silage based on a market price for other feeds. Corn silage was valued by calculating the market price for energy, protein and fiber, the primary ingredients supplied by corn silage. Prices for shelled corn, soybean meal and straw were

used to determine the market value of the ingredients by solving a set of simultaneous equations. All corn silage was converted to 35 percent dry matter.

3.9.2: Financial Market Data

The financial market index, historical rates of returns for dairy farming and available loans rates were used to calculate the risk premium for the capital invested in the business. The risk premium impacts the opportunity cost of capital. The historical rates of return were drawn from Michigan State University, Department of Agricultural Economic, TelFarm's Business Analysis Summary for Dairy Farms staff papers. The Business Analysis Summary for Dairy Farms for years 1991 to 2000 provided return on assets, return on equity, debt to assets ratios, and debt to equity ratios. The opportunity cost of capital calculation was based on the Treasury Bills' rate of return on a one-year bill from 1994 to 1998 and the 20-year average Standard and Poors 500 index rate of return. The loan rates for long-term and short-term debt were taken from the Greenstone Farm Credit System and were used to calculate the weighted average cost of capital for the farms in the study, (Table 3.2).

Table 3.2 Financial Ratios and Terms

	Farm A	Farm B	Farm C
Debt to Assets Ratio	7%	1%	57%
Interest Rates Short-Term	8.35	3.9	8.23
Interest Rates Long-Term	No Debt	6.7	9.25
OCC	8.35%	8.16%	12.3%
WACC	8.33%	8.16%	10.37%

3.10: Enterprise Account used in Project

Four categories of enterprise accounts were used in this project: Profit Centers, Cost Centers, Allocation Accounts and Overhead Accounts. Each enterprise account category has a specific function and its use is important in enterprise analysis, (see Appendix E).

3.10.1: Profit Centers

Profit center enterprises are production accounts for the primary products produced by the farm, (e.g., dairy, corn, etc). These enterprises provide the farm operation with income. Profits centers are analyzed to determine the costs and returns to a specific unit of production, (e.g., costs and returns per hundredweight of milk). The profit center enterprises are where the costs from other enterprise accounts are charged (e.g., transferring expenses out of the fertilizer enterprise account to the cropping enterprises).

3.10.2: Cost Centers

Cost center enterprises track costs of inputs (e.g., equipment and facilities) used by profit centers. Cost center accounts have depreciable assets. For example each tractor has it own enterprise account and within this account are repairs, insurance, interest, fuel and other costs. These enterprise centers can be monitored for excessive expenditures, which could indicate the need for replacement of that asset. Controlling costs of these enterprises is important to the profitability of the business.

3.10.3: Allocation Accounts

Allocation accounts (e.g., feed, fuel, labor, and etc) are related to individual or multiple enterprises. Allocation accounts assign costs to various other enterprises based

upon usage of the material within that enterprise. For example, fertilizer usage is assigned to the corn enterprise based upon the amount applied per acre. All allocation accounts are closed out at the end of the year, each account is allocated out as fixed or variable costs to the appropriate enterprise.

3.10.4: Overhead Accounts

Overhead enterprise accounts capture costs not related to any specific enterprise but belonging to the whole-farm business such as legal fees, pickup truck, and etc. These overhead account costs are related to the general business and are generally a fixed expense. A problem with these overhead accounts has been allocation of their costs to respective profit centers. There are no direct links between these enterprises and profit enterprises. For example, how much should be billed from legal fees to the corn enterprise. In this study, allocation is done on a value added basis.

3.11: Allocation Methods for Credit and Charges to Enterprises

Allocation accounts are holding areas that are used to allow costs or revenues to accumulate during a specific period of time. These accounts are closed at the end of the accounting period and their value is transferred to other enterprises based on the various allocation methods described. Labor was allocated using the Supplemental Physical Data Records where labor hours were assigned to a specific enterprise. Social security, housing, workmen compensation insurance, and medical fringe benefits were also included. Manure was first given a value based on what management through the farm did not have to purchase for crop needs. Crops were debited based on acreages and the manure was credited. Variable and fixed costs for machinery were allocated based on Supplemental Physical Data Records where equipment hours were assigned to a specific

enterprise. Specific equipment, such as equipment used for row crop production was allocated by acreage and for livestock by number of head. Land costs were allocated by first assigning a rental value then charging rent back to the appropriate enterprise by acreage. Management variable fees were allocated based on Supplemental Physical Data sheets. Management fixed cost was allocated based on value added generated by the profit centers. The dairy capital cow account has an inventory value and the dairy replacement account was given a value by the farm manager per head. The dairy cow capital account was allocated based on DHIA movement. The general overhead account was allocated based on value-added generated by the profit centers. Fuel and lubricants were allocated based on Supplemental Physical Data sheets. The utilities (e.g., electricity, LP, etc) account was allocated based on usage figures from TelFarm enterprise budgets. Insurance was allocated using inventory values. Storage and marketing accounts were allocated based on ration sheets or amounts consumed by groups of animals or by feed sold. Livestock supplies were allocated based on usage figures from TelFarm enterprise budgets. Fertilizer was allocated based on usage and acreage planted/harvested. Housing facilities for animals were charged to animals based on usage. Property taxes were allocated based on inventory values of land and buildings. The shop and general repairs account was allocated using inventory values. Housing for machinery was allocated based on inventory values.

Chapter 4

Labor and Management

Labor is one of the most significant inputs in agricultural production. Labor can be defined to include all the productive activities of individuals used in a business. This includes the physical ability to do work and the mental ability to make business decisions, i.e., the management component. Some studies separate the physical labor and related skills from the management labor component. How labor is measured and the value placed on it is important for establishing the cost of agricultural production. Historically, agricultural cost-return models treat labor and management as the same, common input. The physical labor, including management, is treated as a single variable cost.

4.1: Approach to Labor

The Economic Research Service (USDA) (El-Osta and Ahearn) present two different types of labor accounts, labor paid in cash and labor paid in both cash and non-cash. The first type is labor paid in cash including household members. This type is considered as a variable expense and is expressed only in terms of cash outlay. The second type of labor is considered an economic cost. An economic cost includes both cash and non-cash expenses. The non-cash costs are the opportunity cost of unpaid labor and a return for unpaid management.

In the USDA's cost studies the paid expenses for hired labor and management are included in variable expenses. The unpaid farm labor is valued as an equivalent to a hired labor wage rate, exclusive of management and is considered a non-cash expense.

Unpaid management is not directly costed out but is included in the net returns of the farm business as a residual. This residual is considered a return to management and risk.

Another alternative approach to estimating the cost of unpaid family labor and management is the Klonsky alternative approaches (1992). Klonsky conducted a survey regarding methods for measuring management costs and from this survey three estimate approaches follow. These alternative measures were used to estimate the cost of unpaid management labor. The first approach used a percentage based charge on gross receipts for the return to management. The second approach used a percentage charge based on costs for the return to management. The third approach used a specific charge per hour, like the wage rate of hired farm manager for the return to management.

4.2: Labor Types

Labor in this research project can be categorized into four types: (1) management, (2) full-time labor hired, (3) part-time labor hired and (4) specialty labor hired.

Full-time labor hired is paid a wage which includes social security, workmen compensation and health insurance. Some of the employers provided a house for employees and this was not added to their wages. Part-time labor hired is paid a wage which includes social security and workmen compensation. Specialty labor hired was paid a wage with social security and workmen compensation included.

4.3: Methods for Management Labor

Each manager in this study was asked what they would have to pay to hire someone with their skills and experience that is someone to replace him. This is to be exclusive of the management part of their position. The average amount was $10.75 and the range was $10.00 to $12.00 per hour. Management reported their hours in the

Supplemental Physical Data Record (SPDR). To assure that management reported the accurate amount of labor that management actually did give, an adjustment factor was used. This adjustment factor was obtained from their recorded accounting hours for other laborers and the SPDR. For example, farm payroll reported 2,925 hours worked for full-time employee and the SPDR reported 2,642 hours. Then it was assumed that management was under reported on the SPDR records. In this example, the adjustment factor that is applied to management labor would be 2,925 divided by 2,642, which equal a factor of 10.7 percent. To correct this the hours reported were adjusted upward by 10.7 percent or to 3,036 hours. This adjusted figure was then multiplied by the supplied management rate per hour. If management stated $12.00 per hour, then his wage cost would be $36,432 for the year ($12.00 x 3,036 = $36,432).

Social security was added to the management cost of wages. It is calculated by multiplying the wage cost by the employer share for social security rate of 7.65 percent.

Workmen compensation was also added. It is calculated by multiplying the wages costs by the workmen compensation rate of 4.45 percent.

