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Financial survivability of beginning dairy farms : a simulation of Tennessee dairies

David Allen Yates

To the Graduate Council:

I am submitting herewith a thesis written by David Allen Yates entitled "Financial survivability of beginning dairy farms : a simulation of Tennessee dairies." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Kimberly L. Jensen, Major Professor

We have read this thesis and recommend its acceptance:

John Brooker, Larry VanTassell

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Date November 30, 1989

FINANCIAL SURVIVABILITY OF BEGINNING DAIRY FARMS: A SIMULATION OF TENNESSEE DAIRIES

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

David Allen Yates

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ABSTRACT

Economic survivability of the farm operation continues to be a problem in agricultural. The dairy operation has a large financial strain on beginning resources in order for the farm enterprise to survive and be an economic success. This study used FLIPSIM, a farm level simulation model, to determine the impact of a farmer's beginning ratio of equity to assets and beginning level of annual milk production on the financial success of a beginning dairy enterprise.

FLIPSIM, a recursive farm-level model which can be run stochastically, was chosen for the simulation study. FLIPSIM simulates the production, marketing, and financial management of a farm over a specified planning horizon. The model is stochastic in that crop yields and prices and milk and cow prices were assumed to follow a mulitvariate empirical distribution.

Data needed for the simulation model were collected from various sources. A 1988 survey of Tennessee beginning dairy farmers was used as the base data. The survey data was supplemented by data from various farm production records, budgets, and state and national statistics. The combination of information from these sources is used for FLIPSIM to simulate conditions faced by a representative farm.

Under the conditions of this study, beginning equity and milk production levels of 35 percent and 10,000 - 12,000 pounds, 50 percent equity and 10,000 - 12,000 pounds, and 20 percent equity and 14,000 - 16,000 pounds proved to be the most economically successful. The two remaining scenarios of 20 percent equity and 10,000 - 12,000 pounds milk production and 20 percent equity and 12,000 - 14,000 pounds milk

production represent the beginning farmer, with a low equity ratio and few or no years of dairy experience. Of these two scenarios, the higher milk production level allows the farm a greater probability of survival and economic success.

It appears that under the conditions assumed in this study, a beginning diary farmer has a high probability of survival and being an economic success. Even with the lowest equity level and milk production level assumed, the farm has a better than 60 percent chance it will survive and be an economic success.

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PROBLEM AND OBJECTIVES OF THE STUDY

Introduction

The dairy industry in Tennessee has undergone some major structural changes in recent years that have tended to accentuate the crucial role of beginning dairy farmers to the future of the dairy industry in Tennessee. Between 1980 and 1987, the number of farms in Tennessee with Grade A milk permits decreased by 34.8 percent (Tennessee Dairy Statistics; Tennessee Agricultural Statistics). A number of issues have contributed to the trend of declining dairy farm numbers including technological and production changes, as well as marketing conditions and the Whole Herd Buyout Program. Slightly less than 10 percent of the licensed dairies in the state, for example, were removed by the Buyout program in 1985-1986 (Tennessee Dairy Statistics). While the average size of dairy operations increased in the 1980's, total milk production remained fairly stable. As a result, Tennessee often faced milk production deficits (Tennessee Agricultural Statistics). A 1983 survey also indicated that dairy operators in Tennessee tended to be more established and older than dairy operators in other states within the Southern region (Carley), thereby further accentuating the role of beginning dairy farmers in the dairy industry in Tennessee.

Today's beginning dairy farmers face special financing needs, varying experience levels, different sizes of operation, varying growth patterns of the farm, and family demands. Of primary concern to many beginning farmers is the financial survivability of the business. Financially, beginning dairy farmers have two major concerns; how to finance the large capital expenses to first start a dairy operation, and after establishing the operation, how to keep it financially viable.

The extensive financial requirements of beginning dairy farmers are one of the most limiting barriers to entry. It has been established by Shoemaker, Forster, and Erven that high levels of capital are required by today's farm firm. In a simulation model developed by Grisley and Grady, results indicate that under the most favorable circumstance an owner-operator of a dairy farm would need $71,575 in starting equity to be financially solvent at the end of a five-year period. Few beginning farmers have capital funds of this scope. The ability to obtain a loan is therefore of crucial importance.

Interest rate levels at the time a farmer enters dairying are of great importance. During periods of lower interest rates farmers can more easily service larger loans, making the financing issue less prohibitive for a beginning farmer. In the past 10 years, the average interest rate in the Appalachian region for all types of farm loans rose to a high of 10.2 percent in 1983 and 1984, with the rate dropping to 8.8 percent in 1987 (Agricultural Statistics, 1988). Indications in the financial community point to a rise in this rate, with the prime interest rate recently increasing to 11.5 percent (Federal Reserve Bulletin, March 1989). As this occurs, the debt load that many beginning farmers can carry may be reduced, decreasing the amount of starting capital the farmer can obtain from lending institutions.

Once capital is obtained and the dairy operation is started, the beginning farmer must concentrate his or her efforts to keep it financially viable. Evidence suggests that in 1985, 20 to 30 percent of the nation's farmers had financial problems (Grisley). The Appalachian region, which includes Tennessee, Kentucky, West Virginia, Virginia, and North Carolina, had 13,536 farms in financial trouble in 1984. Nationwide, 41,524 dairy farms were in financial stress that same year (Farmline, 1985). Farms in financial trouble were defined as farms with negative cash flows and debt to asset ratios of 40 percent and above.

As financial conditions in the farming community have been characterized by rising interest rates and higher operating costs (LaDue; Sonka, Dixon, and Jones), the threat of bankruptcy has become a reality for some beginning farmers. For operators to survive financially during the beginning years of the farm's operation, they must use sound financial practices, maintain a favorable debt to asset ratio, and be aware and informed of the surrounding financial environment.

Statement of the Problem

As financial barriers to entry and the beginning economic survivability of the farm operation continue to be a problem, fewer new operators will enter agriculture. This concern is especially true in the dairy industry, where farmers can have not only high fixed costs, but high operating costs in the beginning years of operating the farm. Data from an eight county Wisconsin area revealed that debt to asset ratios for dairy farms ranged from .40 for low viability farms to .08 for high viability farms. For full-time nondairy farms with sales of at least $20,000, debt to asset ratios ranged from 0.29 for low viability farms to 0.06 for high viability farms (Salant and Saupe). The net entry of young farm operators on commercial sized farms (farms with sales of at least $20,000) declined by about 40 percent between 1974 and 1982 (Smith). With few operators entering agriculture, the net effect will be fewer total farmers, each having intensive large-scale operations (Smith; Matulich). This only re-emphasizes the difficulties of beginning dairy farmers. As larger scale operations become commonplace, the amount of beginning capital required by young farmers will increase. The trends in agriculture only serve to emphasize that for most beginning farmers to acquire the needed equity funds, these funds must typically come through inheritance or marriage (Grisley and Grady).

As the amount of beginning equity for the establishment of a dairy operation increases, the minimum equity requirements for success becomes an increasing concern. A major contributing factor in determining the financial success or failure of a dairy enterprise is the ratio of equity to assets the farmer has. As the level of equity of the operation drops, so does the probability that the farm operation will be financially successful.

Another factor that can significantly impact the financial success of a beginning dairy enterprise is the operation's level of milk production. With a lower level of annual milk production per cow, the likelihood that the farm will make an economic profit is greatly reduced, compared with an operation which starts out with a higher milk production per cow and efficiently increases production from that point.

Objectives of the Study

In light of the problems facing beginning dairy farmers today, the question exists as to what financial conditions and production levels are necessary for farm survival on a Tennessee dairy. The objectives of the study are therefore:

a) to ascertain the effects of various beginning equity levels on the financial viability of beginning dairy farms, and

b) to determine the effects of a change in the annual average milk production per cow upon the financial viability of starting and continuing a dairy operation.

Review of the Literature

Researchers have found several financial, production, marketing, and demographic characteristics that set beginning farmers and their problems apart from the general farming population. These characteristics stem from the beginning farmers' special financing needs, experience levels, size of operations, growth patterns, and family demands.

Boehlje (1973) suggested that several characteristics of the agricultural sector make entry problems particularly severe. These characteristics include: 1) increasing capital requirements of farm production, 2) illiquid capital requirements, and 3) sole proprietor ownership, where the management and financial functions are transferred from one generation to another. Bohannon, in a case study of the entry methods of 39 dairymen from Middle and East Tennessee, concluded that factors affecting the origination and progression of farm firms are: 1) assistance from external sources, 2) external circumstances surrounding farm entry, and 3) managerial capabilities of the beginning farmer. Hottel and Berry noted increasing capital costs, increasing operation size, and the increasing necessity of adopting new technologies as significant barriers to entry. Similar problems were also suggested by LaDue.

Hottel and Berry noted that the age distribution of farmers indicated an increase in the relative number of farmers under age 35. They also found that from 1970 to 1976, the number of young persons (ages 16 to 34) self-employed in agriculture actually increased about one third, or approximately 94,000. Smith determined that there are three components to entry and exit of farms which determine the total number of farms. The first component, which is regular and predictable, is the aging and eventual retirement of current farmers. The second, which is more variable and often the subject of intense public interest and debate, is the early departure of established farmers. The third, often much less noticed, is the rate of entry of new farmers. Smith also noted that the current diminishing pool of farm-born youth from which to draw entrants, coupled with current recent financial distress in the farm sector and uncertainty about the future of agricultural policy, may further dampen farm entry.

Boehlje (1973) reported that, historically, many new entrants have moved into agriculture via the "agricultural ladder". Using this entry process, new entrants began their career as a hired hand and with hard work and savings, he or she accumulated enough funds to purchase some machinery. Afterward, the entrant became a renter, then part-owner of a farm, then finally full owner of a farm. He concluded that this "agricultural ladder" is no longer a viable source of new entrance, because it does not provide the financial and entrepreneurial training that is so important for a successful new entrant in today's agriculture.

Watzek found that about 80 percent of the beginning Indiana farmers he interviewed received family assistance to get started. A 1985 survey of Tennessee beginning dairy farmers indicated that entrance with family assistance was rated the most effective means of farm entry by beginning dairy farmers (Bohannon). In contrast Herr and Obrecht found, for a sample of grain farmers in Illinois and Missouri who had been farming for approximately three years, that only one-fifth had received a family inheritance or gift as part of their current wealth.

