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ECONOMIC SIMULATION OF SELECTED MANAGEMENT STRATEGIES FOR A TYPICAL DAIRY FARM FACED WITH DECLINING MILK PRICES

by

M. Reed Balls

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Agricultural Economics

Approved:

UTAH STATE UNIVERSITY
Logan, Utah

1989

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Martin Reed Balls

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ABSTRACT

Economic Simulation of Selected Management Strategies for a Typical Dairy Farm Faced with Declining Milk Prices

by

M. Reed Balls, Master of Science

Utah State University, 1989

Major Professor: Dr. Jay C. Andersen
Department: Economics

The purpose of this thesis is to study the effect of lower milk support prices triggered by chronic surplus production problems and to offer alternative management strategies for dairymen caught in the cash flow squeeze precipitated by resulting cuts in the producer price of milk. Historical dairy policy is reviewed and recommendations are offered for consideration in developing dairy policy over the next decade.

FLIPSIM V, a powerful, firm-level computerized simulation model is employed to predict the probable outcome of employing alternative management strategies designed to improve profitability for individual dairymen. The study focuses on a typical farm devised from survey data to be representative of Utah's dairy industry. A five-year planning horizon is simulated.

(117 pages)

CHAPTER I

STATEMENT OF THE PROBLEM

The dairy industry continues to face the dilemma of excess productive capacity. This problem is not unique. Beginning with new, high yielding varieties of wheat developed during the Green Revolution of the early seventies and continuing through the dramatic loss of export markets brought on by deteriorating exchange values for the dollar in the middle eighties, technological change and market dynamics have created similar challenges for many other sectors in American agriculture. The result is a basic restructuring that has been slowly occurring for years. Some of the resources that have been traditionally devoted to agriculture are gradually being withdrawn. Policymakers in Washington have attempted to ease the pain of transition by implementing price supports, deficiency payments and diversion programs. The Food Security Act of 1985 authorized the 1986 USDA Dairy Termination Program (DTP) with the stipulation that it would be followed by cuts in the support price for milk. These recent attempts to stabilize the dairy situation indicate that milk prices will continue to fall. As this occurs, the challenge for individual dairymen becomes one of survival and not just success.

Introduction

Many successful dairymen view DTP, also known as the whole-herd buyout program, as a radical attempt to solve the nagging problem of excess capacity that has grown to plague the dairy industry in recent

years. The DTP was a political solution spawned by the chronic buildup of price depressing surplus stocks coupled with growing taxpayer concern over government subsidies to agriculture. Partially funded by producers themselves, the buyout was designed to eliminate excess milk production via the slaughter or export of one million cows and their female offspring. In retrospect it was a heart-rending and market-wrenching process that failed to accomplish all that was hoped.

The purpose of this thesis is to analyze the basic farm policies that led to DTP, examine its impact on Utah's dairy industry, apply economic reasoning to analyze reaction by Utah dairymen remaining in business, outline optimum choices for dairymen faced with declining milk prices, and to suggest a course of policy action that will help bring milk production levels nearer to market equilibrium. This will be done by (1) reviewing federal dairy policy history prior to DTP, (2) reporting the impact DTP has had on reducing milk production in Utah, (3) simulating the probable outcome of applying various management strategies in an effort to improve economic survival of a typical Utah dairy farm, and (4) applying the results of this simulation in support of a viable policy action to correct the dairy surplus problem.

Economic survival of individual firms engaged in dairy production will be greatly influenced by the course of dairy policy. Hence, recommendations will be developed suggesting the application of alternative management strategies that may be applied to increase the probability of their survival and success.

National Historical Background

Policy decisions leading to the dairy termination program have

their origin in Keynesian economics born during the Great Depression. Roosevelt's New Deal promised a brighter future to farmers who had tenaciously stayed with their land and fought to survive as farm prices plummeted. Price support theory seemed viable, and the idea that Americans should provide parity for farmers who had struggled so hard was politically sound.

The Agricultural Adjustment Act of 1937 marked the beginning of dairy program legislation by establishing a control mechanism for administering the price received by producers of fluid milk. The major objectives of this act were to establish parity prices for dairymen, protect the interest of the consumer, and to avoid unreasonable fluctuations in supplies and price of milk. The Act provides for a two-price system administered through federal milk marketing orders. While there are not federal controls over the prices and selling policies of milk handlers belonging to an order, the buying practices of these dairies with respect to milk purchased from producers is regulated. Under federal orders, the milk market administrator sets monthly, minimum fresh and manufacturing milk prices that dairies must pay at a specified location. The price of Grade A fresh milk resold for fluid consumption is pegged considerably higher than the price of milk diverted for manufacturing use. The market administrator computes a blend price to be paid to Grade A producers based upon a weighted average of the prices paid for manufacturing and fresh milk and the percentage utilization of fresh milk in the Class I, or fluid, market.

Administered pricing initiated under the 1937 Act marked the beginning of government intervention in the dairy industry. In some

areas, such as California, producers opted to establish orders administered through the state rather than the federal government, but the underlying theory is the same. Kessel's brilliant summary of the logic leading to the establishment of federal orders reviews the rationale from two perspectives. In terms of consumer interests, the price of milk eligible for bottling must be higher than the price of manufacturing milk. Not only must fresh milk meet more stringent sanitation requirements, but because it is bulky and highly perishable the cost of transporting fluid milk to metropolitan markets is higher than it is for milk equivalent quantities of manufactured products like cheese and butter. Furthermore, if the supply of fresh milk is to be assured, there will be a surplus of Grade A milk that goes into manufacturing, and since the demand curve for fresh, fluid milk is relatively inelastic and negative in slope, arbitrary price incentives via market orders were deemed necessary to assure that sufficient quantities of Grade A milk be produced for the fluid market.

On the other hand, surplus Grade A milk not demanded in fresh fluid form is diverted for manufacturing into butter, cheese, and\or nonfat powdered milk, even though it has been produced under the same exacting standards required for fluid use. Grade B milk used for manufacturing is cheaper to produce because the production standards need not be as stringent. Because the final product is easily stored and shipped, it is in a market that is at least national, if not international, in scope. These market conditions yield a highly elastic demand curve for milk sold for manufacturing. Producers selling in this market are in perfect competition with each other and

have no opportunity to influence price. Even the strikes and violence that frequently erupted prior to the establishment of market orders proved futile in effectively boosting the price of milk in the long run. Thus, dairymen were acting in their own best interest in demanding regulation of the price incentives available for milk sold for fluid consumption. Administered pricing enabled Grade A producers to differentiate their product from that of other dairymen and to escape the rigors of perfect competition to the extent that the price of Class I milk used for fluid consumption exceeded the price of manufacturing milk.

With the advent of federal orders, the stage for guaranteeing the price of manufacturing milk had been set. The notion that dairy farmers should have government support was further strengthened during the post World War II era when American agriculture struggled to come to grips with a peacetime economy. The stimulus of war and its demand for both guns and butter had called forth all the productive resources the nation could muster. Peacetime brought adjustment, and farmers soon found that they were producing more than they could sell at price levels sustained during the war. The clamor came for government to help assure that a profitable market for manufacturing grade milk be maintained. After careful study, Congress passed the Agriculture Act of 1949 including the flexible support price for milk, and thus established one of the most durable federal dairy programs ever implemented.

Under the 1949 Act, the Secretary of Agriculture could maintain, raise, or lower the support price within certain parameters. This

authority provided discipline that reduced excessive price variability, provided an adequate milk supply, put a floor under producer prices, and kept government purchases at or near the amounts actually needed for armed forces and foreign aid programs. During the 29 year period from 1949 through 1977, purchases by the Commodity Credit Corporation averaged about 5 billion pounds milk equivalent per year, roughly the amount needed to meet the consumptive demand of American military forces (Hatfield, 1986). Furthermore, the average price received by producers for manufacturing milk during that same period was less than the support price in only four of the twenty years. In other words, the program worked quite well in keeping the supply of milk in equilibrium with real market demand.

The Food and Agriculture Act of 1977, however, introduced a more liberal approach to determining price supports for dairy farmers. The production of traditional program crops like corn, wheat, and soybeans had expanded rapidly through the seventies, spurred by growing export markets and USAID programs designed to feed the world. Higher grain prices translated into higher feed costs, and dairymen demanded greater guarantees that milk prices rise to keep pace with grain. The new Act provided that the support price for milk be maintained at 80% of parity and be updated every six months over the next four years. Projections by farm policy analysts at the time were lacking in wisdom that often comes only from hindsight. Rapid consumer inflation of the late seventies and early eighties, coupled with this parity adjustment provision in the 1977 Act, sparked expansion and new entries into the dairy industry that were unprecedented in scope.

The four year period from 1977 to 1981 was a golden age in which both seasoned and would-be dairymen reacted to an attractive support price guaranteed to keep pace with inflation. The U.S. dairy herd began to grow, reversing a 33 year downtrend in cow numbers. Economic signals that had prompted the exit of less efficient producers under the flexible support price program were now distorted by government guaranties to purchase all surplus milk at an attractive price. Milk handlers invested in new processing plants, some of which were designed to produce only those products that the government was willing to buy. Agricultural lenders saw the opportunity to increase their portfolios and solicited loans for new milking parlors, feed silos, and cows. All of these factors working together rapidly facilitated expansion of the entire dairy industry. Almost immediately, CCC purchases began building to the highest level in dairy program history. Figure 1 graphically illustrates the rapid rise in support price that began in the mid-70's and continued through 1980.

Congress soon recognized its error and attempted to correct the problem as early as April of 1981 when the provision to update the support price semi-annually was rescinded. Shortly afterward came the Budget Reconciliation Act of 1981, which dropped the minimum support price to 75 percent of parity.

Then came the Agriculture and Food Act of 1981 which cut the support price even further, removing the parity connection and tieing the support level directly to the amount of CCC purchases. While these changes signaled the end of an era, the effects of the unwise policy decisions made in 1977 were still being felt. Additional measures were

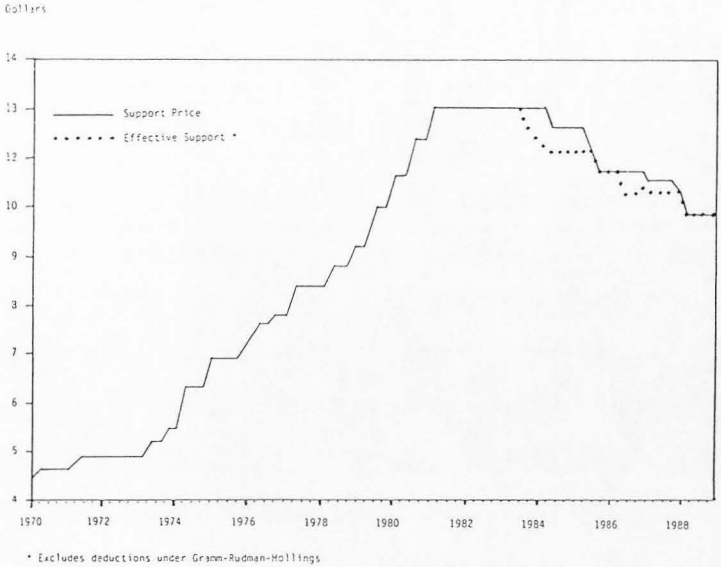

Figure 1. Milk support price

Source: Miller and Short, "The Dairy Industry Since 1970", Dairy Situation and Outlook Report, Economic Research Service, U. S. Department of Agriculture, April, 1988, p. 29.

needed to stem the flow of surplus milk. The Reconciliation Act of 1982 established a minimum support price through 1984 and empowered USDA to begin charging assessments to dairymen to offset program costs if CCC purchases exceeded a stipulated level. Two assessments of fifty cents were levied in 1982 with a refund provision tied to the second if a dairymen voluntarily cut his Class 1 marketings below his base. But few of them did. Hence came the Dairy and Tobacco Adjustment Act of 1983 which deleted prior support price actions and brought three sharp support price cuts of 50 cents each. The first was effective January 1, 1984; the second came April 1, 1985 as CCC purchases still exceeded six billion pounds; and the third was implemented July 1, 1985 because CCC purchases were anticipated to exceed 5 billion pounds that year (Hatfield, 1986). The net effect of the 1983 Act was a drop in the support price from $13.10 to $11.60. But dropping the support price alone was not enough. Purchases by CCC continued well above the 5 billion pound target, as illustrated in figure 2. And while these cuts in support price tended to ameliorate soaring USDA expenditures for the dairy support program, government costs increased by $600 million in 1985. Figure 3 depicts the soaring taxpayer costs indicating that drastic measures had to be taken to bring the dairy problem under control.

Still other measures were needed to stem the flow of surplus milk. The 1983 Act also provided for the Dairy Diversion Program, ostensibly designed to shift the dairy supply curve back and thus relieve pressure on the CCC to maintain market prices through purchases of surplus dairy products. The program allowed producers to voluntarily cut milk

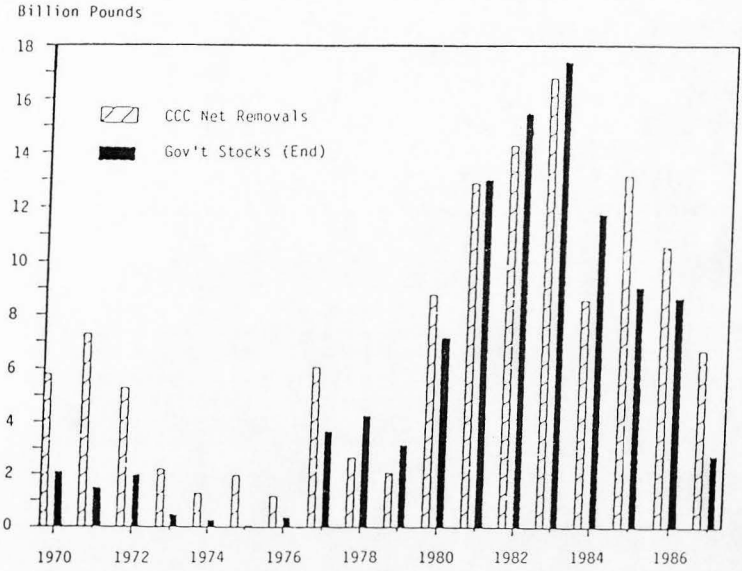

Figure 2. Government purchases and stocks of manufactured dairy products

Source: Miller and Short, "The Dairy Industry Since 1970", Dairy Situation and Outlook Report, Economic Research Service, U. S. Department of Agriculture, April, 1988, p. 32.