Medical insurance was calculated for the management team. Several insurance companies were contacted to obtain a typical rate for a family of four with a $250 deductible and 80% coverage in the 40 to 50 age group. An average annual rate is $3,744, yearly. This fee was added to the labor costs for each member of the management team.

The total wage costs for managers, which included the cost of wages ($36,432), social security ($2,787), workmen compensation ($1,621), and medical insurance ($3,744) which gives a total management cost of $44,584. Divide the total wage cost of

$44,584 by the adjusted hours worked of 3,036 and the average cost per hour for the manager is $14.69. This rate per hour reflects what it would cost the business to hire similar quality labor to do the work done by the manager.

4.4: Methods for Unpaid Family Members

Managers were asked to provide the labor rate they were paying for hired family labor. The average amount was $6.75 per hour and the range was $6.00 to $7.00 per hour. Each employee reported their hours on the Supplemental Physical Data Records (SPDR) and the employer reported labor hours in payroll. To assure the accuracy of reported labor hours, a comparison between SPDR and recorded accounting hours were noted, an adjustment factor was used if there were any differences. For example, one of the project farms payroll reported family labor of 434 hours and the SPDR for the same farm reported family labor of 434 hours. The adjustment factor for this farm's family labor was zero because both payroll and SPDR matched. Family labor wages for this farm was reported as the wage rate of $6.50 multiplied by 434 hours, totaling $2,821.

Social security was added to the cost of wages. It is calculated by multiplying the wage cost by the employer share for social security rate of 7.65 percent.

Workmen compensation was also added. It is calculated by multiplying the wages costs by the workmen compensation rate of 4.45 percent.

The medical insurance was not added because the family member was already covered by the management labor package.

The total wage costs for family labor was $3,162 which included the cost of wages ($2,821), social security ($215.81), and workmen compensation ($125.53). Divide the total wage cost of $3,162 by 434 hours worked and the average cost per hour for the

manager is $7.29. This hourly rate reflects what it would cost the business to hire this family member.

4.5: Return to Management

A return to management reflects the value of managing the operation. This management fee is based on the value of production for the product producing enterprises (e.g., milking herd, corn silage, etc).

The value of production (VFP) for any enterprise is the value of the commodity produced at harvest less variable input costs plus inventory change. For example, in the dairy enterprise it is the value of animal products produced (e.g., milk, calves, cull cows, etc) less the cost of feeds, less purchased animals plus inventory change. This value of production is multiplied by four percent and becomes the management fee for that enterprise. The dollar value is the charge to the dairy enterprise of all unpaid operator and family labor and management for the year. The four percent figure provides the best estimate of unpaid family labor and is the figure currently being used in FINPACK analysis. FINPACK software was developed by the Center for Farm Financial Management at the University of Minnesota and is used by farmers and lenders in the agricultural sector. The return to management is charged to the enterprise as a fixed cost.

Chapter 5

Cost of Capital

5.1: Overview of the Cost of Capital

An important issue in estimating financial returns in the Michigan Dairy Profitability Enterprise Project (DPEP) accounting on dairy farms is choosing an appropriate cost of capital or interest rate for charging various enterprises for the use of capital. Cost of capital is an economic concept and it is important when doing enterprise accounting. This opportunity cost is based on the notion that every input or resource used in an enterprise has an alternative use and should receive at least that value. Whatever use is decided upon, once the input is in production or committed, it is no longer available for another use and that income from the alternative use is forgone.

With respect to the cost of capital concept, the American Agricultural Economic Association's Commodity Cost and Returns handbook (1998) states that, "The key issue is to select a rate of interest that reflects the actual market evaluation of alternatives to the cost, return and risk associated with a given expenditure or revenue." The appropriate level of risk needs to be first determined, and then an interest rate is chosen to reflect that risk. The interest rate used should reflect the financial position of the business's capital in relationship to its level of risk. The higher the risk, the higher the opportunity cost of capital should be.

There are several methods that can be used to estimate the cost of capital and corresponding interest rate. One simple method is to add a risk premium to the borrowing rate to reflect the cost of equity capital. Another method is to use historical

data and the expected market return to calculate the opportunity cost of capital. These approaches are discussed below.

5.2: Methods with Risk Premium

The nature of investing is that a higher expected return is required for investments which carry higher risk than investments with relatively low risk. That is, the expected return on any investment is equal to the sum of the risk-free rate of return plus an extra return to compensate for risk. The risk-free part is really not the problem and can be estimated using Treasury Bills' rate of return for any specific period. The problem remains on how to measure the extra value that is added to account for risk. There are several theories of investment behavior that attempt to convey this value such as: Sharpe, Lintner and Treynor's Capital Asset Pricing Model (CAPM) or Stephen Ross's Arbitrage Pricing Model. As far as the risk premium is concerned in these theories, they generally require a premium over the risk-free rate of return for an investment.

5.3: Methods for Calculation of a Leveraged Risk Premium.

The risk-premium model offers a method for the calculation of the leveraged risk premium. The main assumption in this model is that every holder of a risky investment requires a return that is greater than the return they would receive from a risk-free investment. The expected market return is calculated by adding to the risk-free rate of return to a specific premium for financial risk that is industry risk and operating risk. The risk premium model states the expected market return is equal to the interest rate on a risk-free security, a risk-free security means that is it has no covariance with the market, and a normal risk premium (Hanson and Myers, 1996). Please refer to equation one. The expected market return is ($E(k_m)$) and is determined by a risk-free rate of return for

Treasury Bills (r_{rf}) plus a risk premium (rp). Equation one has three variables and can be solved for the risk premium (rp). This equation will be used to calculate the risk premium for capital investments. As a proxy for the expected market return, the historical return on equity (ROE) for firms is often substituted for (k_m) and the Treasury Bill's rate of return will be substituted for (r_{rf}).

(1) $E(k_m) = (r_{rf} + rp)$

Equation two has been solved for the risk premium (rp) and the risk premium can be estimated for the 35 TelFarm farms in the data set.

(2) $rp = (E(k_m) - r_{rf})$

5.4: Capital Asset Pricing Model.

A variation of the risk premium model as described in equations one is the Capital Asset Pricing Model, (CAPM). This model attempts to quantify risk differently than the risk-premium model. The CAPM model measures risk as the volatility of an asset's returns relative to the volatility of the market portfolio's returns (Harrington, 1983). The advantage of this approach is that risk is the only asset-specific estimate that must be made in the model. Risk or beta (β) is defined as the sensitivity of a farm's business returns related to the return on the market, like the Standard and Poors Composite Index. This type of risk is non-diversifiable. Please refer to equation three. The CAPM model hypothesizes that the relationship between risk and return and states that the expected risk premium on any investment equals it beta times the market risk premium (Brealey, Myers & Marcus, 1995).

(3) $E(r) = r_{rf} + \beta_L(E(k_m) - r_{rf})$

The expected return (E(r)) is equal to the risk-free rate of return (r_{rf}), and a beta leveraged (β_L), multiplied by the risk premium ($E(k_m) - r_{rf}$). By moving the risk-free rate of return (r_{rf}) from the right side of the equation to the left side of the equation, the left side of the equation is now equal to equation two, the risk premium (rp).

(4) $rp = \beta_L(E(k_m) - r_{rf})$

Several assumptions are required. First, Beta (β) is a measure of risk relative to the market and that the expected risk premium on any asset equals beta times the risk premium. Second, Treasury bills have a zero beta because the rate of return is fixed for a specified period and is unaffected by what happens in the general market. Third, that beta is leveraged (β_L), because all farms may have some degree of debt. Fourth, that the expected rate of return ($E(k_m)$) and a risk-free rate of return (r_{rf}) are values that can be estimated.

Solving for (β_L) in equation four, a leveraged beta can be estimated for the 35 TelFarm farms in the data set as in equation five.