The U.S. dairy industry is moving towards large-scale production operations. Both farm and cow numbers have declined for herd sizes less than fifty cows and increased for herd sizes fifty cows or larger in an empirical analysis of long- and short-run costs (Matulich). Dairying in Tennessee is consistent with the national trend of a declining number of dairy farms and increasing average herd size (Haden and Johnson). As these trends occur, it becomes more difficult for a beginning dairy farmer to obtain enough starting capital to begin an operation. As virtually debt-free farmers retire and are replaced by new entrants with small equities in their businesses, the proportion of farmers carrying heavy debt loads will increase (Penson and Duncan).

In a firm level simulation model used to analyze different farm alternatives over a five-year period, Grisley and Grady concluded that difficulty of entry is directly related to the initial level of equity funds held by beginning farmers, their access to debt funds at reasonable rates and terms, and the general profitability of milk production.

The financial investment required to purchase a farm has increased significantly during the last 30 years, making it difficult for the average farmer to meet the payment required on a low equity farm (LaDue). In a survey of 1,161 dairy farm families in Wisconsin, Mississippi and Tennessee by Salant and Saupe, almost half of the farm families had low viability ratios, especially those who were younger and had recently entered farming. In the Appalachian area, 7.1 percent of dairy farms had a negative business cash income and a debt to asset ratio of more than 40 percent (Farmline, 1987). In the same survey, almost half of the surveyed 175,000 dairy farms reported some degree of financial hardship.

A major consideration during the entry stage of farming is maintaining a debt to equity structure that will guarantee survival of the firm during years of drought and/or low product prices (Boehlje, 1973). Haden and Johnson used logit regression in order to determine factors which led to an increased probability of obtaining positive returns to an operator's labor and management. They concluded that Tennessee dairy farmers' debt to asset ratios showed a positive relationship with the probability of success of the dairy farm operation when opportunity costs on owned capital and management's labor are taken into consideration. However, it had a negative influence on cash flow. Hanson and Thompson's use of a multiple linear regression to estimate rates of return found that financial leverage of debts to assets becomes less feasible as income fluctuations increase. The combination of wide fluctuations on income coupled with heavy debt-servicing commitments can also render the farm insolvent.

Debt carrying capacity of a dairy farmer is determined by three major factors: 1) profitability of the farm business, 2) ratio of long-term to short-term debt, and 3) interest rate and term of loan, with profitability of the farm business being the dominant of the three factors (Knoblauch). Additional factors which Knoblauch suggested that a manager must keep in mind when establishing debt capacity are: 1) a dairyman's ability to manage the business under increasing risk from higher debt levels, 2) variability in economic conditions, environmental factors affecting production and how the credit agency will "ride with one" in lean years, and 3) the magnitude of safety margins below the maximum debt carrying capacity to cover any unforeseen capital expenditures. Lines and Zulauf's polytomous multivariate logit regression determined that three significant discriminators in their study of 423 Ohio farm operators' debt to asset ratios were gross farm sales, operator's age, and the percent of land farmed that was owned. These findings suggest that in Ohio, financial stress as indicated by debt to asset ratio, is widespread across farm types and degree of farm family dependence of off-farm income. Also important to beginning dairy farmers is that most institutional lenders use collateral as a basis for making a loan, thus new entrants are effectively limited to family help or inheritance as a source of beginning capital (Boehlje and Thomas).

Another financing alternative available to beginning farmers is non-institutional lending. This type of credit is important to operators if institutional lenders encounter difficulties in serving their financial needs (Boehlje, 1981). Boehlje (1981) determined that the types of non-institutional loans are affected by interest rates. He found that rising interest rates encourage intra-family loans but discourage merchant and dealer loans. Other debt financing alternatives available to farm operators are leasing and off-farm equity capital (Penson and Duncan).

Milk production level of the dairy herd can also influence the ability of a farm operator to survive. Shoemaker, Forster, and Erven's simulated dairy farmers in east central Illinois and determined that financially troubled and/or beginning farmers must be able to produce at higher than average levels if they are to have a chance of survival. Grisley, using Pennsylvania Farmers Association annual records from 1979 and 1983, determined that a number of highly leveraged dairy farmers are efficient milk producers and could survive a financial crisis with a minimum of assistance.

While past studies have evaluated the influence of factors such as debt on survivability, Haden and Johnson's study of contributors of financial performance on selected Tennessee dairy farms used logit regression to determine factors which led to an increased probability of attaining positive returns to operator labor and management. This study of selected Tennessee dairy farms only examined factors that effect the probability of a farmer falling into a given category of returns to operator labor and management. The whole farm financial picture is not examined. Grisley and Grady's research of Pennsylvania and Northeast dairy farmers involved the use of Hutton and Hinman's firm simulation model, being modified to analyze different farm alternatives over a five-year period. Their study analyzed farm types using three levels of milk production, two sources of debt financing and three rental rates for cropland and buildings. By examining these different farms, Grisley and Grady evaluated the necessary level of starting equity needed by these farm types. They concluded that the necessary amount of beginning equity increased significantly when higher interest and rental rates were used.

CHAPTER 2

METHODOLOGY, DATA AND THE REPRESENTATIVE FARM

Methodology

Previous studies examining the ability of beginning dairy farmers to survive and be successful have utilized econometric methods (Haden and Johnson, 1989) or firm level simulation models (Hutton and Hinman, 1969) for their empirical examinations. One factor which has been ignored in these studies is the influence of risk on the survivability and success of beginning farmers. In this study, FLIPSIM (Firm Level Income and Farm Policy Simulator), developed by Richardson and Nixon (1986), is employed to determine the farm's survivability under varying beginning milk production and equity conditions.

FLIPSIM has several advantages that make the model suitable to this type of study. First, FLIPSIM is a validated model that has been used in a myriad of studies (Richardson and Nixon, 1982; Nixon and Richardson; Richardson, Lemieux and Nixon; Grant et al.; Helms, Baliey and Glover). Second, as evident in Grant et al. and Helms, Bailey and Glover, FLIPSIM can be successfully modified to simulate many farm enterprises in varied areas of the country. FLIPSIM also has the ability to operate either deterministically or stochastically at the farm level. This provides the programmer the opportunity to either determine prices and yields, or to let the model, by the use of correlation matrices and fractional deviations, determine prices and yields. By the use of stochastic simulation, the aspect of uncertainty of prices and yields becomes evident in the model.

Several studies have been conducted using FLIPSIM. Richardson and Nixon (1982) used FLIPSIM to simulate a typical Texas High Plains cotton farm to determine whether or not producers would prefer a cotton Farmer Owned Reserve. FLIPSIM was also used to analyze the effects of the Economic Recovery Act of 1981 on the typical Texas High Plains farm operation over a 10-year planning horizon (Nixon and Richardson). In addition, the simulation model was used in a study of the effects of leasing and leverage of firm survival (Richardson, Lemieux and Nixon). Grant et al. used FLIPSIM to analyze a typical size rice farm in Texas to determine how increases in the price variability of rice marketing margins affected producer viability. Furthermore, Helms, Bailey and Glover used FLIPSIM to evaluate alternative tillage practices on mid-sized non-irrigated farms in Utah.

FLIPSIM is a recursive, farm-level, deterministic or stochastic model which simulates the production, effects of farm policy, marketing, financial management, growth, and income tax aspects of a farm over a specified planning horizon. A planning horizon of up to ten years may be simulated for one to 100 iterations. Upon completion of the last iteration, the model performs a statistical analysis of several output variables, develops cumulative probability distributions for these output variables, and estimates the probability of the farm operator remaining solvent for the duration of the planning horizon. The model may be operated deterministically (i.e. annual crop yields and prices and milk and cow prices are determined exogenously by the user) or stochastic, where yields and prices may follow a triangular, empirical, or normal distribution. The model is recursive in that the financial position at the end of the year is the beginning financial position for the following year.

The model calculates the standard financial activities of a farm, such as paying fixed and variable costs, making loan payments, withdrawing family living expenses, depreciating (cost recovering) machinery, and paying income and self-employment taxes. Personal income taxes and self-employment taxes are calculated annually for the farm operator, assuming the operator is married, filing an joint income tax return, and itemizing personal deductions. Long-term and intermediate-term debts are amortized using variable interest mortgages. The market value of farmland is calculated annually as a function of the rate of return to production assets. This allows the value of cropland to adjust over time to the changing profitability of farms in the region. By changing the assumptions regarding beginning equity and debt structure, the probable outcomes for alternative means of entry into farming can be simulated.

Many different types of farm data are needed for the FLIPSIM model. First, basic information about the general farming operation is required for the model. This information includes: acres of farmland owned and leased, value of owned assets, depreciation of buildings, current long-term, intermediate-term and short-term debt, financing terms for new loans and cash flow deficits, property income and self-employment tax rates, overhead costs, available unpaid family labor, hired labor availability and costs, cash lease information and annual percentage change in costs and interest rates. FLIPSIM also requires information on crops grown on the farm. Production costs, crop mix, labor requirements, crop yields and prices, seasonal price indexes, and marketing strategies are needed for each crop enterprise operated by the farm. An inventory of owned machinery on the farm is also required by the model.

The dairy enterprise option is the major focus of this study. Information needed to invoke this option includes: the number of cows milked each month, the number of dry cows, heifers and calves fed each month, culling rate, annual average milk price, cull price, calf price, price paid for replacement cows, seasonal milk price index, seasonal milk production per cow, annual cost of production, labor requirements for cows, dry cows heifers and calves, depreciation for cows and bulls, annual average milk production per cow, size of herd growth, and annual feed requirements for milk cows, heifers, calves and bulls.

When the model is run stochastically, annual crop prices and yields are drawn at random from probability distributions specified by the programmer. He or she can select from independent or multivariate distributions for annual crop prices and yields, annual livestock prices, annual dairy prices and milk production per cow. Variable costs of production are calculated for each crop enterprise and then summed to obtain total input costs. Harvest costs are calculated by multiplying each crop's production (harvested acres times yield) by its harvesting cost per yield acre. Variable production costs per head of livestock and dairy cows are multiplied by their respective herd size numbers to estimate livestock and dairy production costs.