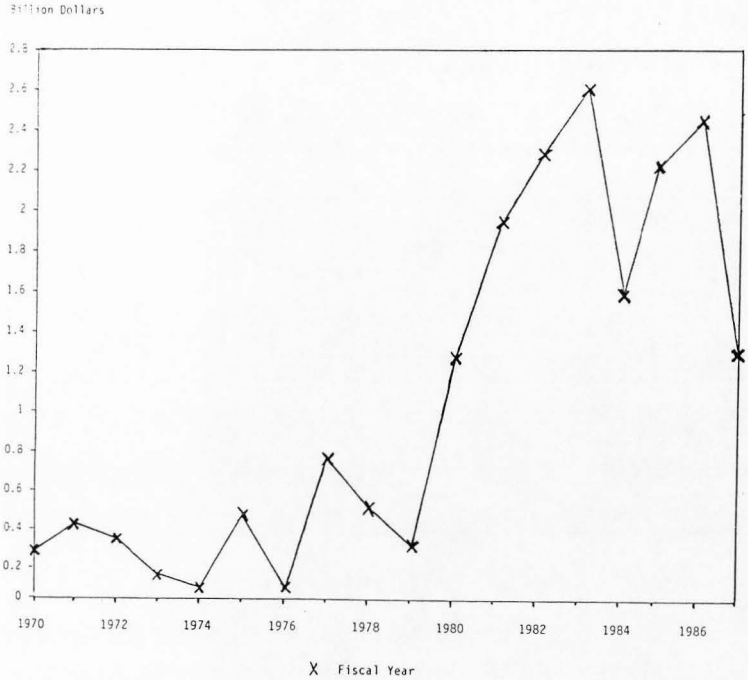

Figure 3. USDA expenditures for the dairy support program

Source: Miller and Short, "The Dairy Industry Since 1970", Dairy Situation and Outlook Report, Economic Research Service, U. S. Department of Agriculture, April, 1988, p. 32.

production from 5 to 30 percent for a 15-month period and receive a government payment of $10.00 per cwt. for making the cut. Dairymen who could substantiate reduced levels of production received payment for the milk they didn't produce. The money to fund these payments came from a mandatory assessment levied on all producers, with both collections and payments being administered through county ASCS offices. This was the first attempt to force the dairy industry to finance the costs of bringing supplies back into balance with demand. Income from assessments covered about 92 percent of the diversion payments.

But the diversion program proved to be little more than a knee-jerk reaction by policy makers trying to cut program costs. Proponents of this program apparently didn't anticipate the dairymen's ability to see through it. Nearly everyone who contracted to reduce production simply culled heavily and began grooming a corral full of replacement heifers to spring into production as soon as their contracts expired. It was a classic case of the fallacy of composition! Dairymen acting in their own best interest came back producing more milk than ever before. Production surged so rapidly after the program ended March 31, 1985 that USDA removals by the end of September had soared 36 percent above purchases for the same period in 1984. Also during September, there were 11.15 million milking cows in America, three percent more than a year earlier and the largest number in over a decade (Agricultural Outlook). The Dairy Diversion Program had failed to make any lasting changes in surplus milk production.

Another policy measure also included in the 1983 Act was the

creation of the National Dairy Promotion and Research Board accompanied by authorization of a 15 cent per cwt. assessment on all milk marketed. Monies collected under this assessment are used to finance a nationwide dairy product research and promotion program. Efforts of the National Board appear to be having a positive influence in identifying dairy products preferred by consumers. Selective advertising developed by the Board may have been successful in stimulating increased per capita consumption of these commodities. However, much of the increased sales must be attributed to lower real prices for dairy products in general.

The Dairy Termination Program authorized by the Food Security Act of 1985 was another attempt by Congress to reduce milk supplies. Under the DTP, or whole-herd buyout program as it is commonly called, some 12 billion pounds of milk production capacity was scheduled to be removed from the U.S. market through the slaughter or export of nearly one million cows and their female offspring. In all, the milk producing capacity of over 1.29 million cows and heifers was taken from the dairy sector. Under the program, dairymen who exited the industry were given cash payments equivalent to the bid price times one year's milk production and were also permitted to sell their existing herds, either for slaughter or for export.

All U.S. dairymen were given the opportunity to submit bids to their county ASCS office indicating the payment per hundredweight they would accept in return for liquidating their herds and agreeing to keep their production facilities out of dairying for a period of at least five years. Those who submitted acceptable bids are required to personally refrain from managing dairy enterprises for others and are

prohibited from selling or leasing their facilities to be used by others for dairying during that same five year period. In many respects, DTP has accomplished what it was designed to do. Novakovic has noted that many of the farmers submitting successful bids were in good financial shape and operated successful, well managed farms. Unlike the participants in the dairy diversion program, these farmers will probably not scramble to rebuild their herds when the five year waiting period expires. In that length of time, most will have found alternative enterprises either in or out of agriculture. Others will have retired, and some may have even subdivided their farmland into building lots. Many analysts feel that few of the DTP removed milking facilities will be returned to production.

But the cost of DTP has been exorbitant, both for remaining dairymen and American taxpayers. USDA's ultimate acceptance of all bids at or below $22.50 per hundredweight resulted in a cash cost of approximately 1.827 billion dollars just to make the contract payments. Additional costs have been incurred administering the program.

Part of the funding for DTP has come through a mandatory assessment collected by the milk handlers on all milk produced by dairymen remaining in business. The initial assessment of $.40 per cwt. was collected on all milk marketed from April 1 through December 21, 1986. Commencing January 1, 1987, the assessment dropped to $.25 per cwt. and continued through September 30, 1987. An additional Gramm-Rudman-Hollings deficit reduction assessment of $.12 per cwt. was charged during the period March 1 through September 30, 1986. Multiplying these assessments by published national milk production

figures for 1987 and 1988 indicates that producer assessments have recovered approximately $694 million of the contract costs. Hatfield (1988a) estimated that assessments extracted only 38 percent of the $1.8 billion contract costs, leaving 1.1 billion dollars to be paid with taxpayer dollars directly from the U.S. Treasury. This does not include administrative expenses. Nor does it include continuing CCC outlays, and as was seen in figure 3, net government expenditures for support purchases have decreased only slightly during the period 1985-87 when compared to 1982-84. Such excessive costs tend to preclude the possibility of Congressional approval for another buyout program, especially in light of current efforts to reduce deficit spending.

Foreseeing that milk cow removal under DTP was not likely in itself to reduce surplus production below the 5 billion pound target, the Congress further provided for mandatory reductions in the support price under the Food Security Act of 1985. In a sense, the whole herd buyout program merely postponed inevitable cuts in support price, and assessments served to precondition remaining dairymen to accept lower prices for milk. The support price for milk remained constant at $11.60 per cwt. through calendar 1986; then interim adjustments in the support price began to be implemented as producer assessments were reduced. First came the cut from $11.60 to $11.35 on January 1, 1987, eliminating any increased cash flow to producers that would have occurred when the Gramm-Rudman-Hollings assessment expired and the DTP assessment was reduced to twenty-five cents. The second price support cut of $.25 came October 1, 1987, the day after assessment collections ended. Thus, the decrease in prices received by producers at the

outset of the DTP has persisted even though the assessment ceased on September 30, 1987.

The first mandatory support price reduction, stipulated under the 1985 Act as a secondary method of reducing surpluses, became effective January 1, 1988. As required by Congress, the Secretary of Agriculture reduced the milk support price by $.50 per cwt. The Act stipulates that additional cuts be made at the beginning of 1989 and 1990 if the level of CCC purchases is expected to exceed 5 billion pounds (milk equivalent). This price reduction is cumulative, meaning that if purchases are forecast to remain above the 5 billion pound target through each of these years, the support price will ultimately be reduced by $1.50 per cwt. Conversely, if CCC purchases for 1989 or 1990 are expected to be less than 2.5 billion pounds (milk equivalent), the Secretary is directed to increase the support price by 50 cents (Korves). The Drought Emergency Assistance Act of 1988 rescinded the fifty cent reduction for January, 1989 and provided an increase in support price of fifty cents for the period March to May, 1989. But if surpluses continue into 1990, additional cuts in the support price appear to be inevitable.

The Problem in Utah

The Dairy Termination Program has had a significant effect on the short-run supply of milk in the Intermountain West and on the economy of dairy areas such as northern Utah. Regional dairymen interested in exiting the industry under DTP tended to submit bids that were somewhat lower than those received in California and the Midwest. Table 1 lists comparative data for the 48 contiguous states. With the national milk

Table 1. DTP Bids Accepted Nationwide and the Resulting Reductions in Milk Marketings and Dairy Cow Populations by State

State	No. of Bids Accepted	1985 Milk Marketings All Bids (mil lbs)	1985 Milk Marketings State Total (mil lbs)	Percent of Milk Mktg. Removed %	Ave. Bid Price ($/cwt)	No. of Cows
AL	91	128	544	23.5	12.51	11667
AZ	15	138	1341	10.3	13.87	6773
AR	221	171	826	20.7	12.59	16080
CA	325	1779	16679	10.7	15.58	114947
CO	69	115	1050	11.0	14.88	8382
CT	53	73	610	12.0	11.66	5321
DE	9	7	145	4.8	11.29	617
FA	48	283	2025	14.0	14.73	23329
GA	179	278	1287	21.6	14.41	24419
ID	315	516	2368	21.8	13.85	34425
IL	307	166	2783	6.0	14.54	13723
IN	282	175	2381	7.4	14.60	13859
IA	803	348	3946	8.8	15.23	30275
KS	274	158	1260	12.5	14.98	13284
KY	399	199	2138	9.3	15.46	19064
LA	90	83	889	9.3	12.99	8003
ME	86	73	659	11.1	13.43	9803
MD	115	124	1668	7.4	15.58	9254
MA	66	110	575	19.1	12.30	8117
MI	846	638	5468	11.7	15.24	46146
MN	2150	968	10762	9.0	15.03	79597
MS	173	148	861	17.2	14.03	14351
MO	645	405	2825	14.3	15.16	36974
MT	31	40	332	12.4	14.01	2845
NE	309	158	1310	12.1	14.18	14109
NV	2	4	261	1.5	14.70	223
NH	58	53	356	14.9	13.65	3869
NJ	34	32	479	6.7	15.42	2453
NM	25	159	1064	14.9	11.78	10189
NY	542	470	11485	4.1	16.05	34858
NC	178	218	1693	12.9	14.45	16381
ND	294	135	1080	12.5	14.43	13213
OH	484	264	4819	5.5	14.80	20312
OK	194	162	1153	14.1	13.86	14547
OR	122	176	1396	12.6	15.09	12496
PA	418	271	9840	2.8	15.67	20614
RI	3	2	42	5.2	12.59	176
SC	58	74	572	12.9	14.73	5947
SD	452	208	1775	11.7	13.88	18951
TN	260	190	2151	8.8	15.67	16575
TX	376	637	3920	16.3	14.93	54986
UT	177	184	1113	16.5	14.07	14010
VT	195	159	2355	7.2	14.25	13268
VA	199	197	2092	9.5	14.57	15437
WA	258	540	3723	14.5	15.28	34094
WV	53	45	372	12.1	14.57	3480
WI	1681	785	24550	3.2	16.00	62633
WY	24	22	127	17.3	14.30	1734
US	13988	12280	141140	8.7	14.88	951619

Source: Cooley, ASCS, USDA, 1986.

price bid limit of $22.50 /cwt., dairy resources responsible for approximately 16.5 percent of Utah's 1985 milk production were eliminated in the short run as participating herds were sold for slaughter.

USDA reports total 1985 milk marketings of 141.14 billion pounds in the United States (Cooley). Utah produced 1.11 billion pounds of milk in 1985, roughly .76 percent of the national total, and yet DTP reductions in Utah account for nearly 1.5 percent of total removals nationwide. The DTP eliminated nearly 12.3 billion pounds or 8.7 percent of the 1985 national milk production capacity. That's a lot of milk, roughly eleven times as much as all of the milk produced in Utah in 1985. Utah lost a total of 177 dairies to the buyout, with the loss felt most keenly in the northern part of the state. In Cache County alone, 61 herds were liquidated during the eighteen-month period commencing April 1, 1986 through September 30, 1987. The point is that proportionately more dairy resources were enticed out of production in Utah than in other areas of the country.

This is in sharp contrast to the Upper Midwest, where surplus dairy production remains a chronic problem. Most dairymen in that area who wanted to participate in the program submitted high bids that ultimately were rejected. Initial reports indicate a reduction of only 3.2 percent in Wisconsin, for example, compared to the targeted decline of 10 percent nationwide. It is generally assumed that much of the surplus milk problem originates historically in the Midwest and been perpetuated by dairymen and processors in that region who have built large dairy plants based on support prices and government purchases

rather than real market demand. But the scope of the problem extends beyond the upper Midwest. During the past three marketing years, 36 states had one or more plants that shipped dairy products to the CCC. Most, if not all, of the 12 remaining mainland states moved surplus milk to a manufacturing plant in another state sometime during the same period. Utah plants have sold in excess of 44 million pounds of dairy products to the CCC since 1980, but only 11.3 million pounds in the past three years (Hatfield, 1988b). In the final analysis, all milk is a part of the nation's milk supply and excess milk, wherever produced, is moved to where the manufacturing plants are located. Manufactured product from any of these plants may ultimately be purchased by CCC.

At first glance, one might think that cutting the support price would adversely affect only those dairymen supplying milk to processors who are selling directly to CCC. But it's more complicated than that. The incentive to build additional processing plants to handle surplus milk is rooted in a support price that has exceeded market equilibrium for an extended period of years. As the support price continues to drop, Utah processors will be forced to either purchase their milk for less or go out of business. Thus, the local farm price for milk must follow the support price, and additional declines in the support price will likely follow.

Table 2 gives the breakdown by counties of Utah dairies participating in the DTP. Over a third of all dairies affected are located in Cache County where most of the data collected for this study originates. It is interesting to note that most of the 177 dairies affected were relatively small, with 81 milking fewer than 50 cows.

Table 2. Utah DTP Bids Accepted and Reductions in Marketings and Dairy Livestock Populations by County

County	Number of Bids Accepted*				1985 Marketings	Cows	Cows, Heifers and Calves
	S	M	L	T	(cwt.)		
Beaver	4	2	0	6	40,113	311	493
Box Elder	11	5	4	20	273,036	2020	3398
Cache	23	36	2	61	600,918	4183	6923
Davis	0	2	2	4	67,264	700	1029
Duchesne	7	6	1	14	85,266	808	1136
Garfield	1	0	0	1	4,364	36	48
Juab	1	1	0	2	11,393	93	177
Millard	4	2	4	10	156,105	1147	2146
Morgan	2	0	0	2	8,653	61	102
Piute	2	2	1	5	41,144	394	654
Salt Lake	0	0	1	1	25,071	169	300
Sanpete	4	0	3	7	100,999	808	1353
Sevier	1	1	0	2	11,321	129	208
Summit	7	4	0	11	85,164	652	1095
Uintah	0	1	0	1	11,713	109	190
Utah	4	7	0	11	103,053	775	1355
Wasatch	3	2	0	5	52,812	428	739
Washington	1	0	0	1	30,726	280	466
Wayne	1	1	0	2	13,457	125	199
Weber	6	4	1	11	115,301	782	1422
Totals	82	76	19	177	1,837,153	14,010	23,423

* S = Small dairies milking 50 cows or fewer
M = Medium sized dairies milking 51-150 cows
L = Large dairies milking over 150 cows
T = Total

Source: Cooley, ASCS, USDA, 1986.