(5) $$\beta_L = \frac{rp}{(E(k_m) \quad r_{rf}}$$

5.5: Methods for Calculation of Unleveraged Beta

The unleveraged beta is calculated by using the Modigliani and Miller (MM) argument that requires the rate of return on equity to increase as the firm's debt to equity ratio increases. In this argument the reasoning is as debt increases the farm's risk of loss

of equity also increases due to the fact that if loans are recalled and repayment by liquidation of secured assets is non-sufficient, then equity will have to be liquidated to cover any shortfalls in repayments of loans. This model is used in two variations, the first variation is used to solve for an unleveraged beta (β_U) and the second variation is used later to solve for the DPEP eight individual dairy farms' leveraged beta (β_L). The (MM) argument principal equation is equation six.

$$(6)\ \beta_L = \beta_U(1+\frac{D}{E})$$

Solving equation six for the unleveraged beta (β_U) in the MM principal argument, the result is equation seven. Using the solution to equation five, the leveraged beta (β_L) from the 35 farms in the TelFarm data set and equation seven, and the unleveraged beta can be estimated for the 35 farms in the TelFarm data set. Note that (t_C) is the tax portion of the equation and will be ignored in the calculation.

$$(7)\ \beta_U = \frac{\beta_L}{(1+(1+t_C)\,{}^{D}\!/_{E})}$$

5.6: Methods for Calculation of a Leveraged Beta using the MM Argument for the DPEP Eight Farms

The leveraged beta is a firm specific calculation and each of the eight farms in the DPEP study has a specific beta leveraged value. This specific value expresses the degree of each farms' indebtedness. The degree to which debt has an effect on the leveraged beta can be seen in the debt to equity ratio value of equation six, as debt increases the ratio also increases. Thus, an unleveraged beta is multiplied by a larger debt to equity ratio and also increases. The net effect is as debt increases so does leveraged beta. In

equation six unleveraged beta is held constant because this value is industry specific. The unleveraged beta is an explicit value for dairy farming and is related to dairy asset returns. Please note that (t_C) is the tax portion of the equation and will be ignored in the calculation.

5.7: Methods for Calculation of the Cost of Capital for DPEP.

The farm's cost of capital is the opportunity cost of capital for that business's existing assets. It is used to value new assets that have the same risk as older assets. Most businesses have debt as well as equity, meaning that the cost of capital is a weighted average of the returns of debt and of equity. In investment terms it could be called the returns that an investor would demand from a portfolio, the portfolio being the different type of security outstanding for the farm business.

Again, using the CAPM model but replacing the left side of the equation expected returns (E(r)) with expected leveraged capital cost (E(k)) and using the Treasury Bills rate of return for (r_{rf}) and using the Standard and Poors 500 Composite Index (S & P 500 Index) rate of return for ($E(k_m)$), and substituting equation six's estimates for (B_L) into equation eight, the results obtained are the leveraged cost of capital. This leveraged cost of capital ($E(k_L)$)is the discount rate or interest rate charged to equity capital. It is the opportunity cost of capital that will be used in weighted average cost of capital (WACC) calculation for each DPEP dairy farm.

(8) $E(k_L) = r_{rf} + \beta_L (E(k_M) - r_{rf})$

5.8: Methodologies for the Calculation of the Weighted Average Cost of Capital

To operate a farm business is a risky venture due to the nature of variables such as weather, biological catastrophe, labor problem and prices. So, the probability of failure is greater than zero. To simply use a loan rate for the cost of capital does no adequately incorporate risk in the financial picture. As borrowing increases so does risk and this financial condition corresponds to higher leverage. The agriculture loan rate does not reflect the relevant cost of risk. To account for the true cost of capital, a type of weighted cost of capital where the cost of equity and the cost of borrowed capital are averaged together giving the weighted average cost of capital (Levy and Sarnat 1994).

The weighted average cost of capital (WACC) is the weighted average costs of debt and cost of equity for the farm business. The WACC is an estimate or way of estimating the farm business's cost of capital. WACC (k_W) for a firm is equal to the cost of capital (k_L) times equity (W_E), plus the interest rate for short debt (k_{STR}) times short term debt (W_{STD}), plus the interest rate of return for long term debt (k_{LTR}) times long term debt (W_{LTD}), divided by the total value of the business (V), equation nine.

$$(9)\ k_W = \left(\frac{((W_E k_L) + (W_{STD} k_{STR})(1 + t_C) + (W_{LTD} k_{LTR})(1 + t_C))}{V}\right)$$

The interest rate charges for the short term debt and long term debt were taken from the Board of Governors of the Federal Reserve System, Economic Research Service and from the Farm Credit System (1998). One assumption in this calculation is the tax rate (t_C) is a tax saving adjustment for the business when it borrows capital but this rate will be equal to zero for this study. Another version of equation nine is equation ten, where all the (k)s are the same as in equation nine but this equation uses the equity to

asset ratio multiplied by (k_L), short term debt to asset ratio multiplied by (k_{STR}) and long term debt to asset ratio multiplied by (k_{LTR}). The difference is that the ratios are calculated before WACC in equation ten rather than during the calculation in equation nine.

$$(10)\ k_W = (((E/A)*k_L)+((D_{ST}/A)*k_{STR})+((D_{LT}/A)*k_{LTR}))$$

5.9: Use of Treasury Bills for the Risk-Free Rate of Return.

Treasury Bills are short-term debt securities, which are sold by the United State Government. The Treasury Bills rate of return will be used for the risk-free rate of return in both the risk premium model and the CAPM model. One crucial assumption of this analysis lays with using Treasury Bills as the risk-free rate of return. Does a theoretical zero-risk asset exist? If the existence of such an asset were true, then this theoretical asset would have no covariance with the general market, like the S & P 500 Index. It would in fact be risk-free and not be subject to the effect of inflation or any other macroeconomic factor. The rate of Treasury Bills does fluctuate with inflation and several macroeconomic factors, but the rate of return, once set, is fixed (Harrington, 1983). Once fixed it is unaffected by the market and therefore has a beta of zero (Brealey, Myers, & Marcus, 1995). Unfortunately, we do not have the perfect risk-free asset. In the absence of such a security, Treasury Bills can meet the criteria for this risk-free asset.

One of the first steps in determining the opportunity cost of capital is to obtain a risk-free real rate of interest. This rate is a risk less rate with zero probability of default. The risk-free rate of return is estimated by using the current annualized rate of return for Treasury Bills at the time the analysis is being done. For example: The rate of return on a

one year Treasury Bill for December 31, 1998 was 4.89% (Federal Reserve Bank of Chicago). This data can be obtained from several financial reporting sources on a monthly or annual basis. The source for this analysis is Historical Returns for Stocks, Treasury Bills and Treasury Bonds from Ibbotson Associates and Bloomberg on the Wide World Web.

5.10: Upper and Lower Bounds for the Risk Premium

The upper bounds of the risk premium can be estimated through the present value model of farmland pricing. The model requires a discount rate for returns that are to be used in the cost flows for farmland. To calculate a discount rate, the historical returns for land in Michigan can be used. Again, the discount rate less the interest rate of return on Treasury Bills for the time period in question is the risk premium for that period. Some of the problems in this approach are that the risk premium also has other factors that give some distortion to the true risk premium. The other factors could be return to management and other factors of production. Each factor would provide the need to adjust the risk premium downward because the return to land alone is what the model is trying to explain, (Hanson and Myers 1996).

Another estimate of the upper bound is taken from the Iowa land value data series from Iowa State University using cash rent and land values, which provides a way to determine the returns to land owners. The results of this study provided a return of ten percent per year, which match up to nearly a six percent risk premium to land owners when the risk-free rate of return, Treasury Bills, for the time period in question is subtracted from the total return. Risk premium is equal to the rate of return on land less the rate of return on risk-free Treasury Bills. (Hanson and Myers 1996)

In a study of "Michigan Land Values" by Hanson (1991-1998) the average return to farmland and building were about 15 percent, take the risk-free rate of return for Treasury Bills from this value and the approximate risk premium estimate is ten percent. This risk premium has some distortions within it but these are minimal. That is returns to management and some returns to production must be removed to provide a good estimate of the risk premium.

These studies do provide some information as to an upper bound limit for the risk premium of about ten percent, (Hanson and Myers, 1996). The risk premium of ten percent seems somewhat high but, land may be a hedge against unexpected inflation and returns to land ownership will be higher than for similar investments.

5.11: Review of the American Agricultural Economics Association's (AAEA) Costs and Returns (CAR) Estimate of Risk Premium

A crude estimate of the risk premium ($E(r_c)$) for agricultural production investments can be calculated by using the CAPM model and Treasury Bills' rate (r_{rf})of return for a given time period. The risk premium or discount rate for agricultural cash flows can be obtained if a known value of beta exists. The beta value in the CAR estimate was positive and greater than zero. However, the CAR estimate of beta was relatively low which is typical for agricultural assets, as beta get smaller in the CAPM model the additive value of ($E(k_M) - r_{rf}$) become smaller and the resulting risk-free rate of return (r_{rf}) has little or no change, equation eleven.

(11) $E(r_c) = r_{rf} + \beta * (E(k_m) - r_{rf})$

Another approach to estimating the risk premium in the AAEA's CAR estimate is the method of starting with a nominal interest rate on agricultural loans and first back out the charges for transactions costs for such loans, and then adding back some factor for risk. The biggest problem with this approach is determining the charge for transaction costs. Another problem is the lending institutions may demand a higher premium on loans because of the probability of default by certain individual farms due to poor financial conditions. Thus the price charged for these agricultural loans may be higher than for loans in other areas. The AAEA did not recommend this approach but it still gave an estimate of a risk premium. In the AAEA estimates for the risk premium their studies provided a reasonable value for agricultural investments of three to six percent.