Labor cost is the sum of updated, full-time employee salaries and benefits plus wages paid to part-time employees. The amount of part-time labor hired is the residual labor required each month after fully utilizing full-time employees and family labor for all crops, as well as the dairy and beef cattle enterprises. Labor requirements for each crop are a function of the number of acres planted and the crop's monthly labor requirements per acre. Monthly labor requirements for the dairy enterprise are calculated based on the number of cows milked monthly, as well as the number of heifer calves, replacement heifers, and dry cows to be cared for each month. Interest cost on operating capital is calculated based on the farm's total variable costs of production for crops, cattle, and dairy, the annual interest rate for operating capital, and the fraction of the year an operating loan is used.

Annual values for exogenous fixed costs are calculated by inflating their initial values by the appropriate annual percentage changes provided by the programmer. Property taxes are calculated as the product of the appropriate property tax rate and the market value of land owned in the previous year.

Amortization of both existing and new long-term and intermediate-term loans is based on their respective loan life, initial amount borrowed, and annual interest rate. Variable interest rate mortgages are assumed for new loans. Annual interest rates for these loans are provided by the programmer.

The market rate of land and farm machinery is updated annually. The market value for used equipment is adjusted using the percentage changes in used equipment prices supplied by the programmer. The market value of farmland can be inflated in a similar fashion.

Marketing strategies for crops are used in the simulation model where the operator can reduce personal income taxes for the current year. This is accomplished in the model by calculating the operator's expected income tax deductions and cash receipts from all sources to determine the proportion of all crops to market in the current year. A seasonal price index for each crop allows the operator to take advantage of seasonal price differences. Annual cash receipts are calculated for the portion of the crop marketed in the current tax year plus the receipts for selling crops stored from the previous year.

Cash receipts for the dairy enterprise are the sum of receipts from monthly milk sales, baby calves sold, bulls sold, cull cows sold, and replacement heifers sold due to failure to breed, sickness, or the operator's herd replacement strategy. When a dairy enterprise is to be simulated, the programmer must specify a herd replacement strategy for culling milk cows (fraction culled annually), heifer calves kept (fraction sold at birth), normal calving fraction, death loss of heifers over one year of age (fraction), and the fraction of replacement heifers sold after one year due to failure to breed or sickness. Given the initial herd size (milk cows and replacement heifers over one year), and the replacement strategy, the model buys and sells cows, heifers, and heifer calves to keep the milking herd at its desired level.

Farm programs in the model are activated separately by options specified by the programmer. Annual cash withdrawals from the operation for family living expenses can be calculated two ways. First, one specific consumption function relating farm family consumption to family size, age of operator, after-tax disposable income, and the Consumer Price Index (CPI) can be used. The other option is simply to increase the set value of family living expenses by the annual change in the CPI. Once family cash withdrawals are calculated for the year, the final cash flow position for the farming operation is determined.

Cash flow deficits can be covered several ways, such as: (a) granting a loan secured by crops held for sale in the next tax year; (b) obtaining a mortgage on equity in farmland and/or intermediate-term assets; or (c) selling farmland. When a cash flow surplus exists, the operator can either invest the surplus in a high yield financial instrument at prevailing interest rates or use the surplus to prepay principle payments on current debts.

Data

In order to address the financial problems facing beginning farmers in Tennessee, an accounting of their characteristics and the problems they encounter must first be made. To more fully assess the financial problems faced, a survey was taken in the Spring of 1988 (Yates, Haden, and VanTassell). This survey described the demographic and farming characteristics, as well as the future growth plans of beginning Tennessee dairy farms.

In addition to the survey, supplemental sources of data were used in order to determine a typical beginning dairy farm in Tennessee. These were: Tennessee Farm Planning, Tennessee Agricultural

Statistics, Agricultural Statistics, Tennessee Dairy Statistics, U.S. and World Agricultural Outlook FAPRI Report, Official Guide: Tractors and Farm Equipment, Federal Land Bank, local county tax assessors, Tennessee Valley Authority (TVA) records, and Dairy Herd Improvement Association (DHIA) records.[1] These data sources provided information on crop and livestock input costs and yields, past crop and milk yields, input price indexes, equipment depreciation information, minimum downpayment requirements and, local property tax rates. The combination of information from these sources is used with the FLIPSIM model to simulate conditions faced by a representative farm.

The Representative Farm

The model farm consisted of 105 acres of cropland and 95 acres of pastureland owned by the operator. Information gathered from the Tennessee survey and the Tennessee Farm Planning Manual indicated that a 200 acre farm operation is typical for the Tennessee dairyman. Seventy-three percent of the cropland was tillable and no land was irrigated. The average value assumed per acre for cropland was $1,455, with the average value per acre for pastureland being $910 (Yates, Haden, and VanTassell).

The initial financial position of the farm is described in Table 1. The beginning equity to assets ratio was 0.20. Current long- and intermediate-term debts were to be financed with twenty and five year loans, respectively. An operating loan could be used as much as three-

[1]The TVA data consisted of financial and production data collected by TVA from dairy farmers throughout the Tennessee Valley Area. The DHIA data consisted of Tennessee dairy farmers who participated in the record keeping program over the past six to ten years.

Table 1. Representative Dairy Farmer's Beginning Balance Sheet and Selected Financial Ratios.

Item	Amount
Assets	
Market Value of Cropland & Farmstead	152,808.0
Market Value of Buildings	52,213.0
Beginning Cash Reserves	5,000.0
Market Value of Owned Pastureland	86,450.0
Market Value of All Farm Machinery	76,971.0
Market Value of All Livestock	104,247.5
Total Value of Assets	$477,689.5
Liabilities	
Total Real Estate Debt	236,931.0
Total Intermediate-Term Debt	145,216.0
Total Debt	$382,147.0
Beginning Net Worth	$ 95,542.5
Initial Financial Ratios for the Farm	
Equity to Assets Ratio	0.20
Debt to Assets Ratio	0.80
Leverage Ratio	4.00

fourths of the current year. Terms for new intermediate- and long-term loans were five and twenty years, respectively, with a minimum 40 and 20 percent downpayment, respectively, for intermediate-term loans long-term loans (Thompson). The annual interest rates used over the planning horizon were taken from the FAPRI Report and are listed in Appendix A.

Debts which were unable to be paid at year-end were refinanced against equity in land for 20 years for long-term loans and four years for intermediate-term loans at the current interest rate plus a two percent charge added for refinancing. The minimum equity requirements for solvency were 0.15 for long- and intermediate-term assets (Thompson).

A minimum cash reserve of $5,000 was required to be maintained at year end. If the cash was not available for the reserve, financing was obtained for the reserve amount. All surplus cash at year end was used to pay off outstanding debts, with any remaining cash invested in a short-term certificate of deposit at the current interest rate.

Buildings that were depreciated are listed in Table 2. Regular buildings were depreciated under the Technical and Miscellaneous Revenue Act of 1988 using a 20-year straight line method. Special buildings, such as the dairy facilities, were recovered using a 7-year straight line schedule. Fixed costs for the farm operation, taken from the survey, are described in Table 3.

The age of the operator at the beginning of the planning horizon was 37 years of age. Family living expenses were set at a minimum of $24,000 and a maximum of $40,000, with a marginal propensity to consume

Table 2. Buildings on the Dairy Farm Which are Eligible for Depreciation.

Buildings	Depreciation
Regular Buildings	
-Free Stall Barn	
-Pole barn-Hay Storage	
-Fencing	
Total Purchase Price	$30,210.0
Calendar Year Purchased	1989
Special Buildings	
-Milk Parlor	
-Calf Huts	
-Silo	
-Silo Unloader	
-Bulk Milk Tank	
-Mechanical Forage Feeder	
Total Purchase Price	$92,310.0
Calendar Year Purchased	1989

Source: Farm Planning Manual, Agricultural Extension Service, University of Tennessee, December, 1988.

Table 3. Fixed Costs for the Dairy Farm Operation.

Costs	Dollars
Property Tax Rate ($Tax/$Value)	0.00745
Total Personal Property Tax	1556.0
Accountant & Legal Fees	131.0
Unallocated Maintance Costs	4270.0
Insurance on Machinery	1181.0
Miscellaneous Fixed Costs	778.0

of 20 percent of disposable income. The dairy operator was assumed to claim four tax exemptions and have a 20 percent ratio between personal income tax deductions and net income (Richardson and Nixon, 1986). No off-farm income was earned by the operator or his family, and the annual return on off-farm investments was ten percent. The operator and his family provided an average of 297.5 hours of labor per month on the farm, with no full-time employees used on the farm (Table 4). The hourly wage rate for part-time labor, if needed, was $7.50 per hour. This wage rate equals an annual salary of $18,000, which includes social security taxes and insurance payments for a full-time employee working 200 hours per month.

Assumed inflation rates for selected costs, as well as the Consumer Price Index for the simulation period, were taken from the U.S. and World Agricultural Outlook FAPRI Report and are found in Appendix A. Necessary machinery for the farm operation, as required from the Tennessee Farm Planning Manual, is also listed in Appendix A. All items were valued on a current market basis and were traded in and replaced at the end of their economic (useful) life. Machinery and other purchased depreciatable items were recovered using a seven-year straight line schedule under the Technical and Miscellaneous Revenue Act of 1988, with the option of first year expensing not in effect.

The representative farm has six crop enterprises. Production costs for these enterprises are listed in Table 5. In Table 6, monthly labor requirements per acre for each crop enterprise are listed along with the hours of unpaid family labor available each month.

Table 4. Available Unpaid Family Labor[a].

	Hours
January	255.0
February	255.0
March	255.0
April	255.0
May	337.5
June	337.5
July	352.5
August	352.5
September	292.5
October	292.5
November	292.2
December	292.2

Source: Farm Planning Manual, Agricultural Extension Service, University of Tennessee, December, 1988.

[a] Family labor includes the farm operator, his wife and two children.

Table 5. Variable Production Costs for Crop Enterprises.