Several of these were isolated operations geographically separated from processing plants and thus were saddled with heavy milk hauling costs.

Initial concerns about the effects of the program on Utah's agricultural economy now appear to be transitory. Cattle prices, which declined sharply at the outset of the program, have recovered and are now higher than they have been in the past five years, due in part at least to reduced numbers of dairy cattle finding their way to market on a regular basis. Overall milk production within Utah is rebounding, as seen in table 3. Although cow numbers remain below pre-DTP levels, the herd appears to be rebuilding and milk production per cow has been increasing steadily since 1984. Average milk production per cow in 1987 increased 3 percent from 1986 to establish a new high of 15,148 lbs. This record is 11 percent higher than the 1982-86 average (Utah Agricultural Statistics, 1988). If this trend continues, total Utah milk production for 1988 will achieve an historical high. Additional measures will have to be taken to deal with the surplus problem, and cuts in the support price seem imminent.

Table 3. Milk Cow Numbers and Milk Production Data for Utah, 1985-1988

Year/Quarter	Milk Cows 1/	Total Production 2/	Milk per Cow 3/
		pounds	pounds
1985 1st qtr	80,000	253,000,000	3,165
1985 2nd qtr	83,000	291,000,000	3,505
1985 3rd qtr	85,000	308,000,000	3,625
1985 4th qtr	83,000	283,000,000	3,410
1985 TOTAL		1,135,000,000	13,675
1986 1st qtr	82,000	285,000,000	3,475
1986 2nd qtr	81,000	308,000,000	3,800
1986 3rd qtr	79,000	298,000,000	3,770
1986 4th qtr	75,000	266,000,000	3,520
1986 TOTAL		1,157,000,000	14,565
1987 1st qtr	74,000	269,000,000	3,365
1987 2nd qtr	76,000	291,000,000	3,829
1987 3rd qtr	74,000	288,000,000	3,892
1987 4th qtr	72,000	273,000,000	3,792
1987 TOTAL		1,121,000,000	15,149
1988 1st qtr	73,000	273,000,000	3,740
1988 2nd qtr	74,000	305,000,000	4,120
1988 3rd qtr	75,000	313,000,000	4,173

1/ Milk cows, average number for quarter; includes dry cows, excludes heifers not yet fresh.
2/ Total produced for quarter.
3/ Excludes milk sucked by calves.

Source: Owens, 1988 and Utah Agricultural Statistics, 1988.

CHAPTER II

LITERATURE REVIEW

Market prices, responding to upward pressure from government price supports, appear to have given dairy farmers incentives to increase milk production since the late 1970's. Chavas and Klemme blame the surplus of the mid-1980's on the inflated dairy price support program of recent years. This artificial price mechanism is largely responsible for the excess supply disequilibrium in the dairy market. The higher milk price has stimulated retention of replacement heifers and herd expansion, an effect compounded by the fact that beef prices during the same period have been relatively low. Thus the decision to slaughter young female dairy stock has been outweighed by larger potential profits to be derived from expanding the size of the milking herd.

Early efforts to reduce the surplus by cutting support prices in 1984 and 1985 were hampered by lags in the farm-retail price transmission shown by Kinnucan and Forker. They hypothesized that middlemen view increases in farm prices caused by higher price supports as permanent increases in costs and rapidly transmit these increased costs on to retail price levels. On the other hand, reductions in support levels are perceived to occur only infrequently and are viewed as largely transitory, resulting in a slower and less complete passthrough. This asymmetry in the price transmission mechanism was shown through regression analysis to cause retail dairy product prices to adjust more slowly to decreases in the farm price of milk than to

increases. Hence, declines in retail prices in response to huge surpluses of dairy products and lower support price have not materialized as quickly as they should.

The most salient criticism of the Dairy Termination Program is related to its cost. Government administrative costs and taxpayer contributions toward DTP have been expensive. U.S.D.A. costs not recovered through the assessment have been estimated to exceed $1.2 billion over the course of the program. Yet for many dairymen struggling to remain in business, the DTP assessment has seemed downright oppressive. Hundreds of large dairies participating in the program continue to receive payments that will exceed $1 million per firm for having sold their cows and exited the industry under DTP (Ag A.M. 12/23/86). Many of them are large firms, with substantial investment in milk parlors and dairy herd housing facilities. Some undoubtedly plan to re-enter the dairy business when the program expires in 1991.

In an address to Associated Milk Producers Inc., the nation's largest dairy cooperative, Secretary of Agriculture Richard Lyng told members that while the Food Security Act of 1985 is serving dairymen well by lowering production, raising consumption and drawing down CCC surpluses of non-fat dry milk, the Dairy Termination Program has been too expensive (Executive News Watch 3/25/87). He warned dairymen not to speculate on future farm policy by increasing the size of their herds and said that any increase in dairy program costs should be paid through assessments on dairy farmers and not by the government.

Despite its cost, the DTP program has paved the way for reductions

in support price, and this is a program that appears to be working. Korves projects the confluence of supply and demand by 1990, but suggests that the support price cuts of $.50 per year through 1988, 1989 and again in 1990 are necessary to achieve this equilibrium. But the Disaster Assistance Act of 1988 has eliminated the cut scheduled for January, 1989. Such Congressional interference is bound to impede reductions in CCC purchases which would otherwise have been accelerated by the high feed costs associated with this year's drought.

Christensen showed that DTP tended to cut cheese production in Utah, and lower levels of cheese production nationwide are a necessary part of trimming surpluses. Utah cheese production for 1987 was 15 percent less than for 1986.

Cropp argues that the increase in demand for dairy products plays a greater role in returning to equilibrium than does the DTP working on the supply side. Increased consumer demand is stimulated by constant and even lower consumer prices for all dairy products, particularly cheese. He predicts that producer prices will continue to fall during the next few years, leveling off at around $10.00 per cwt. This will stimulate further exit from the industry by producers caught in the cost-price squeeze and others who simply retire.

CHAPTER III

METHODOLOGY

Farm simulation models have gained prominence in economic research during the past two decades as a valuable tool in evaluating the effects of various management strategies and government farm programs (Hutton and Hinnman; Patrick and Eisgruber; Hardin; Richardson and Condra; Richardson and Nixon). These models may be programmed to simulate basic economic functions for an individual firm over an extended period of time. Typical functions that may be simulated include crop and livestock production, cash receipts, variable and fixed costs, family living expenses, asset valuation, farm growth, machinery replacement, income taxes, loan acquisition and repayment, and farm programs. The results of simulation allow the analyst to predict the likely outcome of management practices and/or farm programs before they are actually implemented.

A Description of FLIPSIM

Perhaps the most comprehensive simulation model available is the FLIPSIM computer model developed at Texas A & M University by Richardson and Nixon in 1981. FLIPSIM V is the most recent edition of this dynamic model that is generally available for economic research. FLIPSIM V is a powerful, firm level model which simulates the annual production, marketing, financial management, growth and income tax aspects of a farm over a multiple-year planning horizon. It is also recursive, meaning that the economic calculations of each successive

year in the simulation process begin with the economic status of the firm at the end of the year previously simulated. Each completed simulation sequence runs through the entire, multiple-year planning horizon and is referred to as a single iteration. Stochasticity is maintained through repeated iterations because variables such as prices and yields selected by the analyst are allowed to fluctuate at random within the statistical parameters specified in the data. The model is capable of simulating a maximum of 300 iterations over a 10 year planning horizon. Upon completion of the last iteration, FLIPSIM V performs a statistical analysis of up to 489 output variables, develops cumulative probability distributions (cdf) for these output variables, and estimates the probability of the farm operator remaining solvent for the remainder of the planning horizon.

While FLIPSIM V features a limited optional capacity to use linear programming to select optimal input combinations, it is not intended to be a programming model. Instead, FLIPSIM V analyzes the outcome of a given set of input data and assumptions for a typical farm. Almost all of the computational components of the model are based upon accounting equations. Virtually no econometric relationships with fixed parameters are included.

All of the basic functions that must be performed annually by a farm manager are specified in the program to conform to accepted farm management, financial, and accounting principles. These include the specific equations necessary to estimate all of the variables in a detailed set of financial statements (income, cash flow, and balance sheet). FLIPSIM V is programmed to calculate depreciation, federal

income taxes and self-employment taxes from the federal tax codes. Interest rates both for the amortization of existing loans and returns on investment are specified by the analyst. Behavioral relationships such as growth, decay, family living, machinery replacement, timing of cash sales, and farm program participation are also identified and included in the model.

Empirical Criticisms of FLIPSIM

Simulation studies require a broad spectrum of data. One might assume that the broader the data base (i.e., the greater the number of economic variables included in the model), the more accurate the results. While this supposition is sound, one must also remember that the outcome of any simulation study is intimately associated with the veracity and completeness of the descriptive data. Hence care must be taken to enter reliable input information. The acronym GIGO indicating garbage in - garbage out is especially applicable in simulation studies. Moreover, the inclusion of too many variables in the model tends to hinder the researcher's ability to clearly predict what will happen when one of the variables is changed. Thus it is deemed appropriate to hold constant much of the generally accepted economic information used in constructing the framework within which the model will operate and to purposely limit the number of factors that are allowed to fluctuate.

Most criticisms dealing with the use of FLIPSIM focus on the validation and verification of the results. Simulation models are designed to enable the analyst to predict the likely outcome of a given set of management decisions or farm policies prior to their actual

implementation on a given farm, hence, the credibility and accuracy of the projections made are vitally important if use of the model is to be of any practical value. Naylor classifies three methodological positions for validating simulation models, namely: rationalism, empiricism, and positive economics. Rationalism holds that economic models are based on postulates that are of unquestionable truth so the problem of verification is merely a problem of identifying the underlying assumptions in the system to be modeled. Empiricism, on the other hand, holds that observation of results is the only source and the ultimate judge of knowledge. Empiricism thus rejects postulates and assumptions that can not be empirically verified. Positive economics holds that the validation of a model rests on the model's ability to accurately predict the dependent variables and not on the validity of the basic assumptions in the model.

In dealing with these validation problems, Richardson and Nixon suggest a middle of the road approach which recognizes the benefits of both basic assumptions and empirical relationships, as well as predictable results. FLIPSIM V is designed with verification checks built around each of these methodological criticisms. In developing the model, Richardson and Nixon have been very thorough in specifying the data that must be entered to make the model work. Virtually no parameters in the model are estimated; specific inputs are required for every variable encountered. Behavioral relationships between these variables are simulated using at least two equations for each possible farm operator response. Options include those provided by law (e.g. alternative depreciation methods), alternative specifications found in

the literature (e.g. family consumption functions) and the results of actual producer surveys.

During development of FLIPSIM, extensive empirical testing was conducted by programming the basic functions and relationships into a working model and checking for numerical accuracy when used with other functions and the stochastic elements of the model. Each of the stochastic components of the model were tested to insure that they produced random prices and production levels from their assigned distributions. Repeated tests have been conducted to determine how many iterations are necessary to obtain an acceptable estimate of the cumulative probability distribution for net present value. Results indicate that 50 iterations are sufficient and will produce the same parameter values and shape for the net present value cumulative probability distribution as 100, 200, or 300 iterations. Empirical testing is continuing as the model is expanded to simulate different types of farming situations and policies.

Testing for positive economics requires sufficient time to elapse to compare model predictions with actual outcomes for the system being modeled. While sufficient time has not elapsed to allow comparison of a complete 10-year FLIPSIM prediction to the outcome of particular farms, the results of FLIPSIM predictions have been tentatively verified by empirical observation (Bailey; Grant, Richardson, Brorsen, and Rister; Smith).

As FLIPSIM is expanded and improved, Richardson and Nixon are continuing tests for validation in each of the three areas specified above. The model is currently being used by agricultural economists at

Texas A&M University, Utah State University, University of Arkansas, Oklahoma State University, Louisiana State University, Auburn, Clemson, Mississippi State University, University of Minnesota, University of Illinois, and USDA.

How the Model Works

The extensive use and review of the model have aided its creators in developing the current version. FLIPSIM V contains at least 30 subroutines that must be working harmoniously in chronological order before acceptable results can be obtained. Initially, a series of 7 subroutines is activated to read all of the input date for the farm being simulated. The computer is programmed to display error messages due to lack of information or improper ordering of input data by the analyst during this first series. If no error messages appear, the model processes the input data to develop necessary values that are either not provided by the analyst or are provided in a different form than the model requires. Values developed by the model include accumulated depreciation for machinery inventory and breeding stock, the replacement calendar year for the milking herd, the total value of cows, heifers and bulls that may have to be purchased in a given year, etc. Information necessary to amortize existing long- and intermediate-term debts is processed using the debt-to-asset ratio, interest rate(s), length of the loan, and other original loan amount information provided by the analyst. The beginning net worth for the firm is calculated by the model to serve as a basis to which simulations may be compared. In determining the initial net worth, consideration is given to all debts and assets, including cash on hand,

off-farm investments, land, buildings machinery, and all dairy stock. Total debts include accrued income and self-employment taxes due during the first year of the planning horizon. As the model completes the first series of subroutines, all of the information describing the initial economic environment for the farm is stored in a series of backup files. These backup files are used to reinitialize all working files in the model at the outset of each iteration for a stochastic simulation.

Successive subroutines are used (1) to simulate possible variations in the crop mix including the use of linear programming to calculate the profit maximizing crop mix, (2) to calculate variable costs of production adjusted for inflation, (3) to track fixed costs including property taxes, accounting fees, insurance premiums, and miscellaneous fixed costs, all of which are adjusted for inflation as specified by the analyst, (4) to amortize real estate loans, and (5) to account for cash receipts from all sources, including sales of milk, livestock, surplus crops not used for feed, and government payments where applicable.

A special subroutine for dairy enterprises calculates the monthly labor requirements for the herd depending on the number of milk cows, dry cows, heifers, calves and bulls. Annual feed requirements per head for each crop grown on the farm are multiplied by the number of cattle in each category to determine the total feed requirements to be furnished from each crop. Cash receipts from the sale of calves and replacement heifers are calculated based on the replacement schedule, calving rates, and prices included in the input data. The model is

fairly sophisticated in simulating cash receipts and makes an earnest attempt to simulate real world situations. After the analyst specifies the culling rate for the herd and the percentage of calves grown for replacement, for example, the model sells one-half of the culled replacement heifers over 12 months of age at a price equal to 50% of the replacement cost for cows and assumes that the other half sells for only 40% of the replacement cost for cows. These fractions reflect the assumption that only half of the heifers sold go into another milking herd; the others are culled due to sickness, failure to breed, etc. The dairy subroutine also calculates the non-labor, non-interest costs for milk cows, dry cows, heifers, calves and bulls such as cost of purchased feed, veterinary costs, breeding fees, utility costs, milk hauling charges, capital rotation, etc. as specified by the analyst and adjusts these costs each year according to an inflation index. Purchased livestock is expensed for cost recovery using either a straight line or accelerated (ACRS) 3- or 5-year cost recovery system as specified by the analyst. As dairy animals reach the end of their economic lives, they are sold. The market value of all dairy animals remaining on the farm at the end of each year is estimated using the stochastic livestock prices for the year and the number of head in each category. Cows over two years old are valued at the price of replacement cows. The total of these market value figures are used to update the farm's balance sheet at the end of each year.