5.12 Conclusions

The purpose of this chapter was to arrive at a cost of capital for calculating the return on farm capital that reflected each farm's indebtedness and provided a cost estimate that can be used for calculating the costs of equity in the WACC. The average cost of capital (k_L) for the eight farms in this study was .09755 percent, the lowest cost of capital was Farm B at .0816 percent and the highest cost of capital was Farm E at 0.1230 percent. The WACC is the cost of equity, cost of short-term debt and the cost of long-term debt averaged together to provide a weighted cost of capital that accounts for debt risk. Table 5.1 is a summary of the results from the eight farms that completed the study. The lowest WACC was Farm B at 0.0816 with an equity-to-asset ratio of 0.9895. The highest WACC was Farm E at 0.1037 with an equity-to-asset ratio of 0.4288. Thus, the WACC varied from 8.16 percent, the lower bound, to 10.37 percent, the upper bound, which provides limits in this study of the WACC on these dairy operations.

Table 5.1: Weighted Average Cost of Capital for Eight Michigan Dairy Farms

	E/A	K_L	D_{ST}/A	K_{STR}	D_{LT}/A	K_{LTR}	WACC
Farm A	0.9343	0.0835	0.0657	0.0809	0.000	0.0788	0.0833
Farm B	0.9895	0.0816	0.0051	0.0809	0.0054	0.0788	0.0816
Farm C	0.5199	0.1102	0.2818	0.0859	0.1983	0.0813	0.0976
Farm D	0.7431	0.0921	0.1490	0.0809	0.1079	0.0788	0.0890
Farm E	0.4288	0.1230	0.3551	0.0909	0.2161	0.0863	0.1037
Farm F	0.7849	0.0899	0.1693	0.0809	0.0458	0.0788	0.0879
Farm G	0.6125	0.1011	0.0331	0.0859	0.3544	0.0813	0.0936
Farm H	0.6391	0.0990	0.3046	0.0859	0.0564	0.0813	0.0940

Chapter 6

Comparing Three Project Farms

By comparing the farms in this project, one can evaluate a farm's business on the basis of how it compares to other farms in the project. Comparative analysis is useful to examine factors that might influence production costs such as the size of the business. It can also be helpful for identifying a farm's strengths and weaknesses, allowing managers to capitalize on their strengths and minimize losses due to a weakness. In this study comparative analysis will measure the financial differences in profit for selected enterprises. Three different sized operations are used in the analysis. However, comparison between these operations must be viewed in the context of each farm since each is unique with respect to business goals, resources and management skills.

Comparative analysis, as the name implies, is the process of comparing various analysis factors for a certain farming operation with the analysis factors of a group of similar farming operations.[1] When the financial data or performance factors are divided into enterprises (profit and cost centers), each enterprise can be analyzed or compared with a similar enterprise of the group.

Comparative analysis requires detailed and accurate information about the farms to be compared. As noted in Chapter 3, data must be similar in nature for comparisons to be meaningful. Several factors could be used to make comparisons for this study. The factors compared in this study are milk production costs per hundredweight, corn grain production cost per bushel, hay production costs per ton, and cost of raising a heifer per

[1] Managing the Farm Business by Harsh, Connor and Schwab

month. It should be noted that all costs used in this comparative analysis were standardized (e.g., corn comparison per bushel at 84.5 percent dry matter).

6.1: Characteristics of the Case Farms Compared

When making comparisons, it is essential to know the characteristics of the farms and how they might influence the results.

Table 6.1: Farm Characteristics

	Farm A	Farm B	Farm C
Number of Cows	44	160	381
Milking Facilities	Stanchion	Parlor	Parlor
Milk Production (lbs)	25,584	25,171	21,502
Acres Cropped	116	584	615
Number of Managers	1	2	3
Debt to Asset Ratio (%)	0.07	0.01	0.48
Legal Structure	Corporation	Partnership	Partnership

For the three farms being compared, cow numbers ranged from 44 cows to 381 cows, with an average of 195 cows (Table 6.1). Farm A used a stanchion barn milking facility and Farms B and C used a milking parlor. Total acres cropped varied from 116 acres for the small farm to about 600 acres for the other two farms. Partnership was the legal structure for the two larger farms with the smaller farm being a family corporation. Farms A and B financial debt to asset ratios were small while Farm C had debt nearly equal to the assets. Milk production for Farm A and B were very similar at 25,584 and

25,171 pounds per cow, respectfully, while Farm C was slightly lower at 21,500 pounds per cow.

Table 6.2: Revenue for the Dairy Enterprise, (dollars per hundredweight produced)

	Farm A ($/cwt)	Farm B ($/cwt)	Farm C ($/cwt)
Total Revenue	16.22	16.50	16.36
Milk Sold	15.41	15.55	15.24
Cull Cows	0.45	0.41	0.59
Calves	0.22	0.38	0.19
Other Income	0.00	0.01	0.25
Manure Value	0.14	0.15	0.09

6.2: Revenues and Expenses for the Dairy Enterprise

Farm A had the lowest level of total revenue per hundredweight of milk production at $16.22, Farm B had the highest at $16.50, and Farm C had the average of Farm A and B at $16.36 per hundredweight. The main cause for the differences in milk income per cow among the three farms are the prices received; Farm A received $15.41, Farm B received $15.55 and Farm C received $15.24, per hundredweight. There are significant differences in the income for the three farms. Farm B had the highest calf sales at $0.38 and the highest manure value at $0.15. Farm C had the highest cull cow sales and the highest other income, at $0.59 and $0.25, respectfully (Table 6.2.) Other income in the dairy enterprise were patronage dividends and dairy cooperative refunds.

Based upon observations of the farms, Farm B had the highest calf sales, due to lower death losses. Farm C had a higher value of cull sales which was due to a higher

culling rate. As will be noted later, this practice also results in higher replacement costs. It is interesting that the highest price for milk was not achieved by Farm A, the stanchion facility and small-size farm. Higher prices should be the result of better individual animal care achievable with stanchion facilities, but this was not the case. Farm B, a mid-size farm, had the highest milk price because of higher milk premiums.

Table 6.3: Variable Costs related to the Dairy Enterprise, (dollars per hundredweight produced)

	Farm A ($/cwt)	Farm B ($/cwt)	Farm C ($/cwt)
Total Variable Cost	12.60	11.87	15.24
Feed	5.69	5.13	6.66
Replacement Cost	1.32	1.32	2.74
BST	0.33	0.14	0.60
Vet. & Medicine	0.33	0.43	0.59
Supplies	0.51	0.68	0.46
Breeding	0.20	0.13	0.09
Utilities	0.39	0.17	0.21
Dairy Misc.	0.24	0.15	0.05
Equipment	0.29	0.45	0.29
Wages	2.47	2.31	2.57

Farm C, the largest farm, had the lowest price milk sold because of the inability to capture milk premiums.

Variable costs for Farms A, B and C were $12.60, $11.87, and $15.24 per hundredweight, respectfully (Table 6.3). The average variable costs for the three farms were $13.23 per hundredweight. Farm A and Farm C had the highest variable costs for feeds at $5.69 and $6.66 per hundredweight, respectively. Farm B had the lowest feed cost at $5.13 per hundredweight. On average for these farms, it takes 38 percent of the milk revenues to cover feed costs. This figure indicates the importance of controlling feed costs and their effect on profits. Farm C's feed cost was 30 percent greater than Farm B and 17 percent greater than Farm A. Farm C is at a disadvantage from a profitability viewpoint.

Farm C had the highest replacement costs at $2.74 and the highest veterinary costs at $0.59. Also, Farm C had a high cull rate, possibly caused by herd health problems. Farm C had the highest wage costs at $2.57 per hundredweight. Farm B had the highest equipment cost at $0.45. This was partly the result of making major purchases of new equipment. Farm B also had the highest dairy supply costs at $0.68 per hundredweight. Farm A had the highest utility costs at $0.39, which is common with older facilities. Farm A had the highest dairy miscellaneous costs of $0.24 and the highest breeding costs at $0.20 per hundredweight, which was related to using more expensive semen.

With respect to total variable costs, Farm B had the lowest variable costs of the three farms at $11.87 per cwt. Farm C had the highest variable costs due mostly to higher feed and replacement costs. These higher costs were due to a higher turnover rate for the cows and a larger percentage of purchased feeds.