Tobacco	Corn	Alfalfa	Grass	Perm.	Summer	
		Silage	Hay	Hay	Pasture	Pasture
			Dollars per Acre			
Seed	12.50	20.90	10.10	9.68	1.87	20.00
Fert-Lime	190.90	60.85	53.18	31.45	21.38	48.05
Chemicals	157.57	12.18	13.86	0.00	0.00	0.00
Fuel-Lube	41.40	22.18	19.06	15.56	6.61	4.57
Repairs	62.10	33.28	30.77	23.33	1.22	6.86
Other	373.45	0.00	7.00	0.42	0.00	0.00
Total Variable Costs per Acre	837.92	149.39	133.97	80.44	31.08	79.48

Source: Farm Planning Manual, Agricultural Extension Service, University of Tennessee, December, 1988.

Table 6. Monthly Labor Requirements Per Acre for Crop Enterprises.

	Tobacco	Corn Silage	Alfalfa Hay	Grass Hay	Perm Pasture	Summer Pasture	Total Hours
January	0.0	0.0	0.0	0.0	0.0	0.0	0.0
February	0.0	0.0	0.0	0.0	0.0	0.0	0.0
March	6.165	0.265	0.0	0.0	0.0	0.0	6.43
April	6.165	0.265	0.0	0.0	0.0	0.0	6.43
May	19.895	0.570	2.705	1.335	0.450	0.495	25.45
June	19.895	0.570	2.705	1.335	0.450	0.495	25.45
July	15.980	0.0	1.450	1.570	0.565	0.565	20.13
August	15.980	0.0	1.450	1.570	0.565	0.565	20.13
September	35.065	1.900	1.295	0.0	0.0	0.0	38.26
October	35.065	1.900	1.295	0.0	0.0	0.0	38.26
November	81.200	0.0	0.0	0.0	0.0	0.0	81.2
December	81.200	0.0	0.0	0.0	0.0	0.0	81.2
Total Hours per Enter.	316.61	5.47	10.91	5.81	2.03	2.12	342.94

Source: Farm Planning Manual, Agricultural Extension Service, University of Tennessee, December, 1988.

To incorporate the variability in prices and production faced by dairy farmers, several key variables were generated stochastically in the simulation. Prices to tobacco, alfalfa hay, and grass hay, along with yields of tobacco, alfalfa hay, grass hay, and corn silage, were assumed to be distribution multivariate empirical. Because a historocal series of concurrent farm level yields and prices was not available to formulate a correlation martix, the correlation and simulation of these crops was accomplished in a two step process. The first step necessitated the assumption that yields and prices of these crops are correlated the same on the farm level as on the state level. Using this assumption, deviations from the trend of state yields and prices from 1979 through 1988 were used to create a correlation martix, which was then factored and utilized in the simulation to maintain the correlations in these data which have accored over the past ten years (Richardson and Condra). The second step entailed the development of deviations from a trend or mean to be utilized in the empirical distribution process (see VanTassell, Richardson, and Connor). It was assumed prices farmers faced were the same as the average state prices used in the first step. Because the aggregation of farm level yields into state yields dilutes the variability in yields faced on a particular farm, ten years of yields were obtained from subjective probability distribution elicited by Yates, Haden, and VanTAssell. These yields were checked against the past three years of TVA data and were found to be very simuilar in nature. Deviations werer taken from the mean of each series and were then utilized in the generation of the empirical distributions. Because no significant trends were found in the state price and yield data, constant average annual crop yields and prices (Table 7) were utilized over the planning horizon as the trend line from which the fractional deviation fluctuate around.

Permanent pasture and summer pasture yields are assumed to be sufficient to supplement replacement and dry cows. During the simulation period, the crop mix was constant over time. Acres planted and harvested of each crop are described in Table 8. Excess hay produced by the farm was sold at prevailing market prices less ten percent for marketing costs. Seasonal price indexes for each crop are described in Appendix A.

The average number of cattle on hand at the beginning of the planning horizon was: cows milked, 60; dry cows, 16; replacement heifers, 15; and replacement calves, 2 (Table 9). These annual numbers represent the typical sized dairy operation in Tennessee according to Tennessee Valley Authority (TVA) and Dairy Herd Improvement Association (DHIA) records. A 60 cow milking herd is also the typical herd representated by the Tennessee Farm Planning Manual. Monthly production and prices are described in Table 10. The yearly average milk production per cow was 12,000 pounds. Labor requirements for the dairy operation are listed in Table 11. Total yearly labor requirements per head are: milk cows, 60 hours; dry cows and replacement heifers each 8.24 hours; and baby calves, 10.8 hours.

Annual milk prices, cull cow prices, replacement cow prices, calf prices, concentrate prices, and milk production were also distributed multivariate empirical. Milk, cull and replacement cow, calf and concentrate prices were state averages from 1979 through 1988

Table 7. Annual Mean Crop Yields and Annual Mean Crop Prices.

	(Per Acre) Yield	Price
Tobacco	2024.6 lbs.	1.63/lb.
Corn Silage	16.5 tons	--------
Alfalfa Hay	2.86 tons	76.56/ton
Grass Hay	1.93 tons	48.05/ton

Table 8. Acres of Crop Planted, Harvested and Month Sold.

	Acres Planted	Acres Harvested	Normal Fraction Harvested	Month Sold
Tobacco	2.00	1.80	0.90	Nov.
Corn Silage	40.00	38.00	0.95	----
Alfalfa Hay	20.00	19.00	0.95	Dec.
Grass Hay	15.00	14.00	0.95	Dec.
Permanent Pasture	65.00	61.75	0.95	----
Summer Pasture	30.00	28.50	0.95	----

Table 9. Number of Dairy Cattle Fed Each Month.

	Milk Cows	Dry Cows	Heifers	Calves
January	61	18	13	1
February	60	19	13	1
March	60	19	13	0
April	59	15	14	0
May	56	16	16	0
June	55	16	17	0
July	55	16	18	0
August	58	16	18	0
September	63	15	14	3
October	65	14	13	5
November	65	14	13	5
December	63	16	13	3

Table 10. Monthly Production, Milk Production Index and Milk Price Index.

	Milk Production (cwt/cow)	Milk Production Index	Milk Price Index
January	9.90	0.99	1.03
February	9.60	0.96	1.01
March	10.30	1.03	1.00
April	10.80	1.08	0.95
May	10.80	1.08	0.95
June	10.10	1.01	0.95
July	9.90	0.99	0.95
August	9.80	0.98	0.98
September	9.40	0.94	1.01
October	9.90	0.99	1.03
November	9.80	0.98	1.07
December	9.80	0.98	1.06

Table 11. Labor Requirements for the Dairy Operation.

	Milk Cows	Dry Cows	Heifers	Calves
		Hours per Head		
January	5.05	1.37	1.37	0.90
February	5.05	1.37	1.37	0.90
March	5.15	1.12	1.12	0.90
April	5.15	1.12	1.12	0.90
May	4.85	0.63	0.63	0.90
June	4.85	0.63	0.63	0.90
July	4.90	0.38	0.38	0.90
August	4.90	0.38	0.38	0.90
September	4.85	0.30	0.30	0.90
October	4.82	0.30	0.30	0.90
November	5.20	0.32	0.32	0.90
December	5.20	0.32	0.32	0.90

Source: Farm Planning Manual, Agricultural Extension Service, University of Tennessee, December, 1988.

(Tennessee Agricultural Statistics). Milk production averages were obtained from individual farm Dairy Herd Improvement Association (DHIA) statistics from 1979 through 1988. A factored correlation matrix was obtained from the residuals of a trend line estimated for each series. The base price/production levels assumed over the planning horizon are shown in Table 12.

Twenty-five percent of the cows are assumed to be culled annually and 66 percent of calves born sold at birth. The herd has an 85 percent calving rate, a 2 percent death loss for heifers under 12 months of age and a 10 percent culling rate of heifers due to failure to breed or sickness (Table 13).

Table 14 lists annual per animal costs of production for the dairy herd. These expenses are categorized as feed, dairy and miscellaneous costs. The cost of feed raised on the farm is not included in these costs. Annual feed requirements for crops produced on the farm and fed to the dairy herd are summarized in Table 15. For depreciation purposes, 92 head of dairy cattle (includes milk cows, replacement heifers, dry cows and replacement calves) were purchased at the beginning of the planning horizon (1989). The purchase price for these livestock was $81,000. The assumed economic life of the milk cows being eight years.

Table 12. Average Yearly Prices of Milk, Dairy Animals, Annual Production and Number of Animals.

Year	Price Received for Milk	Price Received for Cull Cow	Price Received for Replacement Cow	Milk Production/ Cow (cwt.)	Number of Animals
1989	$12.51	$586.25	$925.00	120.00	92
1990	$12.54	$530.00	$1,080.00	122.00	93
1991	$12.14	$492.50	$1,110.00	124.20	94
1992	$12.24	$468.75	$1,020.00	126.40	95
1993	$11.54	$458.75	$970.00	128.60	96
1994	$10.98	$452.50	$785.00	130.90	103
1995	$10.42	$440.00	$790.00	133.20	110
1996	$ 9.86	$423.75	$750.00	135.50	117
1997	$10.14	$516.25	$835.00	137.90	124
1998	$10.31	$554.38	$850.00	140.30	130

Source: Tennessee Department of Agriculture, Tennessee Agricultural Statistics Service. Tennessee Agricultural Statistics, Annual Summaries, 1978-1988.

Table 13. Assumed Production Ratios for the Dairy Herd.

Category	Ratio
Fraction of Cows Culled Each Year	0.25
Fraction of Calves Sold Annually	0.66
Calving Fraction	0.85
Death Loss for Heifers	0.20
Fraction of Replacement Heifers Sold	0.10

Table 14. Annual Production Costs Per Animal.

Costs	Milk Cows	Dry Cows	Heifers	Calves
Feed[a]	377.01	1.91	1.91	117.00
Dairy[b]	172.96		17.00	
Miscellaneous[c]	17.31	49.31	49.31	
Total	567.28	51.22	68.22	117.00

[a] Feed costs include: dairy feed, salt, bone meal, milk replacer, and calf starter.

[b] Dairy costs include: artificial breeding fees, DHIA dues, vet and medicine, bedding, dairy supplies, ADA dues, and milk hauling.

[c] Miscellaneous costs include: marketing expenses for culls, along with utility costs.

Table 15. Annual Feed Requirements Per Animal Unit.