The final function of the dairy subroutine is to update the dairy herd for the following year. The model does this by solving several identities for the calf herd (birth, death, and sale) to determine the

number of heifers entering the replacement herd; the replacement herd (death, sale, and breeding) to determine the number of replacements entering the milking herd; and the milk cow herd (culling and death) to determine the number of cows to sell or buy to achieve the analyst's desired herd size for the next year. These values are calculated using the number of head in each category coupled with the replacement strategy specified by the analyst.

After calculating through all of the subroutines mentioned above, the model totals cash receipts and cash expenses to arrive at net cash farm income. Total cash farm income includes total crop and livestock receipts plus government payments. Total cash expenses include: operating, intermediate and long-term interest payments; total variable production and harvesting costs for all crop and dairy enterprises; hired labor costs, cash rental payments for cropland, property taxes paid, and other fixed costs. Net cash farm income is calculated as the difference between total cash receipts and total cash expenses. Off-farm income, including dividends, interest, and wages from off-farm employment is not included in net cash farm income but enters into cash flow calculations at the end of each year.

Annual cash withdrawals for family consumption are calculated using a consumption function specified by the analyst. Minimum and maximum values for annual family living expenses included in the initial data are adjusted according to fluctuations in the Consumer Price Index.

After net cash farm income and family living expenses have been determined, the model works through a cash flow subroutine to calculate

net farm income. Accrued income taxes and self-employment taxes are calculated for the year being simulated and are deducted as cash expense during the ensuing year. A minimum cash reserve specified by the analyst must be kept on deposit, but surplus cash may be used for early repayment of debts or used for expansion. If a cash flow deficit occurs, the model automatically tries to refinance. Deficits are initially reduced by granting a lien on crops held for sale in the next tax year. The remaining deficit is handled as follows. First the model tries to refinance the deficit using equity in long-term assets. If the deficit can be fully refinanced with long-term debt, a new loan is acquired and total long-term debt is increased to reflect the value of the deficit plus the appropriate refinance charge. If insufficient long-term equity is available, the model attempts to finance the remaining portion of the deficit with a mortgage on intermediate-term equity. Failing that, the final alternative is to sell cropland. Cropland which has been sold is assumed to be leased back, thus avoiding an over-investment in machinery relative to cropland. When the operator can not reduce the deficit to zero after selling all cropland, the firm is declared insolvent.

Financial ratios are also taken into consideration in determining the solvency of the firm. At the end of each year simulated, the model calculates debt to asset, equity to asset, leverage (debt to equity), and various other ratios commonly used by banking institutions as an index for loan qualification. Using these ratios, a firm may be declared insolvent even though the operator still has a positive net worth.

The overall operation of the FLIPSIM is schematically diagrammed in figure 4. The model simulates the operation of the farm over a specified time period (in this case five years), and repeats this multiple-year planning horizon for 50 iterations during a stochastic analysis. Each iteration begins with the same given data, but the values fluctuate within the statistical limits specified in the data set. Statistical variability in the data develops a unique set of financial statements for the firm at the end of each iteration and calculates a unique net present value for the firm. These net present values are grouped into a cumulative probability distribution, and the model generates a probability statement that projects the economic survival and success of the firm.

With the challenge of falling milk prices identified as the subject of this study, care has been taken to eliminate other variables that may cloud the outcome predicted by the model. Inflation is an example. If one were to assume that feed costs were to increase while milk prices declined, the model would likely make minimizing feed costs appear to be relatively more attractive than a strategy for herd expansion. Conversely, if one assumes that feed costs will remain steady, the model is made to reflect more clearly what strategies will work best in dealing exclusively with cuts in the support price of milk. This is precisely the information that dairy managers need in the wake of DTP. Monetary policy has been fairly effective in controlling the rate of inflation during the eighties. Therefore, it was assumed that normal fluctuations around mean values for the producer price of milk established over the past ten years

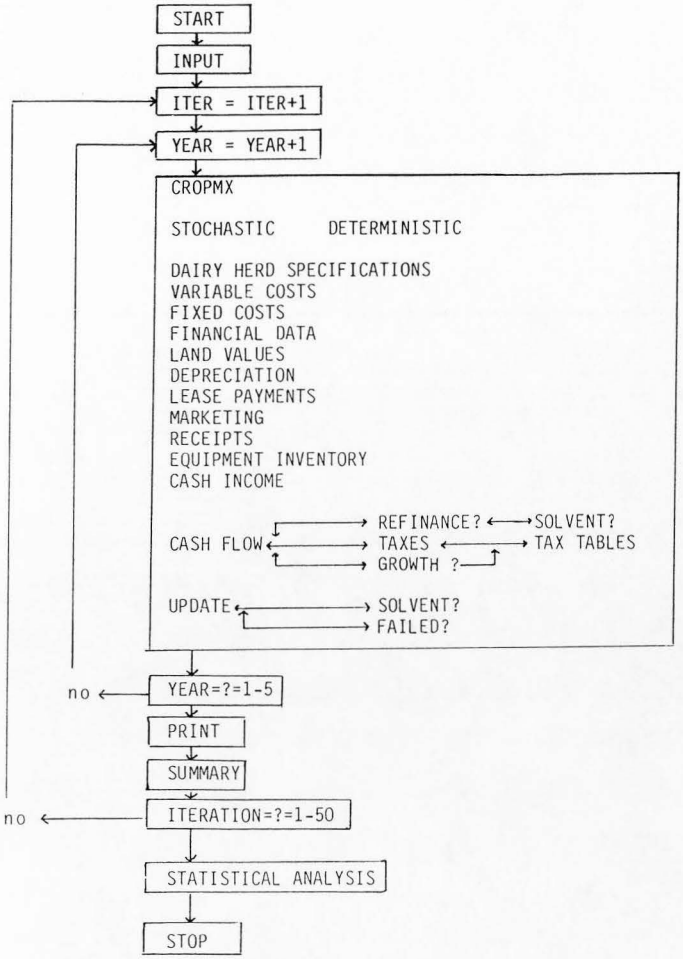

Figure 4. Schematic of the overall FLIPSIM V model

will continue.

Economic and biological variables that are permitted to fluctuate around the norm established since 1976 include seasonal production cycles, seasonal milk price fluctuations, and feed cost indexes along with prices paid or received for replacement heifers, cull cows and baby calves. Month to month fluctuations are simulated using a factored covariance matrix for each variable. The matrix is constructed using general time series data from Utah.

FLIPSIM V projections can be generated for any individual farm provided sufficient data is available, and the researcher can use the results to make specific management recommendations for that particular farm. These specific recommendations are likely to be of limited value, however, when applied to an entire population of dairy farmers. A more useful approach is to simulate conditions on a typical or average farm. The typical farm is described using the mean values of descriptive data collected from actual farms in the sample population.

In determining the characteristics of a typical dairy farm, one of the most important considerations is size. Of the 177 Utah dairies removed under the buyout, 80 were milking fewer than 50 cows at the time the bids were submitted. One may assume that smaller operators were more apt to participate in DTP because they found it difficult to compete with the economies of size and scale enjoyed by their larger counterparts. At the upper end of the buyout spectrum there were 21 dairies milking more than 150 cows. That leaves 76 dairies, or forty three per cent of the operators who sold out under DTP in the mid-size range, milking 50 to 150 cows.

A 1985 FLIPSIM study conducted by Helms focuses on mid-sized dairy farms in Cache Valley. Some of the data for the typical farm comes from Helms and has been updated as needed to fit the current application. However, all of the financial and production data is current and was collected specifically by the author for this study. Using this data, the FLIPSIM V computer simulation model has been applied to forecast the results of selected management options available to Utah dairymen who have continued to operate through DTP. These options include basic Extension Service recommendations such as changing rations in ways that will increase milk production per cow and decrease feed cost per unit of milk. The problem of declining producer prices for milk resulting directly from cuts in the support price is addressed, and FLIPSIM V simulations are used to recommend management strategies that may aid the dairyman in competing at lower prices levels.

Description of the Typical Cache Valley Dairy Farm

Ackerman, Bailey and Jensen supervised collection of extensive socio-economic data from 117 randomly selected dairies operating in northern and central Utah as part of the 1986 USU Farm Stress Survey. Fifty-eight of these farms were classified as medium size, meaning they kept herds ranging in size from 50 to 150 mature milk cows. Primary data for this study comes from a subset of eleven medium-sized Cache Valley dairy producers selected from the overall survey. Cache Valley was selected for study because of the high concentration of dairies in this area and because supporting data necessary to run the model was

readily available. A larger sample of 17 mid-sized dairies was initially selected for this study but 6 were later dropped as being atypical.

The values and capacities of current physical facilities such as herd housing, milk barn configuration, milking equipment and bulk tank capacity together with feed source data are based on interviews with the subset of eleven dairymen owning and managing similar sized dairies in Cache Valley. The individual dairymen that were interviewed are generally known to be excellent managers with better than average production records and relatively low levels of debt.

A typical, mid-sized Cache Valley dairy farm was hypothetically created by combining the mean values of all classes of data collected from the eleven dairymen selected in the subset. It is the operation and management of this typical farm that was simulated for this study. Additional information needed to make FLIPSIM run but not available from the Farm Stress Survey data is taken from Helms. Operation of the typical farm was simulated over a five-year planning horizon, beginning in 1987.

The typical farm is family owned and operated by a married male 47 years of age. The dairyman and his wife have three children, two of whom help part-time performing regular chores associated with the operation of the farm. The farmstead includes a nice home, milking parlor, and various outbuildings adequate for housing all of the existing herd and maintaining the machinery inventory. A total of 150 deeded acres of irrigated cropland are available to produce feed for the dairy livestock kept on the farm. An additional 90 acres of

cropland is leased at the annual rate of $47.50 per acre. The entire acreage is presumed to consist of Class II land and crop yields are projected accordingly. Survey data indicated that a farm this size could have up to 50 acres of pastureland to supplement the feeding requirements for dry stock and the replacement herd; however, forty percent of the farms surveyed kept all stock in drylot without benefit of grazing. To facilitate cost accounting for feed and to more accurately predict weight gain performance in young stock, no pastureland is included for the typical farm. All livestock are housed in corrals and fed with crops grown on the farm or purchased through commercial channels.

The typical farm has an initial milking herd of 104 Holstein cows, 15 of which are assumed to be dry at any given time. A full complement of young female stock is raised on the farm, with beginning inventories of 41 replacement heifers and 37 calves under 12 months of age. Male calves are assumed to be sold at birth. Breeding is done by artificial insemination and no bulls are kept on the farm.

Adequate animal housing is available for the entire herd. The milking parlor is configured with double herringbone stalls, four on each side of the barn and includes a pipeline milking system with a 1200 gallon bulk tank. All outbuildings are assumed to have an economic life of 20 years.

Only six of the eleven farms in the subset provided sufficient data used to calculate debt-to-asset ratios. Since actual appraised values were unavailable, the value of long-term assets for each farm in the subset was estimated as follows. Land values for each farm were

determined by multiplying the actual number of acres owned by an average selling price of $1500/acre. Valuation of the farm dwelling, outbuildings, machinery and equipment was calculated using the mean of estimated cash values reported in the survey. The sum of land and building values was compared to the specific levels of real estate debt reported on each farm, the mean values were calculated, and the initial long-term debt to asset ratio was determined to be .430. Similarly, the initial intermediate-term debt-to-asset ratio was determined to be .290. Intermediate-term assets include dairy livestock of all ages plus all farm machinery. It is assumed that all feed purchases are on a cash basis, with all feed on hand being used during the current year. Hence, existing feed stocks are not considered in calculating this ratio. Neither are the reported values of off-farm investments and livestock held for other enterprises nor liens against them included. The focus of this study is to examine the dairy enterprise as it stands alone. The farm is assumed to have a beginning cash reserve of $5000 for use in day to day operations. A minimum cash reserve of $1000 is arbitrarily specified for the farm to carry at all times. The financial portfolio for the farm is summarized in table 4.

Selected fixed costs not entered elsewhere must be entered separately. These include total annual accounting and legal fees of $333, unallocated maintenance and repair costs of $6095 stemming primarily from maintenance of the milking system, and farm related insurance premiums of $1539. A miscellaneous fixed cost of $1200 was also entered as a precautionary measure to compensate for actual costs that may have been overlooked.

Table 4. Financial Portfolio for the Typical Mid-sized Dairy Farm in Cache Valley

LONG-TERM ASSETS:		
Farmstead		$ 87,300.
Outbuildings (incl. lvstck & mach sheds)		117,100.
Cropland (150 acres @ $1500/acre)		225,000.
Pastureland		0.
TOTAL LONG-TERM ASSETS		$429,400.
INTERMEDIATE ASSETS:		
Farm Machinery and Equipment (per schedule)		$104,750.
Milking Equipment (milker and bulk tank)		$ 15,450.
Livestock		$125,240.
(104 cows @ $835. = $86,840.)		
(41 heifers @ $700 = $28,700.)		
(37 calves @ $300 = $10,100.)		
TOTAL INTERMEDIATE ASSETS		$245,240.
TOTAL ASSETS		$674,640.
LONG-TERM LIABILITIES	$184,642.	
SHORT-TERM LIABILITIES	$ 71,120.	
TOTAL LIABILITIES	$255,762.	
NET WORTH	$418,878.	
	$674,640.	$674,640.