Fixed costs for Farm A were $2.56 per hundredweight. Farm B and Farm C fixed cost were $2.24 and $2.52 per hundredweight, respectfully (Table 6.4). Farm A had the highest general overhead costs at $0.82 per hundredweight. This is a size issue since a small farm has less productive units over which to spread costs. Farm B had the highest management costs at $0.40 per hundredweight. Farm C had the highest interest and insurance costs at $0.62, and the highest building costs at $0.66 per hundredweight. This relates to a higher level of investment in facilities as a result of expanding the herd and making improvements to the milking facility. Farm A had the lowest facilities, building and equipment costs at $0.63, as a result of using an older stanchion barn and used equipment. This lowest facility cost was offset by having higher management and general overhead costs because of the size of the operation.

Table 6.4: Fixed Costs related to the Dairy Enterprise, (dollars per hundredweight produced)

	Farm A ($/cwt)	Farm B ($/cwt)	Farm C ($/cwt)
Equipment & Mach.	0.63	0.82	0.82
Interest & Ins.	0.47	0.35	0.62
Build & Imp.	0.28	0.35	.066
Management Fee	0.37	0.40	0.26
General Overhead	0.82	0.34	0.16
Total Fixed Cost	2.56	2.27	2.52

Total costs for Farm A were $15.17 per hundredweight, for Farm B it was $14.15, and for Farm C it was $17.77 (Table 6.5). Farm A had $1.05 return over total costs.

Farm B had the highest return of $2.35 and Farm C incurred a loss of (-$1.40). Factors causing Farm C to have a loss were the lowest production per cow, and higher variable and fixed costs per hundredweight. Farm B was the most profitable with the lowest variable and fixed costs per hundredweight. Farm A was profitable with the highest milk production of all three farms but had higher variable and fixed costs than Farm B.

Table 6.5: Total Revenue, Variable Cost, Fixed Cost and Net Return for the Dairy Enterprise, (dollars per hundredweight produced)

	Farm A ($/cwt)	Farm B ($/cwt)	Farm C ($/cwt)
Total Revenues	16.22	16.50	16.36
Total Variable Cost	12.60	11.87	15.24
Total Fixed Cost	2.56	2.24	2.52
Total All Costs	15.17	14.15	17.77
Net Return	1.05	2.35	-1.40

Contrasting the three farms in this study showed that the highest production per cow does not guarantee that the milk enterprise will be more profitable because that higher production is often offset by higher feed costs. The difference between the lowest variable cost of production and the highest was $3.37 per cwt. The difference was mainly related to Farm B having high milk production with older but efficient facilities, lower replacement and feed costs. Also, having a larger herd size does not necessary result in lower total costs. The most profitable farm had both high milk production and low feed costs.

6.3: Cost of Production for the Corn Enterprise

Corn revenue for these three farms is the return price at harvest. The harvest price is the local harvest price less the transportation cost to move the corn to market. Of the three farms, Farm A had a slightly higher market price per bushel at $1.77. Offsetting Farm A's better price was lower yields (Table 6.6).

Table 6.6: Corn Enterprise Production Factors

	Farm A	Farm B	Farm C
Acres Production	32	60	190
Yields (Bu)	112	127	124
Labor per Acre (hr)	1.59	5.6	1.65
Income Per Bushel	$1.77	$1.72	$1.69

Table 6.7: Corn Enterprise Variable Cost of Production, (dollars per bushel)

	Farm A ($/bu)	Farm B ($/bu)	Farm C ($/bu)
Labor	0.20	0.46	0.16
Seed	0.19	0.10	0.22
Fertilizer	0.33	0.29	0.62
Chemical	0.20	0.30	0.36
Machinery	0.31	0.44	0.23
Land Cost	0.44	0.35	0.82
Utilities	0.13	0.01	0.38
Other	0.00	0.00	0.05
Total Variable Cost	1.80	1.95	2.84

Farm A had a variable cost of $1.80 per bushel, Farm C had $1.95, and Farm C $2.84. Farm C had the highest variable cost with land, utilities and fertilizer being the highest expenses. Farm A had the lowest variable costs for corn production. This was achieved by having lower labor and chemical costs. Farm B had the highest machinery costs at $0.44 per bushel. The difference between Farm C and Farm A was $1.04 per bushel (Figure 6.6).

Table 6.8: Corn Enterprise Fixed Costs of Production, (dollars per bushel)

	Farm A ($/bu)	Farm B ($/bu)	Farm C ($/bu)
Equipment	0.64	0.27	0.80
Interest & Insurance	0.15	0.10	0.14
Management Fees	0.07	0.07	0.07
General Overhead	0.16	0.06	0.04
Total Fixed Cost	1.02	0.50	1.05

Beyond the variable costs are the fixed costs of corn production. Farm A had a total fixed cost of $1.02 per bushel, Farm B had $0.50 per bushel, and Farm C had $1.05 per bushel. Farm C had the highest equipment costs at $0.80 per bushel. Farm A had the highest interest and insurance cost at $0.15 and the highest general overhead cost at $0.16 per bushel. The difference between Farm C and Farm B was $0.55 per bushel (Table 6.8).

Farm B was the lowest cost producer with a total cost per bushel of $2.45, followed by Farm A with $2.85 and Farm C at $3.89. From a total cost viewpoint all farms were not profitable in the production of corn. For Farm C, the losses more than

exceeded the total returns. These results raise the question of whether these farms should produce corn (Table 6.9).

Table 6.9: Corn Enterprise Total Revenue, Variable Cost, Fixed Costs and Net Return, (dollars per bushel)

	Farm A ($/bu)	Farm B ($/bu)	Farm C ($/bu)
Income per bushel	1.77	1.72	1.69
Total Variable Cost	1.80	1.95	2.84
Total Fixed Cost	1.02	0.50	1.05
Total Cost	2.82	2.45	3.89
Net Return	-1.05	-0.73	-2.20

6.4: Cost of Production for the Hay Enterprise

Hay revenue for these three farms is the price at harvest. The harvest price is the local price less the transportation cost to move the hay to market. Of the three farms, Farm C had the higher market price per ton at $105.06, highest yield at 5 ton per acre, and lowest hours per acre at 2.6. Farm B had a similar price of Farm C at $104.19 but

Table 6.10: Hay Enterprise Production Factors

	Farm A	Farm B	Farm C
Acres Production	48	208	250
Yield in Tons	4.5	3.7	5
Hours per Acre	3.19	7.31	2.60
Income per Ton	$88.24	$104.19	$105.06

had the lowest yield per acres at 3.7 and the highest hours per acre at 7.31. Farm B required 180 percent more hours per acre than Farm C and required 130 percent more than Farm A. Farm A had the lowest price per ton at $88.24 (Table 6.10).

Table 6.11: Hay Enterprise Variable Cost of Production, (dollars per ton)

	Farm A ($/ton)	Farm B ($/ton)	Farm C ($/ton)
Labor	9.05	21.32	6.22
Seeds	5.30	6.47	0.24
Fertilizer	8.80	9.34	6.93
Chemicals	1.00	0	2.56
Supplies	6.88	0	0
Machinery	15.46	10.34	4.02
Custom Hire	0	0	13.91
Land Costs	11.21	14.88	20.00
Utilities	1.13	0.48	0.38
Interest (Operating)	2.45	2.56	2.65
Other (Innoculant)	0.03	0	0
Total Variable Cost	61.31	65.39	56.91

Farm B had the highest total variable cost of $65.39 per ton, Farm A had $61.31, and Farm C had $56.91. Farm B had the highest labor cost at $21.32, seed cost at $6.47, and the highest fertilizer cost at $9.34. Farm C had the highest custom hire cost at $13.91, chemical cost at $2.56, interest cost at $2.65, and the highest land cost at $20.00,

but the lowest total variable costs at $56.91. Farm A had the highest machinery cost at $15.46 with the lowest land costs at $11.21 and lowest interest cost at $2.45 (Table 6.11).

Farm A had the highest hay total fixed cost of production at $45.48 per ton, Farm B had $29.85 and Farm C had $27.63 per ton. Farm A had the highest equipment cost at $32.93 and highest general overhead cost at $7.82 per ton. Farm C had the lowest equipment costs at $19.30, lowest general overhead cost at $2.67, and the highest management fees at $ 4.20, but had the lowest total fixed cost at $27.63. Farm B's total fixed cost were $29.85 (Table 6.12).

Table 6.12: Hay Enterprise Fixed Costs of Production, (dollars per ton)

	Farm A ($/ton)	Farm B $/ton)	Farm C $/ton)
Equipment	32.93	21.20	19.30
Interest & Insurance	1.20	0.95	1.46
Management Fees	3.53	4.17	4.20
General Overhead	7.82	3.53	2.67
Total Fixed Cost	45.48	29.85	27.63

Farm C was the lowest cost hay producer with a total cost per ton of $84.54, Farm B was next at $95.24 per ton and Farm A at $106.79. Farm B and Farm C covered all costs and had positive returns of $8.95 and $20.52, respectively. Farm A had the highest total costs for hay production and was not profitable with a negative net return of $18.55 (Table 6.13).