	Cows Milked	Replacement Heifers	Replacement Calves
Corn Silage (tons)	7.5	2.0	0.0
Alfalfa Hay (tons)	1.0	0.0	0.0
Grass Hay (tons)	0.0	1.0	0.0
Permanant Pasture (tons)	0.5	0.5	0.0
Summer Pasture (tons)	0.5	0.5	0.0

CHAPTER 3

RESULTS AND CONCLUSIONS

Results

A simulation model, FLIPSIM, was used to examine the effects of various beginning equity levels and annual average milk production per cow upon the financial viability of starting and continuing a dairy operation in Tennessee. To obtain a representative sampling of the stochastic process used in the model, a ten year planning horizon was simulated for 50 iterations. Five scenarios were examined. They include three beginning equity levels (20, 35 and 50 percent) with an assumed milk production level of 10,000 - 12,000 pounds of milk, plus two additional milk production levels (12,000 - 14,000 and 14,000 - 16,000 pounds) combined with a 20 percent equity investment. These scenarios were designated as E20, E35 and E50 for the three beginning equity levels at 10,000 - 12,000 pounds of production, and P12 and P14 for the additional two production levels.

Survivability of the representative farm was defined as the probability the farmer would remain solvent over the 10-year planning horizon. To remain financially solvent, the farmer's equity to asset ratio must remain at or above 15 percent.[2]

[2]Information from the Federal land Bank revealed that while they had no absolute minimum equity level needed for a farm to remain solvent, a 15 percent level was an approximate equity level needed for financial solvency.

Table 16 shows the probabilities for survival and success along with the average number of years the farm would remain in operation over the 10-year planning horizon. Economic success was defined as the probability the farm's net present value (NPV) would be greater than zero. Also included in Table 16 are the average NPV, defined as each year's net income discounted at eight percent over the 10-year planning horizon, and the average net worth at the end of the planning horizon discounted over the number of years the farm remained solvent using an eight percent discount rate. The average ending equity to asset ratio, which indicates the average percent of equity the farmer had remaining in his assets at the end of each iteration, is also given, along with the average annual net cash farm income.

Beginning Equity Scenarios

The first equity scenario to be examined, E20, may be considered the base scenario, as it was assumed to represent the typical conditions existing for a beginning dairy farm. It consists of a beginning equity level of 20 percent and annual average milk production of 10,000 pounds, which increases to 12,000 pounds over the 10-year planning horizon. Under the E20 scenario, a dairy farmer would have a 66 percent probability of surviving over the 10-year planning period, and a 66 percent chance of an economic success. Income generated by the farm did not allow the farmer to maintain enough cash flow to remain in business past an average of 6.94 years.

NPV averaged $2,564,889 but ranged from $-106,371 to $6,897,733. Average ending net worth was $1,814,168, with a minimum of $-17,905 and a maximum of $4,955,120. Long-term debts at the end of the last

Table 16. Selected Financial Statistics For the Five Scenarios Examined[a].

	Scenario				
	E20	E35	E50	P12	P14
Probability of Survival	66.0	100.0	100.0	88.0	100.0
Probability of Success	66.0	100.0	100.0	88.0	100.0
Average number of years in operation	6.94	10.0	10.0	8.92	10.0
Net Present Value for All Iterations ($1,000)					
Mean	2564.89	3552.62	3587.59	3208.91	3748.03
Std. Dev.	2237.80	1665.34	1663.94	1858.24	1662.10
Coef. Var.[b]	87.25	46.88	46.38	57.91	44.35
Minimum	-106.37	1025.52	1061.28	-66.53	1209.25
Maximum	6897.73	8261.12	8295.45	7016.96	8448.50
P. V. of Ending Net Worth for All Iterations ($1,000)					
Mean	1814.17	2583.17	2640.72	2288.85	2687.88
Std. Dev.	1548.56	1171.95	1171.47	1289.75	1171.28
Coef. Var.	85.36	45.37	44.36	56.35	43.58
Minimum	-17.91	864.64	922.04	21.93	959.27
Maximum	4955.12	6130.02	6187.37	5039.99	6229.95

Table 16 (continued).

	Scenario				
	E20	E35	E50	P12	P14
Long-Term Debts for All Iterations ($1,000)					
Mean	194.05	141.39	108.84	181.09	174.02
Std. Dev.	28.19	0.00	0.00	19.34	0.00
Coef. Var.	14.53	0.00	0.00	10.68	0.00
Minimum	174.02	141.39	108.84	174.02	174.02
Maximum	232.93	141.39	108.84	232.93	174.02
Intermediate-Term Debts for All Iterations($1,000)					
Mean	64.65	-0.00	-0.00	20.71	-0.00
Std. Dev.	91.04	0.00	0.00	56.67	0.00
Coef. Var.	140.82	-62.74	-62.74	273.68	-62.74
Minimum	-0.01	-0.00	-0.00	-0.00	-0.00
Maximum	199.98	0.00	0.00	178.92	0.00
Ending Equity Ratio for All Iterations (fraction)					
Mean	0.61	0.90	0.91	0.81	0.90
Std. Dev.	0.4271	0.0606	0.0595	0.2703	0.0576
Coef. Var.	69.67	6.70	6.53	33.56	6.41
Minimum	-0.0468	0.7120	0.7231	0.0545	0.7191
Maximum	0.9555	0.9629	0.9652	0.9546	0.9593
Annual Average Net Cash Farm Income for Solvent Iterations ($1,000)					
Mean	475.96	680.36	685.62	609.68	723.33
Std. Dev.	426.75	340.13	339.86	361.44	339.55
Coef. Var.	89.66	49.99	49.57	59.28	46.94
Minimum	-17.00	200.57	206.21	4.06	243.97
Maximum	1368.77	1724.64	1729.79	1329.87	1765.82

Table 16 (continued).

[a] E20=20 percent starting equity, E35=35 percent starting equtiy, E50=50 percent starting equity, P12=12,000 to 14,000 pound annual milk production, P14=14,000 to 16,000 pound annual milk production.

[b] Coefficient of Variation is expressed as a percentage.

solvent year averaged $194,047, with intermediate-term debt averaging $64,650. The average equity to assets ration was 0.61; over three times the beginning equity level. This ratio ranged over the planning horizon from -0.05 to 0.95. Average annual net cash farm income was $475,955. The E20 scenario had 17 insolvent iterations in its first year of operation.

The second scenario, E35, consisted of the base milk production level with a beginning equity level of 35 percent. This 35 percent equity level scenario provided a 100 percent probability of survival and economic success under the assumed conditions. The probability of survival was 100 percent for each of the 10 years in the planning horizon, with the farm remaining in operation all 10 years.

NPV averaged $3,552,621 over the 10 years, with the average present value of ending net worth being $2,583,167. Long-term and intermediate-term debts averaged $141,390 and $0 at the end of the last solvent year. Equity to assets ratio averaged 0.90. The equity ratio again more than doubled from the beginning equity level over the 10 years. Annual average net cash farm income was $680,357, with a range from $200,567 to $1,724,638.

The final equity scenario, E50, assumed a 50 percent beginning equity level combined with the base milk production level. This scenario, like the E35, provided a 100 percent probability of survival and economic success, with the farm remaining in operation all 10 years of the planning horizon. This scenario had the highest NPV at $3,587,592, the highest ending net worth of $2,640,716, the highest ending equity ratio of 0.91 and the highest annual average net cash farm income of $685,624.

Beginning Production Scenarios

When the assumed level of milk production is increased, the financial stability of the farm is also aided. Using the base starting equity level of 20 percent, coupled with a beginning annual average milk production level of 12,000 pounds, which increases to 14,000 pounds over the planning horizon (scenario P12), the farm has a 88 percent probability of surviving and a 88 percent probability of economic success. Income generated by the farm allowed the operation to remain in operation an average of 8.92 years.

Under scenario P14, NPV averaged $3,208,907, the second highest of the production scenarios. The minimum and maximum values varied from $-66,530 to $7,016,958. Ending net worth averaged $2,288,855, with an ending equity to assent ration of 0.81. Again, owners equity more than doubled over the 10-year planning horizon. Long-term and intermediate-term debts averaged $181,085 and $20,706, respectively, at the end of the last solvent year. Long-term debts varied from $174,015 to $232,933, with intermediate-term debts ranging from $-0 to $178,921. The P12 scenario had six insolvent iterations in its first year of operation.

The last production scenario, P14, started milk production at 14,000 pounds and increased production to 16,000 pounds over the 10-year planning horizon. The P14 scenario had the highest average NPV ($3,748,029), ending net worth ($2,687,876), ending equity ratio (0.90) and annual net cash farm income ($723,330) of the three production scenarios. The relative variance of NPV, ending net worth, equity ratio and net cash farm income, as measured by the coefficient of variation, were the lowest of all production scenarios. NPV is almost one and a half times greater than the lowest production level of 10,000 to 12,000 pounds, with an ending net worth almost one and a half times the base scenario. Annual net cash farm income is over one and a half times larger than the base production level scenario of $475,955.

Comparison of Scenarios

Of the five scenarios, E35, E50 and P16 each had a 100 percent probability of survival and a 100 percent probability of success under the assumed conditions. Scenario P12 had the next highest survival and success levels, 88 percent each, with scenario E20 having the lowest levels at 66 percent each. As these starting equity and milk production positions fall, so does the probability of success; dropping to 66 percent for farms with 20 percent beginning equity and annual average milk production of 10,000 to 12,000 pounds.

NPV was highest for the P14 scenario, followed by E50, E35, P12, and E20. The relative variance of NPV, measured by the coefficient of variation, was greatest for the E20 scenario and least for the E50 scenario. The range of NPV for the E35 and E50 scenarios were relatively close, with E35 ranging from $1,025,517 to $8,261,123, and E50 increasing from $1,061,284 to $8,295,449. Even with a 15 percent lower starting equity level, the E35 scenario was able to attain comparably the same maximum NPV.