Overall Leverage Ratio (Debt/Equity)	.614
Overall Debt/Asset Ratio	.380
Long-Term Debt/Asset Ratio	.430
Intermediate-Term Debt-Asset Ratio	.290

Tax liability calculations simulated in the model include both real and personal property taxes, federal and state income taxes, and self-employment tax. Since farmers file income taxes once a year without penalty, taxes due for the current year are assumed to be zero. Although investment credits were eliminated under the 1986 Tax Reform Act, FLIPSIM V had not been updated to reflect this change at the time this study was completed. Since the model was programmed to apply all available credits for depreciation and investment with the goal of achieving zero taxable income, the probability of increased federal income tax liability must be taken into consideration when interpreting the results. An estimated real property tax rate of .7 cents per dollar of current market value was obtained by multiplying the average 1986 Cache County tax rate for land in rural areas by .529 to simulate the reduced valuation for productive cropland permitted under the Farmland Assessment Act. Annual personal property taxes are pegged at $3300, which is the mean value of actual personal property taxes reported in the subset. The marginal state income tax rate for computing state income taxes is set at .06. The real rate for Utah averages .05 on the first $7500 of taxable income and .0775 on everything above $7500. Five personal exemptions are claimed together with personal itemized deductions averaging 20 per cent of net farm income. Maximum annual interest payments which can be claimed as a federal income tax deduction are set at $16,280. Taxable income for the year preceding the start of the simulation was set at $12,273 which is the mean value reported in the subset. The FLIPSIM V model used in this study incorporates the tax rates, depreciation and expensing

schedules, and investment credits that were included in the federal tax code prior to the revisions made in 1987. Revisions of the model are necessary to correct for adjustments in the tax code. The annual self-employment tax rate is programmed in the model to increase from .123 for 1987 to .153 for 1990 and subsequent years following the schedule announced by IRS. Maximum income subject to self-employment tax remains constant at $42,000.

Income from off-farm employment is not included in this study, even though three of the survey respondents indicated that they supplemented their income with part-time jobs. This income is disregarded to permit the model to focus more directly on the effects of the management strategies implemented in the face of declining real milk prices. Income from savings and other off-farm investments is included, however. Quarterly interest payments on $23,500 invested off-farm at 6.0 per cent is available to supplement family income. This rather significant savings value is the average of cash savings reported by the dairymen interviewed for this study and is held for reserve liquidity rather than used to reduce the principle balance of current debt. The model is set up to withdraw all other family living expenses from net cash farm income. The annual cash requirement for family living expenses is permitted to range from $13,200 up to $25,000 maximum. The minimum $13,200 figure was derived by annualizing the average monthly withdrawals from farm income reported in the subset. The maximum value of $25,000 was used by Helms and is $3,000 more than the mean value of maximum withdrawals plus all off-farm income reported in the sample. The marginal propensity to consume after-tax disposable

income was set at 0.4, slightly above the national average suggested by Richardson and Nixon.

Levels of indebtedness and of interest rates have a profound effect on profitability. Excessive loan servicing costs portend the demise of many dairymen. On the other hand, lower debt levels enhance profitability. Debt-to-asset ratios and interest rates used in the model are the mean values calculated from information obtained through interviews with the eleven dairymen comprising the sample population.

FLIPSIM V uses the financial data described above as the basis for the first year of each iteration. As the financial position of the firm changes, the model simulates the amortization of debt or acquisition of new loans as needed. This study assumes a minimum down payment of 30 percent of the loan amount will be required for all new loans. An origination fee of 1 percent of the loan amount is also charged. New long-term loans are assumed to be amortized over 30 years while intermediate-term loans have an arbitrary loan life of 6 years. If refinancing is required, the loan life is reduced to 20 years and 4 years respectively. A minimum equity-to-asset ratio of .30 is required both for long-term and intermediate-term loans. No additional financing is permitted if equity to asset ratio drops below this point. The model simulates all required financial and loan transactions and develops a unique set of financial statements for the firm at the end of each iteration. These statements are analyzed within the model and the net present value for the firm is calculated using an after-tax discount rate of 3 percent.

Interest rates for various types of new loans will vary as shown

in table 5. These are typical rates currently being offered by the Farm Credit System (Production Credit Association and Federal Land Bank) and local commercial banks. Interest rates for outstanding loans are the mean values reported in the subset. Annual interest rate received for ending year cash balances is typical of rates currently paid for 6-month money market certificates.

Table 5. Schedule of Interest Rates

Outstanding livestock debts	13.5%	1/
Outstanding long-term debts	9.4%	2/
Outstanding intermediate-term debts	11.8%	2/
New long-term debts	11.9%	3/
New intermediate-term debts	13.0%	1/
Refinanced long-term debts	11.9%	3/
Refinanced intermediate-term debts	10.5%	4/
Operating loans	12.6%	2/
Annual interest rate received for ending year cash balances	5.6%	5/

Sources:

1/ Reeder, PCA, 1986.
2/ Mean value from data set.
3/ Poulson, FLB, 1986.
4/ Wood, First Security Bank, 1986.
5/ Rate paid on 6-month Money Market Certificates, Wood, 1986.

Qualifying Assumptions

Several assumptions must be made regarding the operation of a typical dairy farm. Such assumptions are necessary in correlating the data derived from the questionnaire and other sources mentioned above as it is entered into the computer in a manner which will permit the model to run smoothly. These clarifying assumptions may be stated as follows:

1. The dairyman enjoys his work and consistently devotes long hours to managing his operation.
2. The dairyman is presumed to be an excellent manager who makes rational decisions based on the economic signals he receives.
3. The milking herd is divided into three separate groups and fed according to the stage of lactation. Each group is housed in a separate corral and fed in a separate manger. A local feed mill is engaged to roll the barley produced on the farm and mix it with other feed concentrates to meet the ration specifications for each herd. This practice allows the dairyman to adjust the ration for each group to meet reduced energy requirements for the cows as milk production tapers off.
4. The milking herd is assumed to have the genetic potential to produce substantially more milk when fed a balanced ration. This assumption is based on survey reports of milk production levels achieved after balancing the ration.
5. Average crop prices and yields are assumed to remain constant over the planning horizon so that the economic benefits of the various

management strategies will be focused on the dairy enterprise alone. The simulated results of dairy management strategies can more readily be predicted when other economic considerations are held constant. Therefore, no allowance is made for inflation during the five-year planning horizon incorporated in this study.

6. Crops produced on the farm are fed to the dairy herd. Any surplus left at the end of the year is presumed to be sold at the prevailing prices listed in the model. These prices were set at $15.00 ton for corn silage, $60.00 per ton for alfalfa hay, and $1.85 per bushel for barley.

7. The Food Security Act of 1985 provides that the Secretary must reduce the milk support price by 50 cents in 1988, 1989 and 1990 if CCC purchases of dairy products are expected to exceed 5 billion pounds in any of those years. The support price dropped by $.50 per cwt. in January 1988 and current levels of CCC purchases indicate it will drop again in subsequent years. These reductions in the support price are assumed to be fully reflected in prices received by producers, and are simulated to occur over the planning horizon as the various management strategies are employed.

8. The price of milk is calculated using 3.50% butterfat and 3.20% protein, the mean values reported in the sample were 3.56% butterfat and 3.21% protein. Since most producers are paid a blend price based on fluid utilization, the seasonal fluctuations in milk prices are calculated using the mean values of monthly prices for both fluid and manufacturing grades of milk marketed in Utah during five previous years, 1981-1985 (Utah Agricultural Statistics 1986). Fluid

utilization data obtained from Doug Larsen at Cache Valley Dairy was used to calculate the actual blend price that would have been paid during the same period.

9. The farm bill agenda for 1990 is already being set, and it appears likely that dairy policy will soon change again. Therefore only a five year planning horizon is simulated.

The Utah Dairy Farm Study conducted by Ackerman, Bailey and Jensen reinforces the notion that dairy farming in Utah is a family tradition with the farm couple jointly making most major management decisions. Both the husband and wife are likely to have grown up on a farm and are likely to be operating a farm that has been in their family for multiple generations. Survey respondents indicated that the operator, with some assistance from other family members, regularly feeds the livestock, does part of the field work, and milks the cows on the average of one time per day. High levels of satisfaction about the quality of family life and enjoyment of farm work indicated in the overall study prompted the specification of a schedule of unpaid family labor available to the farm as shown in table 6. The typical farm operator is assumed to work up to 9 hours per day six days a week (54 hours per week) during the growing season April through September, but only works 7 hours per day (42 hours per week) during the late fall and winter months October through March. Two teenage children on the farm each provide an average of 1 hour labor per day during the school year but work up to 5 hours per day during the summer months June through August. Allowance is made for up to four weeks vacation time including holidays using the schedule shown in table 6.

Table 6. Programmed Supply of Labor Available to the Farm

Month	Full-time Hired Labor	Unpaid Family Labor Maximum Hours Available*
	----------Hours per Month----------	
January	175	250
February	175	240
March	175	250
April	200	275
May	220	300
June	220	470
July	200	450
August	200	400
September	220	275
October	175	250
November	175	250
December	175	250
Total	2310 hrs.	3660 hrs.

* Includes the dairyman and two teenage children.

The model matches the available labor resource against a matrix of man-hours required per unit of production during each month and simulates the cost of hiring additional part time labor as needed. Monthly labor requirements per animal and per crop as estimated by Helms are shown in table 7. In balancing labor supply with labor requirements, the model draws first from hired labor, with residual requirements being filled from the unpaid family labor allotment. The farm is assumed to have one full-time hired milker who receives a cash salary of $18,000 per year. Monthly labor requirements from the hired man are increased during periods of peak work load. If additional labor is needed after all unpaid family labor is used, the model hires part-time help at the rate of $4.05 per hour.

One of the real problems in doing economic research is finding reliable data. Time constraints often prevent the researcher from personally developing all of the data he needs to run simulation models. Helms' thesis proved invaluable in filling this void. His work also included the estimation of the farm machinery complement for a typical Cache Valley dairy developed through on-farm interviews with operators of several mid-sized dairies conducted in Cache Valley in 1985. The machinery complement shown in table 8 originated with Helms but was updated for the present study. Additional information needed to update the machinery complement was obtained through personal interviews with dairymen and equipment dealers. FLIPSIM V simulates machinery depreciation costs and purchase requirements for replacement implements. The salvage value of old equipment is deducted from the purchase price of its replacement at trade-in.

Table 7. Monthly Labor Requirements per Enterprise

Month	Milk Cows	Dry Cows	Heifers	Baby Calves	Corn	Alfalfa	Barley
	------Hours per Animal-------				----Hours per Acre----		
Jan	3.1	0.4	1.65	.46	0.0	0.0	0.0
Feb	3.1	0.4	1.65	.46	0.0	0.0	0.0
Mar	3.1	0.4	1.65	.46	0.0	0.0	0.0
Apr	3.1	0.4	1.65	.46	0.4	0.1	0.4
May	3.1	0.4	1.65	.46	0.5	0.1	0.5
Jun	3.1	0.4	1.65	.46	0.6	1.7	0.6
Jul	3.1	0.4	1.65	.46	0.8	0.8	0.8
Aug	3.1	0.4	1.65	.46	0.6	1.3	0.6
Sep	3.1	0.4	1.65	.46	4.9	1.3	1.0
Oct	3.1	0.4	1.65	.46	0.0	0.0	0.0
Nov	3.1	0.4	1.65	.46	0.0	0.0	0.0
Dec	3.1	0.4	1.65	.46	0.0	0.0	0.0

Source: Basic data from Helms, 1985.

Table 8. Equipment and Machinery Inventory

Description	Year Purchased	Current Value	Economic Life	Replacement Cost
40 hp tractor	1973	$ 4,300.	12 yrs.	$16,000.
80 hp tractor	1986	$35,000.	8 yrs.	$40,000.
60 hp tractor	1980	$12,000.	8 yrs.	$25,000.
manure spreader	1982	$ 1,700.	8 yrs.	$ 6,000.
swather	1980	$ 5,000.	10 yrs.	$15,000.
baler	1986	$ 9,000.	6 yrs.	$10,000.
corn chopper	1980	$ 3,500.	8 yrs.	$10,000.
flail chopper	1980	$ 1,500.	8 yrs.	$ 4,400.
grain drill	1971	$ 1,400.	20 yrs.	$ 6,100.
corn planter	1978	$ 750.	20 yrs.	$ 1,600.
front-end loader	1982	$ 1,800.	7 yrs.	$ 3,000.
hay elevator	1980	$ 500.	10 yrs.	$ 1,000.
feed wagon	1976	$ 1,200.	12 yrs.	$ 5,600.
hay stacker	1979	$ 4,500.	12 yrs.	$24,600.
scraper	1974	$ 500.	15 yrs.	$ 2,800.
3-bottom plow	1977	$ 1,300.	15 yrs.	$ 5,200.
harrows	1970	$ 300.	10 yrs.	$ 850.
tandem disk	1977	$ 1,500.	15 yrs.	$ 6,000.
cultivator	1975	$ 650.	15 yrs.	$ 3,200.
sprayer	1982	$ 550.	15 yrs.	$ 850.
1/2 T pickup	1978	$ 1,200.	10 yrs.	$ 9,500.
3/4 T pickup	1984	$ 6,000.	5 yrs.	$11,500.
2 T truck	1980	$ 7,000.	15 yrs.	$18,000.
1 1/2 T stock truck	1974	$ 3,000.	15 yrs.	$16,000.

Source: Basic data from Helms, 1985.

The entire farm is planted in crops grown to feed the dairy herd. Programmed acreage was derived from the average proportions of each crop grown on the 11 farms in the sample population. The typical farm in the study has 34 acres planted in field corn for silage, 144 acres planted in alfalfa hay, and 62 acres planted in barley. Published Utah enterprise budgets for these crops were adjusted to conform to sample observations before setting up the model (Davis and Bond). The actual budgets entered for this study are shown in table 9. Assuming that average yields remain constant at 17 tons/acre for corn silage, 4.5 tons/acre for alfalfa hay, and 85 bushels/acre for barley, the farm produces 648 tons of alfalfa hay, 578 tons of corn silage, and 5270 bushels of barley each year. Not all of this feed will be beneficially utilized; however, some is assumed to be lost to spoilage as shown in table 10. Given the crop balance originally outlined, the typical farm ends up with a surplus of 172.1 tons of hay which is sold at $60 per ton for additional cash income of $10,326. Income from hay sales is used to help offset the purchase of 8531 bushels of barley needed to complete the initial ration requirements. FLIPSIM automatically fills this deficit feed requirement by purchasing barley at 110 percent of prevailing market prices. Surplus barley would be sold at $4.80 per cwt., but the cost of barley purchased is $5.28 per cwt. This makes the cash outlay for barley $21,171. Barley cost net of hay income is $10,845 per year. These figures are only approximate, however, because while crop yields and prices are assumed to remain constant from year to year, consideration is given to normal seasonal price fluctuations that occur from month to month. Seasonal price indexes for each of the

Table 9. Crop Budgets

Corn Silage yielding 17 Tons/Acre

INPUT	Annual Variable Costs in $/Acre, Excluding Labor
Seed	21.00
Fertilizer	50.00
Chemicals	23.75
Fuel & Lube	15.02
Machinery Repair	26.93
Irrigation	10.00
Harvesting	118.50
TOTAL	264.75

Alfalfa Hay yielding 4.5 Tons/Acre

INPUT	Annual Variable Costs in $/Acre, Excluding Labor
Seed	4.93
Fertilizer	15.00
Chemicals	12.25
Fuel & Lube	13.78
Machinery Repair	12.15
Irrigation	10.00
Harvesting	39.29
TOTAL	107.40

Barley yielding 85 Bushels/Acre

INPUT	Annual Variable Costs in $/Acre, Excluding Labor
Seed	13.50
Fertilizer	20.80
Chemicals	8.00
Fuel & Lube	10.55
Machinery Repair	9.74
Irrigation	7.00
Harvesting	35.20
TOTAL	103.99

Source: Davis and Bond, 1986, plus observations from sample.