Table 6.13: Hay Enterprise Total Revenue, Variable Cost, Fixed Cost and Net Return, (dollars per ton)

	Farm A ($/ton)	Farm B ($/ton)	Farm C ($/ton)
Income per Ton	88.24	104.19	105.06
Total Variable Cost	61.31	65.39	56.91
Total Fixed Cost	45.48	29.85	27.63
Total Cost	106.79	95.24	84.54
Net Return	-18.55	8.95	20.52

6.5 Cost of Production for the Heifer Enterprise

To calculate the cost of production of the heifer enterprise and adjust for the different lengths of time before a heifer enters the milking herd, "heifer-months" are used as the unit of production. A "heifer-months" are the total number of months all heifers have accumulated in the heifer enterprise (e.g., if a heifer has been in the heifer enterprise 24 months, its unit would be 24). Farm C had total "heifer-months" at 2,651 and Farm B had very similar total "heifer-months" at 2,604. However, Farm C had an average

Table 6.14: Heifer Enterprise Production Factors

	Farm A	Farm B	Farm C
Heifer-Months	306	2604	2651
Average Number Heifers	20	47	133
Hours per Heifer-Month	0.80	1.01	0.70

number of heifers at 133 while Farm B had an average number of heifers at 47. Farm C had the lowest labor hours per "heifer-month" at 0.70 and Farm B had the highest hours per "heifer-month" at 1.01 (Table 6.14).

Next are the "heifer-month" variable costs which are in dollars per "heifer-month". Farm B had the lowest total variable cost at $42.27 per "heifer-month" followed by Farm A at $56.58 and Farm C at $74.78. Farm C had the highest total variable cost with the highest costs being; feed costs at $48.62, custom hire at $9.30, and labor at

Table 6.15 Heifer Enterprise Variable Cost of Production, (dollars per heifer month)

	Farm A ($/heifer-month)	Farm B ($/heifer-month)	Farm C ($/heifer-month)
Labor	8.85	10.74	8.75
Repairs	0	0.16	0.09
Feed	30.15	24.35	48.62
Custom Hire	0	0	9.30
Supplies & Bedding	3.26	2.30	2.07
Building & Imp.	3.36	0.32	0.09
Utilities	4.38	0.99	1.96
Breeding	3.06	0.50	0.96
Veterinary & Med.	1.08	0.82	1.43
Equipment	1.75	1.96	1.32
Other	0.70	0.11	0.20
Total Variable Cost	56.58	42.27	74.78

$8.75. Farm B's highest costs were labor at $10.74, supplies and bedding at $2.30, and equipment at $1.96. Farm A had some of the highest variable costs which were supplies & bedding at $3.26, utilities cost at $4.38, breeding cost at $3.06, building & improvement cost at $3.36, and other cost at $0.70 (Table 6.15).

The total fixed costs of production for the heifer enterprise are Farm A at $24.01 per "heifer-month", Farm B at $11.86, and Farm C at $19.20. The lowest fixed cost of production was Farm B at $11.86, which had the lowest fixed cost for all categories. Farm A had the highest cost at $24.01, with all categories being the highest except building & improvement cost at $6.02. Farm C had the highest building & improvement cost at $6.86 (Table 6.16).

Table 6.16: Heifer Enterprise Fixed Cost of Production, (dollars per heifer month)

	Farm A ($/heifer-month)	Farm B ($/heifer-month)	Farm C ($/heifer-month)
Equipment & Mach.	4.80	3.72	4.43
Interest & Insurance	8.08	2.86	6.01
Building & Imp	6.02	4.10	6.86
Management Fees	1.59	0.64	1.16
General Overhead	3.52	0.54	0.74
Total Fixed Cost	24.01	11.86	19.20

The total "heifer-month" costs, variable and fixed, were Farm A at $80.59, Farm B at $54.13 and Farm C at $93.98. Farm B had the lowest heifer cost of production at $54.13, with both variable and fixed being the lowest at $42.27 and $11.86, respectfully.

Farm C had the highest cost at $93.98 per heifer month, with variable costs being the highest of all three farms (Table 6.17).

Table 6.17: Heifer Enterprise Total Cost, Variable Cost and Fixed Cost, (dollars per heifer month)

	Farm A ($/heifer/month)	Farm B ($/heifer/month)	Farm C ($/heifer/month)
Total Variable Cost	56.58	42.27	74.78
Total Fixed Cost	24.01	11.86	19.20
Total Cost	80.59	54.13	93.98

6.6: Conclusions

Three different size farm operations were used in this comparative analysis and the strengths and weaknesses have been noted for the different enterprises; milk production, corn production, hay production and heifer production. The results were somewhat contrary to the expected outcome in relationship to the size of the farm operation (e.g., the smallest operation did have the highest milk production per cow but not the highest milk price and the largest operation did not have the highest total revenues but the lowest).

The milk production enterprise final results were Farm B had the highest net returns ($2.35 per hundredweight) from the highest total revenues less the lowest total costs. Farm C's results were just the opposite with the lowest net returns, (-$1.40 per hundredweight) from the average total revenues less the highest total costs. Farm A fell between the two extremes with net returns ($1.05 per hundredweight) from just less than the average total revenues less the average total costs.

The corn production enterprise results were that all three farm operations did not have positive net returns on corn production and total income per bushel was less than total costs in all farm operations. These farms may have been better off not producing corn.

The hay production enterprise results were that Farm C had the highest net returns ($20.52 per ton) from the highest income per ton less the lowest total costs. Farm B was next with net returns ($8.95 per ton) and Farm A had the lowest net return (-$18.55 per ton) from the lowest income per ton and the highest total costs.

The heifer production enterprise results were, Farm B had the lowest total costs ($54.13 per heifer-month), Farm A was next with total costs ($80.59 per heifer-month) and Farm C's total costs were ($93.98 per heifer-month).

Chapter 7

Summary

This study focused on the use of enterprise analysis to evaluate the profitability of eight Michigan dairy farm operations. To conduct enterprise analysis, extensive data are required. Data collected in this project included financial transactions, inventories, use of shared resources (e.g., labor, machinery and farm produced feeds) and production figures. Enterprise accounting indicates which enterprises were profitable and which ones are not. To use an analogy, enterprise accounting is looking at the trees in a forest and the trees are the individual components that comprise the forest. By knowing which trees are healthy and which are not, it is possible to take appropriate actions to improve the health of the forest.

7.1: Cost of Capital Summary

Opportunity cost is a key economic principle used in enterprise accounting. This principle was used in defining the cost of capital for the business and allocating capital cost to the various enterprises. In determining the cost of capital, the goal was to estimate a risk adjusted cost of capital for each farm business. Risk adjusted cost of capital is based on the farm debt structure and the risk premium for the industry

The process for estimating a risk adjusted cost of capital started with determining a risk premium for dairy farms. Using historical TelFarm data from dairy operations the industry risk premium was determined to be four percent. The second adjustment relates to debt levels of the farm. The higher the debt level, the greater the business risk and the higher interest rate paid by the business. Adding the risk premium of the industry and the

risk factor for the debt level of the farm to the cost of risk-free Treasury Bills, a cost of equity capital could be defined for each farm.

This cost of equity capital was used to calculate a weighted average cost of capital (WACC), which considers the level of equity and borrowed capital and cost of each of these capital resources. A WACC was required since all farms in this study had some degree of debt. The WACC highest estimate was 0.1037 percent and the lowest estimate was 0.0816 percent.

7.2: Comparative Analysis Summary

A comparative analysis was conducted on three of the farms in the study. These three farms illustrate the importance of enterprise analysis in making management decisions. Farm B had the highest net return for three enterprises and the lowest cost on the heifer enterprise (Table 7.1). Farm C was the opposite of Farm B with the lowest net return on the three enterprises and the highest cost on the heifer enterprise. Farm A fell between Farm B and Farm C, with positive net returns on the dairy enterprise, but with losses in both the corn and hay enterprise, and next to the highest cost for the heifer enterprise.

The dairy enterprise for the three farms covered both variable costs and fixed costs with the exception of Farm C, which did not cover fixed costs. Since dairy was the primary enterprise of these farms, Farm B was the best positioned to remain competitive in the long run because of good cost controls and high returns. The future for Farm C in the dairy business was of some concern. Unless this farm was better able to control key costs such as feed expenses and heifer replacement expenses, it likely struggled financially.

The corn enterprise did not fair well on any of these farms. None of the farms covered either variable and fixed costs. The corn enterprise was not a profitable enterprise and these farms should look for alternatives for meeting their grain needs.

For the hay enterprise, the farms covered variable costs and fixed costs with the exception of Farm A, which did not cover fixed cost. Considering the need for hay roughage on these farms, hay should remain as part of the enterprise mix.