Cumulative probability distributions of ending NPV for all iterations of all five scenarios are plotted in Figure 1. The distribution for scenario P16 clearly dominates all other distributions

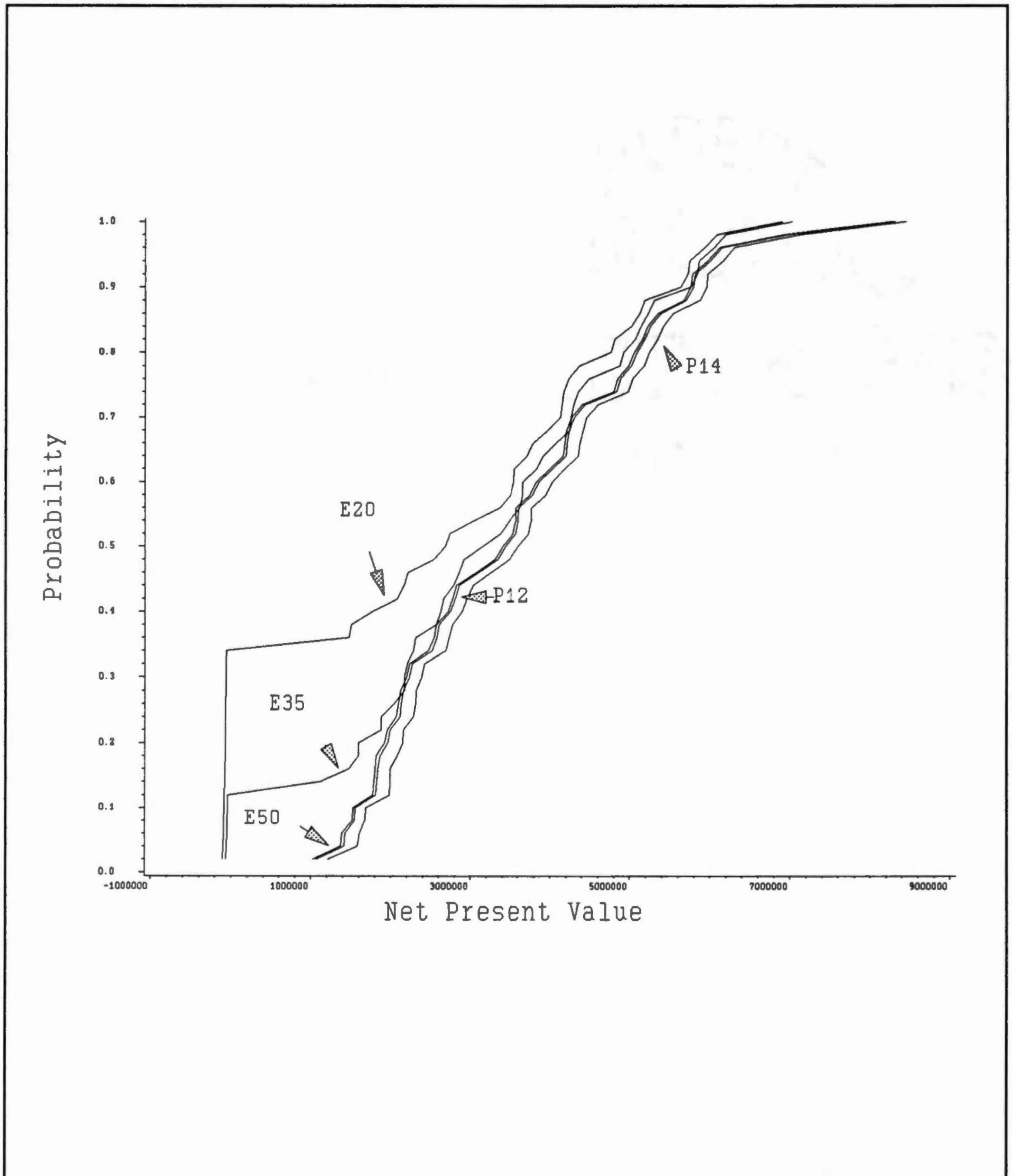

Figure 1. Cumulative Probability Distributions of Net Present Values for the Five Scenarios.

since it is below and farthest to the right. This shows that the P14 scenario has the greatest probability of attaining the highest NPV's of all scenarios. Negative NPV's for the E20 and E35 scenarios reflect the insolvent iterations of the scenarios. Also significant to note is how similar the E50 and P12 scenarios are distributed, with both scenarios experiencing almost identical values.

The average present value of ending net worth was again highest for the P14 scenario. Next was E50, E35, P12 and E20. The same pattern followed for the relative variance as occurred for NPV. E50 had the lowest variation, with E20 having the highest.

Comparison of ending long-term debt reveals that the E20 maintained the largest average long-term debt, with decreasing debt obligations for the P12, P14, E35 and E50 scenarios. The E20 scenario also exhibited the largest intermediate-term debt, followed by the P12 scenario. The other scenarios has average intermediate-term debts of zero.

Average annual net cash farm income for solvent iterations ranged from $475,955 to $723,330. Scenario P14 had the highest annual net cash income, followed by E50, E35, P12 and E20. This is the same pattern exhibited by the NPV's and ending net worth.

Ending equity for the five scenarios ranged from 0.61 to 0.91. The E50 had the highest ending equity ratio (0.91); over one and a half times its starting equity of 0.50. E35 and P14 both had ending equity levels of 0.90, but E35's equity level increased two and a half times, while the P14 scenario's ending equity was four and one half times greater than beginning equity. P12 ended with an equity ratio four times greater than its starting level. Even E20 with the lowest ending equity level of 0.61, tripled its equity from its beginning level.

Sensitivity Analysis

Previous scenarios assumed the dairy operation had a tobacco enterprise to supplement income from the dairy enterprise. While a common situation in Tennessee, it is not always true. In order to compare the effect of a tobacco enterprise, the five original scenarios were again simulated, without the tobacco enterprise. Selected financial statistics are presented in Table 17. From these statistics, the E20 scenario was the most affected, measured by the lowering of selected financial variables, followed by the E35 scenario. The major reason for this decrease in the financial performance of these two scenarios is that the income from the tobacco enterprise is no longer figured into net income. Without this extra income to net farm income, the E20 and E35 scenarios were drastically affected by the absence of growing tobacco.

In the E20 scenario the probability of survival dropped to zero without the tobacco enterprise. For the E35 scenario the probability of survival and economic success fell to 14 percent and 20 percent, respectively. Average NPV's for the E20 and E35 scenarios were negative, as well as the ending equity ratio of the E35 scenario. Interesting to note is that the probability of survival and success of the P12 scenario increased eight percent without the tobacco enterprise. This could be due from the reduced labor costs of not growing tobacco, which more than compensated for the lost revenue from the tobacco enterprise.

Table 17. Selected Financial Statistics For the Five Scenarios Examined Without the Tobacco Enterprise[a].

	Scenario				
	E20	E35	E50	P12	P14
Probability of Survival	0.0	14.0	100.0	96.0	100.0
Probability of Success	6.0	20.0	98.0	96.0	100.0
Average number of years in operation	2.82	9.66	10.0	9.64	10.0
Net Present Value for All Iterations ($1,000)					
Mean	-63.51	-60.21	76.84	183.86	403.09
Std. Dev.	23.35	56.77	33.56	59.78	21.59
Coef. Var.[b]	-36.76	-94.28	43.67	32.51	5.36
Minimum	-100.83	-128.68	-19.64	-53.12	338.87
Maximum	17.69	60.86	150.95	279.74	452.19
P. V. of Ending Net Worth for All Iterations ($1,000)					
Mean	12.19	2.38	147.93	170.13	331.43
Std. Dev.	29.64	52.99	25.89	37.59	16.26
Coef. Var.	243.10	2229.10	17.50	22.10	4.91
Minimum	-48.19	-71.24	76.68	35.35	284.67
Maximum	65.32	105.69	206.85	238.44	367.55

Table 17 (continued).

	Scenario				
	E20	E35	E50	P12	P14
Ending Equity Ratio for All Iterations (fraction)					
Mean	0.03	-0.01	0.33	0.35	0.68
Std. Dev.	0.0755	0.1270	0.0517	0.0731	0.0287
Coef. Var.	291.14	-1537.43	15.68	20.98	4.24
Minimum	-0.1357	-0.2113	0.1788	0.0863	0.5918
Maximum	0.1440	0.2259	0.4434	0.4822	0.7413

[a] Scenarios are the same as defined in Table 16.

[b] Coefficient of Variation is expressed as a percentage.

Two other sets of scenarios were simulated to determine the effects of varied financial conditions on the equity and production scenarios. These scenarios are probable conditions that may effect the dairy farmer in the near future. The first scenario examined was a 40 percent increase in interest rates paid by the farm operator. Selected financial statistics for this scenario are presented in Table 18. The E50 scenario was unaffected by increased interest rates, with its probability of survival and success remaining at 100 percent. The E20, E35 and P14 scenarios each had a six percent decrease in their probability of survival and success, with the ending equity ratios for these scenarios showing a similar decrease from the initial scenarios. The P12 scenario was the greatest scenario affected, experiencing a 20 percent drop in its probability of survival and success and a decline in its ending equity ratio to 0.63.

While the probability of survival and success declined for four of the five scenarios, the average NPV's and ending net worth values for all scenarios were very similar to the original scenarios. NPV's and ending net worth values were similar because if the farm did not go insolvent as a result of the higher interest rates, the financial performance of the operation was very similar to the original scenarios. The probability of survival and success were lowered as the number of insolvent iterations increased. For the E20 scenario, there were 20 insolvent iteration in year 1; E35 had one insolvent iteration in year 4 and two insolvent iteration in year 5; P12 had 16 insolvent iterations in year 1; and P14 had three insolvent iterations in year 1. The E50 scenario had no insolvent iterations, which is why it attained

Table 18. Selected Financial Statistics For the Five Scenarios Examined With Interest Rates Increased 40 Percent[a].

	Scenario				
	E20	E35	E50	P12	P14
Probability of Survival	60.0	94.0	100.0	68.0	94.0
Probability of Success	60.0	94.0	100.0	68.0	94.0
Average number of years in operation	6.40	9.68	10.0	7.12	9.46
Net Present Value for All Iterations ($1,000)					
Mean	2580.32	3645.53	3809.11	2835.69	3840.97
Std. Dev.	2489.56	1997.58	1821.57	2416.93	2001.91
Coef. Var.[b]	96.48	54.80	47.82	85.23	52.12
Minimum	-133.71	-194.97	1037.90	-96.54	-59.37
Maximum	7377.09	8818.12	8870.89	7505.73	9008.10
P. V. of Ending Net Worth for All Iterations ($1,000)					
Mean	1848.94	2659.68	2826.47	2029.07	2778.66
Std. Dev.	1742.59	1430.46	1289.56	1688.82	1421.84
Coef. Var.	94.25	53.78	45.62	83.23	51.17
Minimum	-45.24	-70.78	913.14	-8.07	29.10
Maximum	5362.83	6604.88	6675.70	5455.60	6708.42

Table 18 (continued).