Table 10. Disposition of Crops Produced on the Farm

Corn Silage		
Quantity Produced	578	Tons
Loss to spoilage & shrinkage	64	
Fed to cows	514	
Fed to heifers	0	
Fed to calves	0	
Surplus for sale off-farm	0	
Alfalfa Hay		
Quantity Produced	648.0	Tons
Loss to spoilage & manger waste	6.5	
Fed to cows	321.3	
Fed to heifers	114.8	
Fed to Calves	33.3	
Surplus for sale off-farm	172.1	
Barley		
Quantity Produced	5,270	Bushels
Loss to spoilage & manger waste	0	
Fed to cows	10,764	
Fed to heifers	1,927	
Fed to calves	1,110	
Purchase from off-farm	8,531	

three crops are taken from Helms and are shown in table 11. As the purchase and sale of barley and hay is simulated throughout the year, the model refers to these indexes to make minor stochastic adjustments to the prices paid for barley and received for surplus hay.

Retail costs of concentrates required for the initial ration but not produced on the farm are listed in table 12. Alfalfa hay, corn silage, and barley are also listed at the farm prices for which surplus quantities may be sold. The prices of feed concentrates listed in table 12 were multiplied by annual ration requirements to derive the cash outlay required per animal for feed concentrates purchased as shown in table 13.

The cost of purchased barley is not included with the other concentrates, however, because it is automatically calculated within the model. Annual feed requirements per animal for crops produced on the farm were programmed into FLIPSIM as shown in table 14. This information is analyzed by FLIPSIM and the appropriate cash outlay required for barley purchases is calculated depending on the stochastic selection of seasonal crop price fluctuations determined for each iteration.

Purchases of other feed concentrates are included with the variable costs shown in table 13. Custom rolling of harvested and purchased barley is assumed to cost $.85 per cwt. and is entered separately. Other cash expenses that must be entered at this point include veterinary services, breeding fees, utility expenses, and charges for milk hauling and capital rotation assessed by the processor.

Table 11. Seasonal Price Indexes for Crops

Month	Corn Silage	Alfalfa Hay	Barley
January	0.95	0.95	1.00
February	0.95	0.95	0.99
March	0.92	0.92	1.02
April	0.98	0.98	1.03
May	1.03	1.03	1.05
June	0.98	0.98	1.03
July	1.03	1.03	0.97
August	1.03	1.03	0.94
September	1.04	1.04	0.96
October	0.97	0.97	1.00
November	1.04	1.04	1.00
December	1.07	1.07	1.00

Source: Helms, 1985.

Table 12. Feed Costs Under Initial Conditions

Selling Price for Commodities Produced on the Farm

Description of commodity	$/cwt.
Corn Silage, 30% dry matter	.75
Alfalfa Hay, 19.5% protein, 24% mostly crude fiber	3.00
Barley, 46-48 lbs. per bushel	4.80

Purchase Price for Commodities Purchased off Farm

Description of commodity	$/cwt.
Barley, 46-48 lbs. per bushel	5.28
Whole Cottonseed	10.00
Brewers Grain, dried, 25% protein	6.25
Molasses Dried Beet Pulp	5.10
Ground Limestone	4.80
Salt	5.00
Dicalcium Phosphate	19.50

Source: Mickelson, 1987.

Table 13. Annual Cash Expenses per Animal for Dairy Herd Under Initial Conditions

Milking Cow		
Feed Concentrates Purchased		$173.19
Custom Rolling Harvested Barley		41.40
Veterinarian Services		26.11
Milk Hauling		51.19
Breeding Fees		25.31
Capital Rotation		24.98
Utilities		64.11
	TOTAL	$406.29
Dry Cow		
Salt		$ .50
Miscellaneous		6.50
	TOTAL	$ 7.00
Replacement Heifer		
Custom Rolling Harvested Barley		$ 18.78
Breeding Fees		25.31
	TOTAL	$ 44.09
Heifer Calf less than 12 months old		
Custom Rolling Harvested Barley		$ 12.00

Table 14. Annual Feed Requirements per Head of Livestock for Crops Produced on the Farm

Milking cows including dry period

Crop	Pounds per head
Corn silage	9880
Alfalfa hay	6180
Barley	4865

Replacement heifers between 12 and 24 months of age

Crop	Pounds per head
Corn silage	0
Alfalfa hay	5600
Barley	2209

Heifer calves under 12 months of age

Crop	Pounds per head
Corn silage	0
Alfalfa hay	1800
Barley	1410

Source: Mickelson, 1987.

Except when otherwise specified, the dairy herd is maintained at 104 cows, with 89 milking and 15 assumed to be dry at any given time. An annual culling rate of .23 is entered to specify the fraction of the herd that is replaced each year. Cull cows are assumed to sell at an average price of $442 per head throughout the planning horizon. Replacement cattle normally come from the farm's own heifer herd but may be purchased at an average price of $800 per head throughout the planning horizon. These were typical prices received for cull cows and replacement heifers in 1986 (Utah Agricultural Statistics, 1987). The annual calving rate calculated from sample observations was entered at .90, meaning that 9 out of ten cows in the milking herd will freshen each year. Fifty percent of all calves born on the farm are presumed to be bulls and are sold at birth at an assumed price of $35 per head. Only the heifer calves are raised to maturity on the typical farm. Death loss for heifers under 12 months of age is assumed to be 20 percent, a seemingly high mortality rate that was calculated directly from the sample. Of the heifers raised to maturity, 3% are assumed to be sold due to sickness or failure to breed. These animals are sold at rotating prices of $320 or $400 per head, as specified by the model.

Milk production records for the typical herd were simulated using the mean values collected from the sample, and are higher than state average. The rolling herd average is 17,787 lbs. per cow, or approximately 58 lbs. of milk per day over a 305-day period. Not all of this milk is sold, however. Up to 5 percent of the milk produced is fed to baby heifer calves raised on the farm. The initial amount of milk available for sale is therefore set at 16,890 pounds per cow and

is presumed to increase at the rate of one percent per year over the planning horizon to simulate genetic improvement in the herd. Actual milk production per cow will vary with the ration that is fed. Hence, a basic ration was initially calculated to provide the net energy necessary to yield 17,787 lbs./year rolling herd average (Mickelson). The basic ration is designed to maximize the use of feeds produced on the farm. Rations for all ages of livestock under initial conditions are shown in table 15.

Seasonal fluctuations naturally occur with changes in ambient temperatures and the amount of energy required to maintain body temperature in the cow. A seasonal index was calculated using seven years of statewide Utah data published for the period 1977-1984, and this index value for each month was multiplied by the average monthly milk production of 1482.25 lbs. per cow to simulate seasonal production cycles on the typical farm. The seasonal index and average monthly milk production per cow are shown in table 16.

Seasonal fluctuations in price of milk are also inherent in the dairy industry. A price index was also calculated using available time series data and is shown in table 17. Many other factors affect the price of milk. Under the administered pricing of the federal order system, the price of fluid milk in Utah is tied to the price received in Minnesota and Wisconsin. The formula for calculating the prices paid by Intermountain Milk Producers Association in 1986 was obtained and applied to calculate the price that this cooperative would actually

Table 15. Ration for Dairy Livestock Under Initial Conditions

Milking Herd, Average Cow Weight = 1300 lbs.

Feed	Group #1	Group #2	Group #3
	(Quantities of feedstuffs shown as lbs./day)		
Corn Silage, 30% DM	25.00	25.00	25.00
Alfalfa Hay, 24% MCF	14.60	18.67	20.44
Barley, 46-48#/bu	18.41	15.48	14.07
Brewers Grain, DR 25P	6.21	1.00	
Cottonseed, whole	6.05	3.50	.06
Limestone, ground	.17	.16	
Salt	.16	.14	.14
Dicalcium Phosphate	.08	.14	.17
Beet Pulp, Mol. Dried			3.03

Dry Stock

Alfalfa Hay	11.86 lbs./day
Corn Silage	37.00 lbs./day
Salt	.14 lbs./day

Heifers

Size	Milk	Alfalfa Hay	Barley	Salt	Days Fed
thru weaning	14.8	0.00	0.00	0.00	120
300 lbs., gain 1.5 #/day		4.07	4.75	.01	66
400 lbs., gain 1.8 #/day		5.82	5.89	.02	55
500 lbs., gain 1.8 #/day		8.05	6.11	.02	55
600 lbs., gain 1.8 #/day		10.12	6.26	.02	55
700 lbs., gain 1.8 #/day		11.98	6.28	.03	55
800 lbs., gain 1.6 #/day		15.08	4.94	.03	63
900 lbs., gain 1.6 #/day		15.88	5.48	.03	63
1000 lbs., gain 1.6 #/day		16.34	6.14	.03	63
1100 lbs., gain 1.6 #/day		15.84	7.43	.03	135

Source: Mickelson, 1987.

Table 16. Seasonal Fluctuations in Milk Production

Month	Seasonal Index 1/	Monthly Milk Production
		(cwt./cow)
Jan	0.9614	14.25
Feb	0.8987	13.32
Mar	1.0167	15.07
Apr	1.0167	15.07
May	1.0707	15.87
Jun	1.0525	15.60
Jul	1.0815	16.03
Aug	1.1146	16.52
Sep	0.9857	14.61
Oct	0.9864	14.62
Nov	0.9823	14.56
Dec	0.8116	12.03

1/ Eight year average 1977-1984.

Source: Utah Agricultural Statistics, 1985.

Table 17. Seasonal Price Index for Milk

Month	Price Index 1/
January	1.043
February	1.027
March	1.010
April	0.993
May	0.974
June	0.949
July	0.941
August	0.995
September	0.980
October	1.015
November	1.027
December	1.035

1/ Five year average 1981-1985.

Source: Utah Agricultural Statistics, 1986.

have paid for milk produced on the typical farm (Funk). Prices improve as butterfat and protein content of the milk increase, and as utilization of fluid milk increases. Milk produced on the typical farm is presumed to average 3.5 percent butterfat and 3.2 percent protein, with 45 per cent utilization of the Class I base. Following the formula obtained from Dr. Funk, the blend price of milk prior to DTP was determined to be $11.39 per hundred pounds of milk. Thus, $11.39 per cwt. was entered as the price received by the producer under initial conditions.

To simulate economic reality, the element of risk is injected into the model using a correlation matrix. The correlation matrix is constructed using time series data that approximates the fluctuations in market prices and production records that may be anticipated by the firm or enterprise being studied. For dairy farm simulation FLIPSIM V employs six random variables in the correlation matrix, namely: (1) annual milk price, (2) annual cull cow price, (3) annual replacement cow price, (4) annual calf price, (5) annual milk production per cow, and (6) the index of feed costs. Published time series data for Utah accumulated over the past ten years was used to construct the matrix employed in this study. The values calculated for the correlation matrix are shown in table 18. Since the purpose of the matrix is to inject stochastic variation into levels of milk production as well as the prices paid and received for dairy livestock that may be expected to occur over the planning horizon, actual historical data for Utah was used rather than the variation observed in the sample. Thus, the mean values shown in the table are not related to the initial prices and

Table 18. Means, Standard Deviations and Correlation Matrix for Dairy Operation Enterprises (1981-1985)

	MP ($/cwt.)	CP ($/cwt.)	RP ($/cwt.)	CFP ($/cwt.)	PROD (lbs./yr.)	I
Mean	12.61	37.36	77.73	61.63	16148.02	127.92
Std. Dev.	0.6368	3.1880	12.0197	3.7647	377.6274	9.9478

Correlation Matrix

	MP	CP	RP	CFP	PROD	I
MP	1.0	0.00018	0.32386	0.06199	0.06053	0.25116
CP		1.0	0.57180	0.62762	0.24336	0.50053
RP			1.0	0.32772	0.45514	0.13775
CFP				1.0	0.26483	0.18467
PROD					1.0	0.18817
I						1.0

Key:

MP = Milk Price ($/cwt), blend price calculated using typical monthly utilization factors and Class I, Class III prices taken from 1986 Utah Agricultural Statistics, p. 69.

CP = Cull Cow Price ($/cwt), ave. wt. assumed to be 1300 lbs., data for all cows from 1986 Utah Agricultural Statistics, p. 67.

RP = Replacement Cow Price ($/cwt), ave. wt. assumed to be 1300 lbs., data for milk cows from 1986 Utah Agricultural Statistics, p. 68.

CFP = Calf Price ($/cwt), data for calves from 1986 Utah Agricultural Statistics, p. 68.

PROD = Milk Production (lbs./cow), data for USU dairy herd, 1981 - 1985, Lamb.

I = Index of Feed Costs, data from U.S.D.A. Prices Received and Paid by Farmers, various issues.

production records detailed previously that were used to simulate the typical farm.

The empirical probability distributions for milk prices, cull cow prices, replacement heifer prices, calf prices, milk production per cow, and feed costs are generated by the model for each iteration. To develop this curve, the model employs a series of ten fractional deviations about the means for each variable included in the factored covariance matrix. These fractional deviations are multiplied by the initial values entered in the model; i.e. cull cows priced at $442 per head, replacement heifers at $800 per head, calves at $35 per head, and so forth. Variation in feed costs is calculated following the index of feed costs reported in Prices Received and Paid by Farmers for the 60 month period from January, 1981 through December, 1985. The initial values of feed costs are shown in tables 12 and 13. Fluctuations in the levels of milk production and prices are projected in a similar manner, but with more variability arbitrarily calculated as follows.

The milk price starts at $10.87 per cwt. for the first year simulated, $10.37 per cwt. for the second year, $9.87 per cwt. for the third year, and $9.37 per cwt. for the fourth and fifth years. This arbitrary reduction is used the simulate cuts in the support price originally projected under the 1985 Act following the completion of DTP. Seasonal fluctuations in milk prices are also calculated monthly following the index shown in table 17.

Milk production per cow is arbitrarily presumed to increase due by 1 percent per year to simulate genetic improvement in the herd. The initial rolling herd average of 17,787 lbs. per year is first reduced

by 5 percent to account for colostrum and other milk fed to calves, giving an initial average milk production of 16,890 lbs. per cow. Average milk production increases over the next four years to 17,060, 17,230, 17,400, and 17,570 lbs per cow, respectively. These averages are adjusted monthly following the seasonal index shown in table 16.

The empirical probability distributions for each variable are calculated within the FLIPSIM model and subsequently applied in calculating the outcome of each iteration. Iteration is the term used to describe the process of simulating the financial operation of the farm over the five year planning horizon specified in the model. During each iteration, the values of the each variable specified in the correlation matrix shown in table 18 are programmed to fluctuate at random within the parameters of its respective empirical probability distribution. Because individual values are selected at random, the calculated outcome of each iteration, or five year simulation, is unique. Stochasticity is maintained through repeated iterations of the simulation process. The outcome of fifty iterations are compared to generate the probability statements shown in the results.