The heifer enterprise showed that to raise a heifer for 24 months, the lowest cost was $1,300 and the highest cost was $2,256. Across the three farms the cost to raise a heifer exceeded the cost of purchasing a heifer. These farms should consider alternatives to raising heifers such as contracting the raising of heifers.

Table 7.1 Net Return for Dairy, Corn, and Hay Enterprise and Total Cost of the Heifer Enterprises

	Farm A	Farm B	Farm C
Dairy enterprise Net Return	$1.05/cwt	$2.35/cwt	-$1.40/cwt
Corn Enterprise Net Return	-$1.05/bu	-$0.73/bu	-$2.20/bu
Hay Enterprise Net Return	-$18.55/ton	$8.95/ton	$20.52/ton
Heifer Enterprise Total Cost	$80.59/heifer-month	$54.13/heifer-month	$93.98/heifer-month

In doing comparative analysis, several propositions were supported:

(1) Farms with high labor costs were less profitable.

(2) Farms with high heifer replacement costs were less profitable.

(3) Fixed costs were higher for smaller farms and net returns were lower because of economics of scale.

7.3: Suggestions for Future Enterprise Accounting

If this type of research is to be conducted in the future there is a need to find more efficient means to collect data. For example, the supplemental physical data records (SPDR) were difficult to maintain by project participants. Entering the data daily on SPDR sheets was the most neglected and disliked task of record keeping for project participants.

From a research viewpoint it should be noted that the farm sample size was small for this project and was biased toward managers who were willing to keep detailed and time consuming records. Thus, the results presented are likely to reflect that of better managed farms. Future research must find easier methods for data collection while maintaining data accuracy. These methods will entice a more representative pool of farmers to participate in the project.

Finally, since doing enterprise accounting is a very time consuming and information intensive process; managers should become fully familiar with the process before implementing the system. Furthermore, annual enterprise accounting may not be required. It might be possible to use enterprise accounting every few years to obtain the knowledge for making adjustments in the business.

Appendix A

Supplement Physical Data Records

Cattle Labor and Machinery Use:							
Name:_____	ID #:_____				Week of:_____		
	Sun	Mon	Tue	Wed	Thur	Fri	Sat
Cows (5110)							
Milking							
Feeding							
9312 Tractor/9352 Feeding Eqpt.							
Scraping							
9316 Skid Steer							
Hauling Manure							
9313 Tractor/9360 Manure Eqpt.							
9316 Skid Steer							
Heifers (5120)							
Feeding							
9312 Tractor/9352 Feeding Eqpt.							
Scraping							
9316 Skid Steer							
Hauling Manure							
9313 Tractor/9360 Manure Eqpt.							
9316 Skid Steer							
Office(9830)							
9392 Office Eqpt.							
Other Activities							

Supplement Physical Data Records

Crop Labor and Machinery Use							
Name:_____	ID #:_____				Week of:_____		
	Sun	Mon	Tue	Wed	Thur	Fri	Sat
Hay (3301)							
9322							
9323							
9324							
Haylage (3300)							
9322							
9324							
Corn (3118)							
9321							
9324							
9331							
Corn Silage (3110)							
9322							
9324							
Oats (3136)							
9321							
9324							
Soybeans (3268)							
9321							
9324							
9331							
Wheat (3172)							
9321							
9323							

Labor and Machinery Use:							
Name:_____	ID #:_____				Week of:_____		
	Sun	Mon	Tue	Wed	Thur	Fri	Sat
Fix/Repair...							
Tractors							
9311 AC WD-45							
9312 JD 2555 or JD 2640							
9313 JD 4240 or JD 7800							
Harvesting Equipment							
9321 Combines							
9322 Forage Chopper							
9323 Baler							
9324 Other Forage Eqpt.							
Other Cropping Equipment							
9331 Gen'l Tillage							
9332 Row Crop Eqpt.							
9333 Drill							
9334 Field Sprayer							
Trucks							
9341 Pickups							
9342 Straight Trucks							
Livestock Equipment							
9351 Milking Eqpt.							
9352 Feeding Eqpt.							
9360 Manure Eqpt.							
Dairy Facilities							
9411 Milking Facilities							
9412 Milking Herd Housing							
9413 Heifer Housing							
Other Eqpt. (Specify)							

Appendix B

Michigan Hay Prices 1998

Hay Prices for 1998

USDA-NASS Michigan Agricultural Statistics 1998-1999

Month	All Hay (ton)	Alfalfa (ton)
January	$108.00	$110.00
February	$102.00	$105.00
March	$98.00	$100.00
April	$99.00	$105.00
May	$101.00	$95.00
June	$93.00	$90.00
July	$81.00	$80.00
August	$92.00	$82.00
September	$93.00	$87.00
October	$92.00	$87.00
November	$97.00	$91.00
December	$86.00	$88.00
Average	$95.17	$93.33

Appendix C

Corn Prices 1998

Corn Prices 1998

Michigan Grain Elevator Locations

Data	Breckenridge	Hamilton	Jonesville	Saginaw	Webberville
7-Jan	$2.48	$2.50	$2.51	$2.58	$2.53
14-Jan	$2.49	$2.52	$2.52	$2.59	$2.61
21-Jan	$2.48	$2.50	$2.51	$2.58	$2.53
28-Jan	$2.49	$2.52	$2.52	$2.59	$2.61
4-Feb	$2.42	$2.49	$2.47	$2.54	$2.56
12-Feb	$2.38	$2.42	$2.40	$2.50	$2.52
18-Feb	$2.39	$2.42	$2.40	$2.49	$2.51
25-Feb	$2.36	$2.43	$2.39	$2.47	$2.49
4-Mar	$2.41	$2.45	$2.44	$2.51	$2.53
11-Mar	$2.48	$2.52	$2.52	$2.58	$2.60
18-Mar	$2.38	$2.42	$2.43	$2.48	$2.50
25-Mar	$2.31	$2.36	$2.37	$2.41	$2.43
1-Apr	$2.24	$2.40	$2.28	$2.32	$2.34
8-Apr	$2.17	$2.30	$2.22	$2.29	$2.29
15-Apr	$2.23	$2.23	$2.26	$2.33	$2.35
22-Apr	$2.18	$2.22	$2.21	$2.31	$2.31
29-Apr	$2.18	$2.24	$2.20	$2.24	$2.30
6-May	$2.27	$2.29	$2.29	$2.39	$2.42
13-May	$2.17	$2.17	$2.17	$2.28	$2.30
20-May	$2.16	$2.19	$2.15	$2.27	$2.29
28-May	$2.06	$2.16	$2.08	$2.17	$2.19
3-Jun	$2.10	$2.21	$2.11	$2.19	$2.21
10-Jun	$2.00	$2.15	$2.07	$2.14	$2.16
17-Jun	$2.06	$2.22	$2.13	$2.20	$2.22
24-Jun	$2.28	$2.30	$2.34	$2.38	$2.40
1-Jul	$2.08	$2.18	$2.13	$2.17	$2.19
8-Jul	$2.11	$2.22	$2.16	$2.22	$2.24
15-Jul	$1.91	$2.06	$2.02	$2.06	$2.08
22-Jul	$1.92	$2.04	$2.03	$2.05	$2.08
29-Jul	$1.85	$1.99	$1.92	$1.97	$2.00
5-Aug	$1.76	$1.91	$1.85	$1.88	$1.91
12-Aug	$1.74	$1.88	$1.82	$1.86	$1.89
19-Aug	$1.74	$1.89	$1.83	$1.86	$1.89
26-Aug	$1.63	$1.77	$1.68	$1.77	$1.80
2-Sep	$1.58	$1.75	$1.62	$1.75	$1.78
9-Sep	$1.67	$1.81	$1.69	$1.81	$1.80
16-Sep	$1.68	$1.77	$1.67	$1.76	$1.78
23-Sep	$1.65	$1.74	$1.66	$1.75	$1.75
30-Sep	$1.69	$1.77	$1.69	$1.73	$1.79
7-Oct	$1.79	$1.82	$1.77	$1.81	$1.86
14-Oct	$1.90	$1.98	$1.87	$1.94	$1.99

21-Oct	$1.80	$1.87	$1.79	$1.87	$1.88
29-Oct	$1.77	$1.89	$1.70	$1.80	$1.80
4-Nov	$1.72	$1.82	$1.68	$1.80	$1.82
11-Nov	$1.82	$1.92	$1.95	$1.90	$1.92
18-Nov	$1.83	$1.91	$1.84	$1.91	$1.95
24-Nov	$1.80	$1.92	$1.85	$1.92	$1.96
2-Dec	$1.85	$1.88	$1.85	$1.92	$1.97
9-Dec	$1.84	$1.87	$1.85	$1.94	$1.98
16-Dec	$1.86	$1.96	$1.90	$1.99	$2.03
23-Dec	$1.85	$1.92	$1.88	$1.95	$1.99
30-Dec	$1.84	$1.92	$1.89	$1.95	$1.99
Average	**$2.01**	**$2.09**	**$2.04**	**$2.11**	**$2.16**