	Scenario				
	E20	E35	E50	P12	P14
Ending Equity Ratio for All Iterations (fraction)					
Mean	0.53	0.84	0.91	0.63	0.85
Std. Dev.	0.4661	0.2644	0.0572	0.4033	0.1991
Coef. Var.	87.34	31.44	6.31	63.63	23.46
Minimum	-0.1220	-0.2060	0.7170	-0.0207	0.0713
Maximum	0.9476	0.9535	0.9558	0.9469	0.9501

[a] Scenarios are the same as defined in Table 16.

[b] Coefficient of Variation is expressed as a percentage.

a 100 percent probability of survival and success.

The other scenario examined was a $0.50 per cwt. decrease in the price of milk received by farmers. Selected financial statistics are shown in Table 19. Again, the E50 scenario was unaffected by the decrease in milk price, with its probability of survival and success remaining at 100 percent. The P14 scenario experienced a two percent drop in its probability of survival and success and also a two percent decrease in its ending equity ratio. The E20 and E35 scenarios each had a four percent decline in their probability of survival and success, with a similar decrease in their ending equity ratios. Once again, P12 had the sharpest drop in its probability of survival and success, with an eight percent decline.

The same situation is evident with the average NPV and ending net worth values, as was discussed in the increased interest rate scenarios. The probability of survival and success increased as the number of insolvent iterations increased, with E20 having 19 insolvent iteration in year 1; E35 having two insolvent iteration in year 6; P12 having ten insolvent iteration in year 1; and P14 having one insolvent iteration in year 1.

Conclusions

The E35, E50, and P14 scenarios proved to be the most economically successful, with the probability of survival and success being 100 percent over the 10-year planning horizon. Also, each of the three farm scenarios remained in operation an average of 10 years over the 10-year period. The two remaining scenarios, E20 and P12, represented a 66 and 88 percent probability of survival and success,

Table 19. Selected Financial Statistics For the Five Scenarios Examined With Milk Price Decreased $0.50 per cwt.[a].

	Scenario				
	E20	E35	E50	P12	P14
Probability of Survival	62.0	96.0	100.0	80.0	98.0
Probability of Success	62.0	96.0	100.0	80.0	98.0
Average number of years in operation	6.58	9.84	10.0	8.20	9.82
Net Present Value for All Iterations ($1,000)					
Mean	2446.64	3443.73	3557.46	3002.20	3681.64
Std. Dev.	2287.35	1790.74	1666.38	2040.29	1717.71
Coef. Var.[b]	93.49	52.00	46.84	67.96	46.66
Minimum	-111.13	-152.44	1027.26	-75.44	-39.76
Maximum	6872.63	8229.61	8263.93	6983.46	8413.33
P. V. of Ending Net Worth for All Iterations ($1,000)					
Mean	1736.35	2491.25	2618.91	2143.85	2640.24
Std. Dev.	1581.79	1271.84	1172.76	1414.79	1209.88
Coef. Var.	91.10	51.05	44.78	65.99	45.82
Minimum	-22.66	-39.09	896.92	13.02	48.71
Maximum	4936.43	6107.45	6164.80	5015.69	6204.47

Table 19 (continued).

	Scenario				
	E20	E35	E50	P12	P14
Ending Equity Ratio for All Iterations (fraction)					
Mean	0.57	0.87	0.91	0.74	0.88
Std. Dev.	0.4398	0.2055	0.0601	0.3328	0.1249
Coef. Var.	76.49	23.59	6.59	45.03	14.15
Minimum	-0.0596	-0.1108	0.7203	0.0327	0.1171
Maximum	0.9557	0.9631	0.9654	0.9550	0.9596

[a] Scenarios are the same as defined in Table 16.

[b] Coefficient of Variation is expressed as a percentage.

respectively, with E20 remaining in operation an average of 6.94 years and P12, 8.92 years.

NPV of the five scenarios revealed that P14 had the highest average value at $3,748,029. Decreasing values for NPV were followed by scenarios E50, E35, P12 and E20. Cumulative probability distributions of the NPV's showed that the P14 scenario had the greatest probability of attaining the highest NPV of the five examined. While each of the scenarios generated enough income to obtain a positive average NPV, the minimum values of the E20 and P12 NPV's were negative. This reflects the farmers potential for financial problems in these scenarios.

Ending net worth were highest for the P14 scenario, followed by the E50, E35, P12 and E20 scenario. This is the same pattern that the NPV's followed.

Long-term debt for the scenarios decrease as equity levels and milk production levels increase. As starting equity levels increase, the farmer's capital base increases, which reduces the need for long-term debt financing. With increases in milk production, more net income can be generated to repay long-term debt obligations quicker and thereby lessen the debt load.

Intermediate-term debt varies over the five scenarios. Scenario E20 has the largest intermediate-term debt among scenarios, and the highest average long-term debt. The P12 scenario has the next highest intermediate-term debt and also the nest highest long-term debt. Scenarios E35, E50 and P14 were left with no average intermediate-term debts because of the farmer's ability to pay them off with excess income.

The ending equity ratio was highest for the E50 scenario, followed by E35 and P14. P12 had the next highest ratio, while E20 accrued the lowest ending equity among the five scenarios. The P14 scenario increased its equity level the greatest, by a factor of 4.5. P12's ending equity level was over four times greater than its starting equity level, with E20 tripling its ending equity level. E35's ending equity level was 2.5 times greater than starting equity, with E50 increasing by a factor of 1.5.

Average net cash farm income has the same pattern as NPV, with P14 having the highest income, followed by E50, E35 P12 and E20. The largest increase in net cash farm income was found between the E20 and E35 scenarios. A 30 percent increase in net cash income was noted between the E20 and E35 scenarios, with almost a 22 percent increase between the base scenario E20 and P12.

E20 and P14 were the only scenarios where the probability of survival adversely effected by the loss of the cash income generated by tobacco. The probability of survival dropped to zero for the E20 scenario and to 20 percent for the E35 scenario.

Scenario P12 was affected the greatest with a 40 percent increase in the interest rates paid by the farmer. Its probability of survival and economic success dropped 20 percent. E20, E35 and P14 each experienced a six percent drop in their respective probabilities of survival and economic success.

Similar to the previous scenario, P12 encountered the greatest effect when the price of milk was lowered $0.50 per cwt. It had an eight percent probability decrease in survival and economics success. E20 and E35 has a four percent decline in their probability of survival and success, with P14 showing a two percent decrease in survival and economic success.

With the assumptions of this study, high milk production levels are generally more important to a beginning diary farm, as the P14 scenario was the top performer. Following P14, the higher equity levels led in importance. When the tobacco enterprise is removed, high milk production remains the best scenario, with the higher starting equity levels following in importance. When other variables are changed, such as increased interest rates and lower milk prices, the scenarios show that high beginning production levels are more important than equity levels. Again, after the P14 scenario, the higher equity levels are the next best scenarios. This concurs with the results from the base scenarios.

CHAPTER 4

SUMMARY AND LIMITATIONS

Summary

Economic survivability of the farm operation continues to be a problem in the agricultural industry. With fixed costs and operating costs in the beginning years of operation, the dairy operation can incur a financial strain on beginning resources which can decrease the farm's ability to survive and be an economic success. Two factors which can be important to the financial success of a beginning dairy enterprise are the farmer's beginning equity to assets ratio and the farmer's beginning level of annual milk production.

The general objectives of this study were to examine the effects of various starting equity levels and milk production levels on the financial viability of the dairy farm. Five scenarios were analyzed: E20, a 20 percent equity level with a 10,000 - 12,000 pound milk production level; E35, a 35 percent equity level and a 10,000 - 12,000 pound milk production level; E50, a 50 percent equity level and a 10,000 - 12,000 pound milk production level with a 20 percent equity level; P12, a 12,000 - 14,000 pound annual milk production level with 20 percent equity; and P14, a 14,000 - 16,000 pound annual milk production level with 20 percent equity.

Of the five scenarios examined, the E35, E50 and P14 proved to be the most economically successful, providing a 100 percent probability of survival and economic success under the assumed conditions. The E20 and

P12 scenarios had a 66 and 88 percent probability of survival, respectively. The P14 scenario obtained the highest average NPV of $3,748,029, with E20 the lowest of $2,564,889. The present values of ending net worth were also highest for P14 at $2,687,876 and lowest for E20, $1,814,168. Cumulative probability distributions of NPV's showed that P14 had the greatest potential of attaining the highest NPV of the five scenarios.

Average long-term debt fell as beginning equity levels and milk production levels increased. As equity and production levels increased, the need for long-term debt financing is decreased. Intermediate-term debts average zero for the E35, E50 and P14 scenarios, with E20 having the highest intermediate-term debt and P12 following. The ending equity ratio was highest for the E50 scenario and lowest for the E20 scenario. Also noteworthy is the increase in equity ratio levels from the beginning to the end of the planning horizon. The E50 scenario's ending equity level was one and one half times greater than its beginning level of 0.50. The E20 scenario, with the lowest ending equity of the five scenarios, tripled its ending equity level.

With the removal of the tobacco enterprise, E20 and P14 were the only scenarios adversely affected by the loss of extra income. The probability of survival dropped to zero for E20 and to 20 percent for E35.

When interest rates rose 40 percent, P12 witnessed a 20 percent decrease in its probability of survival and success. The other scenarios were not as drastically affected. With a $0.50 drop in the price of milk, P12 was again the most adversely affected, with an eight percent decrease in its probability of survival and success.

Conclusions and Limitations

Under the assumed conditions of this study, scenarios E35, E50, and P14 proved to be the most economically successful. These equity and production levels would be more common for farmers who are older, have a larger equity base built up and have a number of years of dairy production management to their credit. Conversely, E20 and P12 more closely represents the young beginning farmer, with a low equity ratio and few or no years of dairy experience. Of the two scenarios, the higher milk production level allows the farm a greater probability of survival and economic success.