The Empirical Model

A deterministic run was made to ascertain that all of the input data was being read properly. Under initial conditions, the model determined annual variable production costs to be $9.83 per cwt. of milk. With the producer price of milk pegged at $11.39, the typical farm is operating well above its shutdown point. But total costs were calculated to be $11.87 per cwt., indicating that the firm is minimizing losses rather than maximizing profits. Economic profits are

earned only when total revenue exceeds total cost. Since the individual dairyman is unable to influence the price that will be paid for his product, he must try to minimize his production cost. This first run suggests a poor return on investment that could necessitate debt restructuring to extend the amortization of existing loans, but in balance the dairy is financially well off enough to be pay all operating costs and have money left over for principal payments. Non-monetary economic values such as independence and lifestyle satisfaction combine to keep the enterprise attractive and viable. But as the price of milk drops, survival of the firm may be threatened. Serious equity erosion leading to bankruptcy occurs as the price drops below variable costs of production. Remedial changes in management practices designed to reduce these costs are clearly in order.

To illustrate this point, variable costs of production were calculated for the first 95 dairymen surveyed in the data set collected by Ackerman, Bailey and Jensen. Nearly one-third of the dairymen in this sample face serious difficulty if price of milk drops to the $9.37 level that has been projected under the current farm bill. Table 19 summarizes the variable costs determined from the sample.

Suggested Management Strategies

Following recommendations from USU Extension, five different management strategies were simulated by adjusting the input information in the FLIPSIM V model. Each strategy includes feeding a different ration than was originally specified. Various rations that may be fed using different management strategies are shown in table 20. Each of

Table 19: Comparison of Declining Milk Price and Variable Production Costs for Random Sample of 95 Utah Dairymen 1/

Price of Milk	No. of Dairymen with Var. Costs > Milk Price	Percentage with Var. Costs > Milk Price
$11.39	8	8.4
$10.87	13	13.7
$10.37	18	18.9
$ 9.87	24	25.3
$ 9.37	29	30.5
$ 8.87	38	40.0

1/ Calculated using data from Ackerman, Bailey, and Jensen, 1987.

Table 20. Ration for Milking Herd Under Different Management Strategies

Strategy #1: Eliminate Corn Silage

Feed	Group #1	Group #2	Group #3
		lbs./day	
Alfalfa Hay, 24% MCF	22.54	27.20	29.82
Barley, 46-48#/bu	22.54	18.54	3.40
Cottonseed, whole	4.14		
Corn Grain, gr or rld	.79	3.71	14.88
Dicalcium Phosphate	.17	.21	.16
Salt	.16	.15	.14
Limestone, ground	.14		
Beet Pulp, mol. dried	.02	.52	

Strategy #2: Optimize Genetic Potential

Feed	Group #1	Group #2	Group #3
		lbs./day	
Corn Silage, 30% DM	25.00	25.00	25.00
Alfalfa Hay, 24% MCF	11.17	18.25	21.11
Barley, 46-48#	15.17		2.96
Cottonseed, whole	10.79	4.64	
Brewers Grain, DR 25P	5.87	5.34	
Corn Grain, gr or rld		14.25	13.13
Beet Pulp, mol. dried	4.10		
Limestone, ground	.55	.25	
Salt	.17	.15	.14
Dicalcium Phosphate	.04	.18	.17

Strategy #3: Total Mixed Ration

Feed	Group #1	Group #2	Group #3
		lbs./day	
Alfalfa Hay, 24% MCF	19.50	15.76	20.38
Corn Silage, 30% DM		25.00	25.00
Beet Pulp. mol dried	15.64	6.49	
Brewers Grain, DR 25P	8.93	7.16	.52
Corn Grain, gr or rld	7.12	11.99	14.15
Barley, 46-48#	5.50		2.65
Cottonseed, whole	1.83	1.18	.04
Cottonseed Meal, 41 S		1.63	
Limestone, ground	.27	.36	
Salt	.18	.16	.14
Dicalcium Phosphate			.16

Note: The production curve maximum (lbs.of milk produced/cow/day) within each group varies according to stage of lactation as shown below for each ration.

Ration Strategy	Group #1	Group #2	Group #3
#1	80	60	50
#2	93	71	50
#3	93	73	50

Source: Mickelson, 1987.

these rations will produce a different average level of milk production when fed to the herd. The footnote at the bottom of table 20 shows the different average levels of production that can be expected from the rations described in the various management strategies (Mickelson; Bath and Bennett).

STRATEGY #1. Corn silage is eliminated from the ration. Corn silage as a milk producing feed is inferior to alfalfa hay. Previous studies have indicated overall total input costs may be reduced by eliminating corn silage and feeding more hay (Andersen, Miller, and Mickelson; Helms).

This strategy is simulated in the model by making the following changes:

1. Corn is completely removed from the crop rotation, and the entire farm is planted in hay and grain, with 150 acres of alfalfa and 90 acres of barley. The equipment inventory remains constant.
2. The model is reprogrammed to reflect only two crop enterprises instead of three.
3. The dairy ration is balanced to meet current production levels without the use of corn silage. Additional barley must be purchased to provide for ration requirements over and above the amount produced on the farm. The adjusted ration is shown in table 20.

STRATEGY #2. The operator feeds a balanced ration formulated to boost production to 20,000 lbs. rolling herd average. This requires additional investment in a larger bulk tank. All concentrates are purchased at the local feed mill.

This strategy is simulated in the model by making the following

changes:

1. The ration is balanced to increase the rolling herd average to 20,000 lbs.
2. A used 2000 gallon bulk tank is purchased and installed, requiring an out-of-pocket investment of $7200 after trade- in allowance for the existing tank (Nelson). This project is fully financed with a new intermediate term loan and the debt-to-asset ratio is increased from .290 to .310 to reflect the additional debt incurred with the purchase of the tank.

STRATEGY #3. The operator feeds a total mixed ration that is formulated to boost production to 20,000 lbs. rolling herd average. This requires additional investment for construction of a commodity barn plus purchase of a larger bulk tank, a grain chopper and a mixing/grinding feed wagon. Feeding a total mixed ration is expected to increase milk output by 3 percent (Mickelson).

This strategy is simulated in the model by making the following changes:

1. A commodity barn is built requiring a cash investment of $21,500 (Abbott). Construction cost is fully financed, increasing the long term debt-to-asset ratio from .43 to .447.
2. The farm machinery inventory is changed by purchasing a new Gehl grain chopper for $8000, trading the existing feed wagon for a new BMH feed mixer wagon at cash expense of $28,000, (Ellis) and trading the existing 1200 gallon bulk tank for a used 2000 gallon tank requiring a cash investment of $7200 (Nelson). The $43,200 borrowed to finance this expansion increases the intermediate debt-to-asset

ratio from .290 to .398.

3. The ration is balanced using bulk commodities purchased at broker prices listed in table 21 (Edwards). Bulk feed prices reduce unit costs. Daily feed costs for this and other rations fed to the milking herd are shown in table 22.

STRATEGY #4. The operator feeds a balanced ration to maintain milk production at current levels (17,787 rolling herd average) and expands the cow herd by purchasing 20 cows. A larger bulk tank and a new lounging shed are required to accommodate the expanded herd. Strategy #4 is simulated in the model by making the following changes:

1. The dairy herd is expanded by purchasing 20 top quality dairy heifers ready to freshen at a cost of $18,800. Average cost of $940 per head is based upon a recent sale of 35 head of springing heifers in northern Cache Valley (Jackson). The purchase is simulated by increasing the milking herd from 89 to 105 cows and increasing the intermediate debt levels by $18,800. Supporting herds are increased to 19 dry cows, 49 heifers, and 44 heifer calves, and the model is programmed to calculate feed costs for all livestock. The rolling herd average is maintained at 17,787 lbs. for the first year.
2. The larger herd requires a cash investment of $12,000 to build a new lounging shed complete with manger and, concrete alleyway, and water (Abbott). The bulk tank is upgraded to 2000 gallon capacity at a cash cost of $7200 (Nelson).
3. Total cash outlay for livestock, shed and equipment is $38,000, all of which is borrowed. The long term debt-to- asset ratio is increased from .43 to .445 and the intermediate term debt-to-asset

Table 21. Concentrate Feed Costs at Broker Prices

Description of commodity	$/cwt.
Whole Cottonseed	9.90
Cottonseed Meal	9.25
Brewers Grain, dried, 25% protein	4.25
Molasses Dried Beet Pulp	4.85
Corn Grain, Ground or Rolled	5.00
Soybean Meal	11.50
Ground Limestone	4.80
Salt	5.00
Dicalcium Phosphate	19.50

Source: Edwards, 1987.

Table 22. Daily Feed Costs for Rations Fed under Various Management Strategies

Initial Conditions and Strategy #4 - Expand Milking Herd

	Group 1	Group 2	Group 3
Milk production (lbs./cow)	80	60	50
Ration cost ($/cow)	2.53	1.95	1.68

Strategy #1 - Eliminate corn silage

	Group 1	Group 2	Group 3
Milk production (lbs./cow)	80	60	50
Ration cost ($/cow)	2.38	1.97	1.84

Strategy #2 - Boost production to 20,000 lbs. rolling herd ave.

	Group 1	Group 2	Group 3
Milk production (lbs./cow)	93	71	50
Ration cost ($/cow)	2.95	2.30	1.66

Strategies #3 & 5 - Feed total mixed ration at broker prices

	Group 1	Group 2	Group 3
Milk production (lbs./cow)	93	71	50
Ration cost ($/cow)	2.95	2.30	1.66

ratio is increased from .290 to .357.

STRATEGY #5. The operator combines all of the strategies previously listed except that he continues to grow and feed corn silage. A total mixed ration is formulated for 20,000 lbs. average milk production and fed to the expanded herd of 124 mature cows. All major feed concentrates used in the ration and not grown on the farm are purchased directly from a commodity broker in semi-trailer lots. A commodity barn and lounging shed are both built as described above. New equipment purchased includes a larger bulk tank (2000 gallon), corn grain chopper and feed chopper/mixer wagon. The entire expansion is financed with borrowed money.

This strategy is simulated in the model by making the following changes:

1. The value of assets held by the operator is increased to include the new buildings and equipment. Under the assumption that the entire expansion is financed with borrowed money, the long term debt-to-asset ratio increases from .43 to .471 and the intermediate debt-to-asset ratio increases from .298 to .431.
2. Inventories of livestock and equipment are adjusted upward and the model is programmed to calculate additional feed and amortization costs as previously outlined under strategies #3 and #4.

All of the strategies listed above were compared using different milk price scenarios that may develop. Downward adjustments in the support price are assumed to be fully reflected in the prices received by producers. The milk price used in this study is the blend price calculated for milk with 3.5 per cent butterfat and 3.2 per cent

protein content assuming 45% Class I utilization.

The blend price prior to DTP was determined to be $11.39 per hundred pounds of milk (Funk). This is shown as the base price. A variety of downward adjustments in the base price occurred under the Dairy Termination Program. For example, DTP mandated an initial producer assessment of $.40 per cwt. to be paid by all dairymen continuing in business. The DTP assessment plus the $.12 Gramm-Rudman assessment meant an immediate reduction of $.52 per cwt. in producer prices commencing in April of 1986. Deduction of this assessment from the base price resulted in a producer price of $10.87 for the period April 1, 1986 through December 31, 1987. Had the buyout alone been sufficient to eliminate surplus milk production, further reductions in the support price would have been unnecessary. But surpluses continue, and price cuts appear to be inevitable. CCC purchases during 1987 totalled 6.7 billion pounds milk equivalent and are projected to be much higher in 1988 (Miller and Short). In fact, CCC purchases for the period January 1, 1988 to May 20, 1988 totaled 6.3 billion pounds, up 69 percent from the same period in 1987 (Hatfield, 1988b).

The first fifty cent cut in the support price was imposed as scheduled on January 1, 1988 as mandated by Congress. This cut in support price effectively reduced producer prices by the same amount, dropping the price received for milk produced on the model farm to $10.37 per cwt. The Food Security Act of 1985 authorizes additional cuts of $.50 per cwt. during the next two years if CCC purchases persist above the 5 billion pound target. If these cuts were imposed, producer prices for a hundred pounds of milk may be projected to fall

to $9.87 in 1989 and to $9.37 in 1990. This study assumed the worst possible scenario at the time the simulations were done and encompasses three consecutive cuts in support price of $.50 each. Though these cuts have not materialized for 1989, the cuts seem sure to come at a later date so that the analysis may apply a year or more later. Table 23 lists the projected average producer prices that were calculated for each year simulated in this study.

Dependent relationships, such as the effect of seasonal changes in milk price, are simulated by merging average milk prices listed in Table 23 with the historical seasonal price index tabulated in table 17. In the real world, one thing that is certain is change. Values measured today may not hold tomorrow. FLIPSIM V attempts to compensate for this change by using statistical variation to stochastically project the expected financial profile that will result from applying each of the management strategies described in this chapter.

Table 23. Annual Price of Milk

Year Simulated	Scenario	Blend Price 1/
		$/cwt.
1985	Prior to DTP	11.39
1986	Initial assessment	10.87
1987	Initial assessment	10.87
1988	First cut -$.50	10.37
1989	Second cut -$.50	9.87
1990	Third cut -$.50	9.37
1991	Aftermath of 3 cuts	9.37

1/ Average blend price for milk with 3.5% butterfat and 3.2% protein, assuming 45% Class I utilization.

CHAPTER IV

RESULTS

This chapter lists the results that were obtained by simulating operation of the model farm using the various management strategies outlined above.

The model was first run deterministically to ascertain that the data were all entered properly. In other words, a simulation was made without statistical variation. The mean values entered from the data set were held constant rather than allowed to fluctuate stochastically. The resulting output was checked by manually comparing total variable costs with the output derived from the model. Deterministic cost analyses are tabulated in table 24. Variable costs include annual cash expense for feed concentrates purchased, production costs for crops grown on the farm, the custom rolling of barley, hired labor, costs of breeding and veterinary care, capital rotation, milk hauling, utilities, equipment depreciation, and interest costs at the rate of 11.8 percent on intermediate term loans allocated to the dairy enterprise. Under initial conditions, the total variable costs were determined to be $1660.20 per cow. Variable costs per hundred pounds of marketed milk were calculated using the initial rolling herd average of 17,787 pounds reduced by five percent to account for milk that was fed to calves. Thus the average production of marketable milk was calculated at 16,898 pounds per cow. Under initial conditions, the variable cost was determined to be $9.83 per cwt. of milk produced.