Appendix D

Soybean Prices 1998

Soybean Prices 1998

Michigan Grain Elevator Locations

Data	Breckenridge	Hamilton	Jonesville	Saginaw	Webberville
7-Jan	$6.45	$6.45	$6.57	$6.61	$6.41
14-Jan	$6.48	$6.49	$6.56	$6.60	$6.42
21-Jan	$6.49	$6.52	$6.55	$6.60	$6.55
28-Jan	$6.49	$6.56	$6.55	$6.61	$6.64
4-Feb	$6.49	$6.62	$6.56	$6.61	$6.64
12-Feb	$6.48	$6.59	$6.54	$6.60	$6.63
18-Feb	$6.55	$6.54	$6.45	$6.55	$6.57
25-Feb	$6.25	$6.34	$6.30	$6.38	$6.40
4-Mar	$6.17	$6.32	$6.27	$6.33	$6.35
11-Mar	$6.36	$6.46	$6.47	$6.54	$6.56
18-Mar	$6.24	$6.30	$6.32	$6.38	$6.40
25-Mar	$6.19	$6.26	$6.25	$6.33	$6.35
1-Apr	$6.11	$6.24	$6.20	$6.25	$6.27
8-Apr	$5.99	$9.16	$6.10	$6.17	$6.17
15-Apr	$6.11	$6.06	$6.18	$6.25	$6.25
22-Apr	$6.12	$6.17	$6.20	$6.26	$6.28
29-Apr	$6.17	$6.20	$6.23	$6.29	$6.31
6-May	$6.26	$6.26	$6.37	$6.43	$6.45
13-May	$6.18	$6.18	$6.29	$6.37	$6.39
20-May	$6.18	$6.24	$6.24	$6.33	$6.35
28-May	$5.91	$6.04	$5.99	$6.06	$6.12
3-Jun	$5.88	$6.07	$6.03	$6.08	$6.14
10-Jun	$5.87	$6.04	$5.99	$6.05	$6.11
17-Jun	$5.91	$6.07	$6.02	$6.09	$6.15
24-Jun	$6.44	$6.54	$6.58	$6.59	$6.64
1-Jul	$6.16	$6.09	$6.17	$6.21	$6.26
8-Jul	$6.24	$6.32	$6.36	$6.37	$6.42
15-Jul	$5.69	$6.09	$6.08	$6.13	$6.18
22-Jul	$5.90	$6.09	$6.02	$6.03	$6.08
29-Jul	$5.72	$5.91	$5.85	$5.79	$5.84
5-Aug	$5.35	$5.57	$5.48	$5.46	$5.49
12-Aug	$5.17	$5.34	$5.33	$5.33	$5.36
19-Aug	$5.28	$5.38	$5.37	$5.28	$5.33
26-Aug	$5.03	$5.14	$5.22	$5.15	$5.15
2-Sep	$4.96	$5.11	$5.21	$5.13	$5.13
9-Sep	$4.92	$5.16	$5.17	$5.07	$5.07
16-Sep	$4.82	$4.94	$5.06	$5.06	$5.11
23-Sep	$4.82	$4.91	$4.88	$5.06	$5.06
30-Sep	$4.79	$4.86	$4.79	$4.86	$4.87
7-Oct	$4.94	$4.93	$4.90	$4.98	$4.99
14-Oct	$5.15	$5.11	$5.14	$5.22	$5.23

21-Oct	$5.15	$5.09	$5.10	$5.21	$5.22
29-Oct	$5.11	$5.07	$5.07	$5.12	$5.15
4-Nov	$5.11	$5.17	$5.07	$5.15	$5.20
11-Nov	$5.36	$5.36	$5.35	$5.39	$5.44
18-Nov	$5.34	$5.47	$5.40	$5.47	$5.47
24-Nov	$5.20	$5.33	$5.30	$5.35	$5.45
2-Dec	$5.40	$5.57	$5.46	$5.52	$5.61
9-Dec	$5.24	$5.44	$5.36	$5.36	$5.45
16-Dec	$5.14	$5.33	$5.25	$5.27	$5.34
23-Dec	$5.10	$5.25	$5.20	$5.20	$5.27
30-Dec	$5.08	$5.23	$5.20	$5.20	$5.27
Average	**$5.68**	**$5.85**	**$5.77**	**$5.81**	**$5.88**

Appendix E

Enterprise Accounts

Profit Centers

- Livestock
  - Dairy
    - 5110 Milking Herd
    - 5120 Replacement Heifers
    - 5119 Dairy Assets Account
    - 5129 Custom Raised Heifers
    - 5150 Bulls
    - 9112 Purebred Dairy Business
  - Swine
    - 5310 Sows and Breeding Stock
    - 5370 Feeder Pigs
    - 5380 Market Hogs
  - Beef
    - 5210 Cows and Calves
    - 5220 Beef Heifers
    - 5290 Feeder Beef
    - 5250 Bulls
  - Other Livestock
    - 5600 Horses
    - 8200 Sheep
    - 8246 Poultry
- Crops
  - Forage Crops
    - 3119 Corn Silage
    - 3301 Hay Baled
    - 3300 Haylage
    - 3399 Miscellaneous Forage
  - Feed Crops
    - 3118 Corn
    - 3136 Oats
  - Cash Crops
    - 3268 Soybeans
    - 3206 Field Beans
    - 3552 Sugar Beets
    - 3172 Wheat
    - 3800 Fruits
    - 3600 Vegetables
    - 3150 Rye
- Other Income
  - 9290 Government Program Payments
  - 9291 Milk Marketing

9294 Investments (Hedging, 401K, IRA, etc)
9295 Personal (e.g. stocks in FCS, MMPA, etc.)
9296 Other Sales (e.g., sand, timber, etc.)
9297 Custom Services
9299 Consulting

Cost Centers

Machinery and Equipment

Tractors

9311 Tractors Small (e.g. 10 - 50 HP)
9312 Tractors Medium (e.g. 51 - 100 HP)
9313 Tractors Medium to Large (e.g. 100 - 150 HP)
9314 Tractors Large (e.g. 151 - 250 HP)
9315 Tractors Very Large (e.g. 250 + HP)
9316 Tractors Specialty (e.g., crawler, skid steer)
9319 Other Farm Tractors

Harvesting Equipment

9321 Combine
9322 Forage Chopper
9323 Baler
9324 Other Forage Equipment

Other Cropping Equipment

9331 General Tillage (e.g. plow, disk, field cultivator, etc.)
9332 Row Crop (e.g. planter, row cultivator, etc.)
9333 Grain Drill
9334 Field Sprayer
9335 Orchard Sprayer
9336 Irrigation Equipment

Trucks

9341 Pickups
9342 Straight Trucks
9343 Large Trucks (e.g., semi-tractor trailer)

Livestock Equipment

9351 Milking Equipment
9352 Feeding Equipment
9359 Other Livestock Equipment
9360 Manure Equipment
9370 Storage and Marketing Equipment

General Purpose Equipment

9391 Shop Equipment
9392 Office Equipment
9399 Other Miscellaneous Equipment (e.g. running gears)

Facilities

9411 Milking Barn
9412 Milking Herd Housing
9413 Replacement Heifer Housing

9420 Other Livestock Facility
9430 Crop Storage Facility
9440 Manure Storage Facility
9450 Machine Shed Storage and Shop Facility

Real Estate
9510 Cropland
9520 Pasture
9530 Timber (Woodlands)
9580 Rental Property

Storage and Marketing Accounts
9610 Forages Storage and Marketing
9620 Grains Storage and Marketing
9630 Others Storage and Marketing

Allocation Accounts
9710 Feed
9720 Fertilizer
9730 Crop supplies

Labor
9741 Manager/Owner
9742 Salary
9743 Seasonal
9744 Unpaid Family
9745 General Labor Insurance and Withholdings
9746 Other Specific Labor

9750 Maintenance and Special Crops
9760 Utilities
9770 Fuel and Lubricants
9780 Livestock Supplies
9790 Manure

Overhead Accounts
9810 Taxes
9820 Insurances
9830 General Overhead
9840 Interest
9850 Shop and General Repairs

Special Enterprise Closing Accounts
9899 Limited Liability Corporation (LLC)
9901 Cash
9902 Net Worth
9999 Special Account (Unclassified)
???? Loss and Gain Account

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