Even with the lowest equity level and milk production level assumed, the farm has a better than 60 percent chance it will survive and be an economic success. This leads to the conclusion that more than half of young beginning dairy farmers with low equity levels and milk production levels can survive and be an economic success during the crucial beginning years of operation under the conditions assumed in this study. These young farmers, with well-tuned financial management advice and accepted production management practices, have the opportunity for survival and economic success in the early years of operation.

Caution must be taken in the transferability of the results to other dairy operations. While care was taken to describe a typical dairy operation in Tennessee, no two enterprises or operators are alike. Many of the basic parameters and assumptions, both financial and production relationships, such as the interest rates, milk prices, land values, cow values, production costs, and crop yields, when changed, can have a major effect on the results obtained. Care should therefore be taken in interpreting the results.

One major assumption is that the value of milk cows and the feed cost for these cows was the same for the three production levels. Higher producing cows are likely to cost more per cow, but data was not available to distinguish the value of different production levels of milk cows. The same point must also be made with higher feed costs; the data was not readily available to incorporate this relationship. Another limitation is that the costs of production, as obtained from the TEnnessee Experiment Station budgets, assume a high level of management. As the management level of dairy farmers differ from this assumption, a cost-price squeeze could occur. This could drastically change the probability of success and survival rates obtained in this study.

This study has laid the groundwork for future research in this area of financial viability of dairy farms. Areas of interest that would have important financial consequences on the farm are changes in the current dairy policy, production costs increasing with production and lowering beginning equity levels in order to determine the absolute minimum equity levels needed by dairy farmers. In light of many changes in the dairy industry, examination into these areas can further clarify the financial picture of beginning dairy farmers.

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APPENDIX

Table A1. Annual Interest Rates, Inflation Rates, and Self-Employment Tax Rates for 1989-1998.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
<u>Annual Interest Rates</u> (fractions)										
Old Long-Term Loans	0.1030	0.1020	0.1070	0.1190	0.1200	0.1090	0.1080	0.1110	0.1190	0.1240
Old Intermediate-Term Loans	0.1070	0.1060	0.1110	0.1230	0.1240	0.1130	0.1120	0.1150	0.1230	0.1280
New Long-Term Loans	0.1070	0.1060	0.1110	0.1230	0.1240	0.1130	0.1120	0.1150	0.1230	0.1280
New Intermediate-Term Loans	0.1120	0.1110	0.1160	0.1280	0.1290	0.1180	0.1170	0.1200	0.1280	0.1330
Refinance Long-Term Loans	0.1180	0.1170	0.1220	0.1340	0.1350	0.1240	0.1230	0.1260	0.1340	0.1390
Refinance Interm-Term Loans	0.1370	0.1360	0.1410	0.1530	0.1540	0.1430	0.1420	0.1450	0.1530	0.1580
Operating Loans	0.1090	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150	0.1150
Received for Cash Reserves	0.0700	0.0690	0.0650	0.0640	0.0660	0.0740	0.0800	0.0830	0.0710	0.0670
<u>Annual Fractional Change In Prices</u> (fractions)										
New Farm Machinery	0.0470	0.0610	0.0470	0.0470	0.0550	0.0660	0.0600	0.0660	0.0650	0.0750
Used Farm Machinery	0.0260	0.0290	0.0370	0.0400	0.0410	0.0350	0.0350	0.0360	0.0390	0.0440
Fixed Costs, Insur.	0.0380	0.0430	0.0250	0.0280	0.0330	0.0360	0.0500	0.0490	0.0520	0.0520
Seed Costs	0.0099	0.0470	0.1098	0.0193	0.0294	0.0435	0.0464	0.0463	0.0463	0.0463
Fertilizer, Lime	-0.0742	0.1046	0.1919	0.0349	0.0619	0.0529	0.0523	0.0476	0.0476	0.0476
Chemical Costs	0.0500	0.0400	0.0290	0.0320	0.0290	0.0300	0.0320	0.0340	0.0390	0.0500
Fuel & Lube Costs	0.0460	0.0530	0.0250	0.0350	0.0500	0.0500	0.0870	0.0660	0.0680	0.0470
Repairs on Machinery	0.0164	0.0544	0.0678	0.0287	0.0363	0.0402	0.0494	0.0422	0.0422	0.0422
Other Production Costs	0.0350	0.0410	0.0180	0.0210	0.0290	0.0330	0.0500	0.0480	0.0520	0.0520
Custom Costs	0.0380	0.0430	0.0250	0.0280	0.0330	0.0360	0.0500	0.0490	0.0520	0.0520
Hired Labor Costs	0.0883	0.0227	0.0282	0.0207	0.0228	0.0287	0.0129	0.0132	0.0132	0.0132
Off-Farm Investments	0.0260	0.0290	0.0370	0.0400	0.0410	0.0350	0.0350	0.0360	0.0390	0.0440
Inputs for Livestock	0.0370	0.0330	0.0350	0.0060	-0.0150	0.0050	0.0240	0.0300	0.0620	0.0500
Building Values	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
<u>Consumer Price Index and Self-Employment Tax Rates</u>										
Consumer Price Index	331.8	345.1	359.9	376.1	391.2	407.6	424.3	441.7	462.9	486.5
Self-Employment Tax Rate	0.130	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150
Maximun Income Subject to Self Employment Tax ($)	48000.0	51000.0	51000.0	51000.0	51000.0	51000.0	51000.0	51000.0	51000.0	51000.0

Source: Food and Agriculturla Policy Research Institute, <u>FAPRI U.S. and World Agricultural Outlook</u>. Iowa State University, Staff Report # 1-89, February, 1989.

Table A2. Summary of Machinery.

	Model Year	Current Market Value	Original Purchase Price	Estimated Salvage Value	Accum. Economic Life	Current Recovery (Deprec.)	Replacement Cost
Tractor, 100 hp.	1986	13,440	19,425	0	7	16,025.6	30,000
Tractor, 60 hp.	1989	11,268	13,500	0	10	1,350.0	18,000
Tractor, 50 hp.	1984	6,720	10,503	0	8	10,398.0	15,000
Tractor, 34 hp.	1981	2,774	6,604	0	6	6,538.0	10,200
Plow	1980	242	1,157	348	7	809.0	1,966
Disk, 8 ft.	1980	283	1,198	360	7	838.0	2,036
Disk, 12 ft.	1989	1,905	3,100	0	7	310.0	3,589
Harrow, 10 ft.	1981	142	532	0	7	330.9	905
Harrow, 14 ft.	1989	724	1,000	0	10	100.0	1,365
Chisel Plow	1988	1,060	1,568	0	10	470.4	2,257
Culipacker, 8 ft. 4 in.	1980	407	1,722	518	7	1,204.0	2,927
Culipacker, 10 ft.	1988	1,770	2,600	0	7	780.0	3,767
Culitvator, 1 row	1980	135	608	247	7	361.0	970
Culitvator, 4 row	1989	1,638	2,400	0	7	240.0	3,085
Grain Drill	1980	354	1,693	509	7	1,184.0	2,878
Spreader, 10 ft.	1983	1,032	1,352	0	6	405.0	1,945
Spreader, 8 ft.	1981	242	907	0	6	564.2	1,542
Spreader,Spin	1983	184	541	0	6	541.0	919
Sprayer, Boom	1987	210	395	0	7	197.5	644
Sprayer	1988	2,167	3,000	0	8	900.0	4,612
Tobacco Transplanter	1980	77	367	110	10	257.0	624
Corn Chopper	1989	4,614	8,000	0	7	800.0	9,303
Corn Header	1989	1,751	3,000	0	7	300.0	3,531
Corn Planter	1985	2,511	4,500	0	10	3,150.0	6,825
Silage Wagon	1989	3,672	5,000	0	7	500.0	7,404
Silage Wagon	1989	3,672	5,000	0	7	500.0	7,404
Silage Blower	1989	1,412	2,100	0	7	210.0	2,847
Mower Conditioner	1989	3,315	4,517	0	8	451.7	6,244
Hay Rake	1982	377	1,120	0	10	1,120.0	1,904
Hay Baler, Square	1982	1,742	4,431	0	8	4,431.0	7,318
Hay Baler, Round	1989	4,956	5,800	0	7	580.0	9,993
Bale Carrier	1989	153	200	0	7	20.0	310
Hay Wagon	1980	246	1,170	354	7	823.0	2,000
Hay Conveyor, 10 ft.	1980	77	371	112	7	259.0	630
Rotary Mower, 10 ft.	1988	1,529	2,900	0	8	870.0	3,255
Rotary Mower, 5 ft.	1982	170	590	0	8	590.0	962

Table A2. (continued). Summary of Machinery.

Sources: Farm Planning Manual, Agricultural Extension Service, University of Tennessee, December, 1988.

National Farm and Power Equipment Dealers Association. Official Guide: Tractors and Farm Equipment., St. Louis, MO, Fall 1987.

Table A3. Seasonal Price Indexes.

	January	February	March	April	May	June	July	August	September	October	November	
December												
Tobacco	0.927	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.014	1.010
Corn Silage	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Alfalfa Hay	0.990	0.980	0.990	1.000	0.959	0.595	1.112	1.082	1.010	0.990	0.990	0.990
Grass Hay	0.958	0.938	0.958	1.000	1.063	1.104	0.958	1.083	1.000	0.917	0.938	1.000
Permanant Pasture	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Summer Pasture	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Tennessee Department of Agriculture, Tennessee Agricultural Statistics Service. Tennessee Agricultural Statistics, Annual Summary, 1988.

VITA

David Allen Yates was born in Jefferson City, Tennessee on August 19, 1965. He was raised in Rutledge, Tennessee on a dairy farm owned and operated by his father and uncle. He attended Joppa Elementary School then attended Rutledge High School where he graduated in 1983. The following September he began his undergraduate studies at Walter's State Community College in Morristown, Tennessee. In September 1985, he transferred to the University of Tennessee to complete his studies. He was awarded a Bachelors of Science degree in Agricultural Business in June 1987. After graduation he accepted a graduate research assistantship and began the M.S. program within the Department of Agricultural Economics and Rural Sociology. Mr. Yates completed the requirements for the Master of Science degree at the University of Tennessee, Knoxville in December 1989.