Table 24. Deterministic Cost Analyses of Various Management Strategies Implemented in 1987

Strategy 1/	Variable Costs	Variable Costs	Total Costs
	$/cow	$/cwt.	$/cwt.
Base	$1660.20	$9.83	$11.87
#1	$1582.65	$9.29	$11.31
#2	$1662.99	$8.75	$10.58
#3	$1691.08	$8.64	$10.61
#4	$1221.76	$7.23	$ 8.99
#5	$1161.83	$5.94	$ 7.61

1/ Key to Strategies

Base = Typical farm operating under initial conditions.
#1 = Corn silage is eliminated from the ration.
#2 = Ration adjusted to produce 20,000 lbs. rolling herd average.
#3 = Same as #2, except that feeds are presented in the manger as a total mixed ration.
#4 = Base ration with the herd expanded by 20 cows.
#5 = A combination of #3 and #4, with a total mixed ration being fed to the expanded herd.

This point is critical. In the short run, as long as the price of milk received by the producer remains above the variable cost of production, the dairyman minimizes his losses by continuing in the business. This does not mean that he is making a profit. Profits can only be made when total revenue received exceeds total cost, and total cost is the sum of fixed costs plus all variable costs. Fixed costs are inherent to ownership and will continue regardless of whether cows are being milked. Revenues in excess of variable costs don't necessarily imply that the dairy enterprise is profitable; they simply indicate that the producer is able to generate revenue to at least partially offset the fixed costs associated with his investment in the milking parlor and corrals. As producer prices decline, however, the producer approaches a point where he will either shut down or adopt some strategy that will enable him to reduce his variable costs. Failure to make adjustments would permit the erosion of equity to continue and would eventually force him out of business. Cash infusions become necessary whenever the producer price for a hundred pounds of milk falls below the variable cost of production.

With variable costs being verified under initial conditions, the computer was used to calculate average variable costs that would be incurred under each management strategy. As seen in table 24, it appears that the implementation of any one of the proposed management strategies would be an effective means of lowering production costs. Expansion of the dairy herd appears to be the most effective single strategy. The model shows that for the typical farm, average variable costs may be cut from $9.83 to $7.23 per cwt. simply by adding more

cows to the herd. The cost savings of $2.60 per cwt. is certainly attractive and explains at least part of the economic motivation for dairymen to expand their herds following DTP.

There are actually two forces that provide the stimulus for change: economies of size and increasing returns to scale. By changing the combination of several inputs the dairymen may be able to more efficiently utilize his milking parlor. This phenomenon is known as economies of size. Better economies of size may be achieved by adjusting several variables such as ration content, method of presentation, available herd housing, bulk tank capacity, and the number of cows milked. Likewise, changes made in any one of these variables while all others are held constant may improve the investment return on the skilled labor and specialized equipment employed in the dairy operation. These efficiency gains are known as increasing returns to scale.

In this study, milk output was increased 18 percent by adding twenty more cows to the herd. But the corresponding increase in total costs was less than 18 percent. The variable costs associated with feeding, housing, veterinary care, and milking rose proportionately, but fixed costs remained the same. Given the existing milking parlor, milking equipment, and herdsman expertise, technological considerations are such that the dairyman can lower his unit costs by adding more milking cows to the herd. The model indicates that following herd expansion, the increased efficiency in utilizing the milking parlor and milking equipment allows the dairyman to recover the investment costs associated with expanding the size of herd housing, replacing the

existing bulk tank with a larger one and buying young cows to produce more milk.

The deterministic cost analyses tabulated in table 24 indicate that dairymen may be able to reduce their costs by adopting any one or more of the management strategies simulated. But deterministic calculations do not take into consideration the vagaries of seasonal price fluctuations and production cycles. These risks were simulated by running the model stochastically through 50 iterations over a five year planning horizon incorporating the statistical variation shown in the covariance matrix (table 18). The planning horizon runs from 1987 through 1991 and assumes that the support price for milk is cut $.50 per year during 1988, 1989, and 1990. The model was used to project the probability of economic survival for the typical dairy under the declining price scenario. Given the milk/feed price ratio prevalent in mid-1987, the model projected that the dairy not only would survive, but had a 100 percent chance of economic success over the course of the 5 year simulation. Although this held true even when none of the suggested strategies were implemented, the degree of success was greatly enhanced when the recommended management strategies were implemented. The resulting impact of each strategy in relation to equity and income is outlined in tables 25 and 26.

Consider first the effects on the dairyman's equity as shown in table 25. If no action were taken to improve present management, and if feed costs were to remain relatively stable as they did through the mid-1980's, the net worth of the dairyman on the typical farm would continue to grow, albeit rather slowly. Net worth at the outset was

Table 25. Effects on Equity Resulting Under Various Management Strategies

After Tax Net Present Value

Strategy	Mean Value	Std. Dev.	Coefficient of Variation	Minimum	Maximum
BASE	104565.2	33872.2	32.4	34744.9	186444.4
#1	91000.7	48811.1	53.6	17534.4	206522.0
#2	175697.0	37276.9	21.2	111037.0	263562.2
#3	208259.0	39303.5	18.9	138575.1	304934.0
#4	328199.0	39477.0	12.0	255806.3	428329.4
#5	536590.0	41214.3	7.7	461878.2	642712.4

Present Value of Ending Net Worth

Strategy	Mean Value	Std. Dev.	Coefficient of Variation	Minimum	Maximum
BASE	470197.3	27725.3	5.9	410144.0	533014.0
#1	457043.0	37496.4	8.2	394836.0	530487.3
#2	518751.0	28958.0	5.6	465989.1	577990.2
#3	550140.0	28159.5	5.1	495034.1	609105.0
#4	608993.4	28377.4	4.7	556764.0	679552.3
#5	745859.0	30059.7	4.0	687014.0	814593.0

Total Equity/Total Assets at End of Last Solvent Year

Strategy	Mean Value	Std. Dev.	Coefficient of Variation	Minimum	Maximum
BASE	.7270	.0340	4.7	.6570	.8114
#1	.7047	.0458	6.5	.6324	.8030
#2	.8008	.0331	4.1	.7452	.8825
#3	.7883	.0282	3.6	.7376	.8612
#4	.8594	.0145	1.7	.8254	.8803
#5	.8350	.0060	0.7	.8135	.8471

Note: Assumes three successive cuts in USDA milk support price ($.50/yr. 1988-1990).

Table 26. Effects on Income Resulting Under Various Management Strategies

Internal Rate of Return

Strategy	Mean Value	Std. Dev.	Coefficient of Variation	Minimum	Maximum
BASE	.0630	.0140	22.4	.0358	.0930
#1	.0599	.0186	31.1311	.0209	.0941
#2	.0877	.0140	15.9191	.0624	.1219
#3	.0967	.0142	14.6370	.0703	.1313
#4	.1300	.0145	11.1643	.1096	.1588
#5	.1760	.0140	7.9316	.1562	.2022

Average Annual Total Cash Receipts

Strategy	Mean Value	Std. Dev.	Coefficient of Variation	Minimum	Maximum
BASE	212515.1	5912.0	2.8	200965.0	230295.2
#1	208531.0	8037.1	3.9	196941.0	228228.0
#2	235900.0	6585.4	2.8	223168.0	255986.0
#3	244304.2	6768.4	2.8	231253.0	264984.4
#4	243564.0	7014.2	2.9	22995.3	264770.0
#5	279950.2	8036.1	2.9	264592.0	304494.3

Average Annual Net Cash Farm Income

Strategy	Mean Value	Std. Dev.	Coefficient of Variation	Minimum	Maximum
BASE	36161.4	6873.8	19.0	23445.4	54783.5
#1	32895.0	9064.3	27.6	19931.2	54686.8
#2	52888.8	7945.4	15.0	38822.3	74128.6
#3	61019.1	8303.0	13.6	47163.2	83465.2
#4	86541.4	8344.9	9.6	70205.2	110511.0
#5	136176.0	8239.4	6.1	120869.0	160532.3

Note: Assumes three successive cuts in USDA milk support price ($.50/yr. 1988-1990).

determined to be $418,878 as shown in table 4; the present value of the ending net worth five years later is projected to have grown to $470,197 for an average increase of $10,264 per year. In other words, financial growth and economic success may be expected even though the price of milk is projected to fall.

However, this success cannot be guaranteed. The standard deviation and the coefficient of variation are measures of the risk encountered in achieving the projected mean values shown in the table. The smaller these numbers, the greater the likelihood that the actual outcome will be near the projected mean. For example, statistical theory states that given a normal distribution, the projected values will fall within the range of plus or minus one standard deviation from the mean 68.26 percent of the time, within the range of plus or minus two standard deviations from the mean 95.46 percent of the time, and within three standard deviations on either side of the mean 99.74 percent of the time. Thus, one is virtually assured that the present value of ending net worth under the base scenario is between $387,022 and $553,372, with a high probability that it will be near the reported mean. The actual minimum and maximum values calculated by FLIPSIM V are shown in the table. The coefficient of variation is determined by dividing the standard deviation by the mean value and is a better measure of relative risk. The coefficients of variation shown in tables 25 and 26 are expressed as percentage for convenience in comparison.

The ratio of total equity divided by total assets increases from .620 at the outset to .727 at the end of the projection, indicating

that the dairyman will be able to continue reducing his debt load even though the price of milk is reduced. Given the favorable milk feed price ratios and low levels of indebtedness observed in the sample, the outlook is favorable. Even if no action is taken, FLIPSIM V projects that the typical dairy will still be solvent and successful at the end of the planning horizon.

The outlook is good for income as well. With no action taken, the typical dairy can expect an average internal rate of return of 6.3 percent. Likewise, average annual net cash farm income is projected to be $36,161, well above the minimum income level of $13,200 required to meet family living expenses. Surplus cash income would be used for principal payments and capital replacement, such as equipment purchases. Even with the mean reduced by the equivalent of three standard deviations, income remains adequate at $15,542 per year. The minimum average annual net cash farm income encountered by FLIPSIM V under the base scenario was $23,445. The coefficient of variation is higher on the income side, presumably because of tax considerations. It should be noted that changes in the IRS code implemented in 1987 were not available on FLIPSIM V when these projections were calculated. These changes have increased taxes to farmers in most cases.

A note of caution must also be considered regarding the marked increase in net cash farm income that may be achieved by incorporating both the balanced rations and herd expansion programs outlined under strategy #5. Table 26 implies that average annual income could be increased by $100,000. Income gains of this magnitude cannot be sustained throughout the sector. Early adopters of these strategies

are likely to reap greater benefits than those who lag, but as more and more dairymen adopt the strategies one of two results is bound to occur. Either the market price will drop or the cost of applying the strategies will increase, or both. The important thing to note is the relative gains that may be made by adopting one strategy or another.

Equity and income results for each strategy are outlined in the tables. It's interesting to note that strategy #1, which called for elimination of corn silage from the ration, actually appears to have a dampening effect both on income and on equity accumulation when compared to the base strategy of making no management change. This seems indicate growing corn for silage on owned or rented farmland may be economically advantageous when the silage is included in the ration fed on the farm. Purchase of silage grown off of the farm was not considered in this study. Andersen, et. al. have indicated that the decision whether to produce corn silage on the farm probably depends more on agronomic considerations than on potential feed cost savings in dairying. The outlook for eliminating corn silage may have been better if the equipment (i.e. corn planter and corn chopper) used to harvest corn were sold at the outset of the simulation rather than kept in inventory and allowed to depreciate. Elimination of corn silage is not necessarily recommended.

Strategy #2, which calls for the feeding of a computer balanced ration to increase milk production to 20,000 pounds rolling herd average as permitted within the genetic potential of the herd, was shown to be more desirable than taking no action at all. However, a comparison of the coefficient of variation for each of the values

measured suggests that this strategy is relatively risky, especially in view of the smaller gains in mean values achieved. Strategy #3, the presentation of a total mixed ration in the manger, appears to be both less risky and more profitable than feeding a computer balanced ration alone.

Expansion of the milking herd (strategy #4) appears to be the best single management change that the dairyman can implement to contend with falling milk prices. FLIPSIM V projects that this strategy alone may more than double the internal rate of return and increase average net cash farm income by over $50,000 per year. Thus, even though debt level is increased by $38,000, the increased cash flow generates ample additional income that not only services the debt but makes substantial equity gains as well.

But the greatest returns appear to be evident if all of these strategies are incorporated together. Under this final scenario, (strategy #5) average annual net cash farm income increases more than triple the levels experienced under initial conditions and the internal rate of return is projected to exceed 17 percent. The key for this success appears to be in amassing sufficient capital or acquiring the necessary credit to make the initial investment in additional cattle, feed and equipment required to make the strategy work.

In light of these projections, one can readily understand the natural response of the dairy industry to continue to expand in spite of lower milk prices. In fact, the lower milk support price may actually act as an incentive for an individual dairyman to expand. Economic forces motivate expansion wherever the additional investment

will permit the firm to move out along its long-run average cost curve. But these same forces may also force other dairymen out of business. Within the American free enterprise system, and under conditions of perfect competition, declining milk prices require sharper attention to management. Expansion opportunities appear to be greater for established dairymen who over a period of several years have been able to reduce their debt-to-asset ratio below .40 and thus reduce the amount of income that must be allocated to debt service. Even the best manager is constrained by his availability of investment capital, whether owned or borrowed. Interest costs may preclude firms with high debt from financing the additional cattle, buildings, and equipment needed for expansion, even though use of the milking parlor remains under its optimum level.

New complications cloud the outlook even more. The drought of 1988 has forced feed costs sharply upward and is creating tremendous financial pressure on all Utah dairymen. Firms like the typical farm simulated in this study that produce all or most of the roughage feeds required by their herds are faced with increasing prices for purchased concentrates used in the ration. Those dependent on outside sources for hay and barley are especially at risk. Typical Utah hay prices have risen from $60 in mid-1987 to $90 currently, and continue to rise. Using least cost ration figures developed by Andersen, et. al., a series of milk/feed price ratios may be calculated to estimate the impact of rising hay prices on the cost of the ration. Characteristic milk/feed price ratios are shown in table 27. These are estimates

Table 27. Representative Milk/Feed Price Ratios Resulting from Increasing Feed Costs and Reductions in the Support Price of Milk

Scenario	Ratio
Initial conditions, base ration, hay at $60/ton	2.49
Initial conditions, base ration, hay at $90/ton	2.27
1988 reduction in milk support price, hay at $60/ton	2.38
1988 reduction in milk support price, hay at $90/ton	2.16
Further support price reduction of $.50/cwt., hay at $60/ton	2.26
Further support price reduction of $.50/cwt., hay at $90/ton	2.06

only, and do not take into account the rising costs of grain and other commodities used in formulating the ration. They are useful, however, in roughly simulating the effect of higher hay prices on the results previously outlined in this chapter. As the milk/feed price ratio falls, so does the dairyman's income. The impact of these lower ratios on net cash farm income and projected internal rates of return is summarized in table 28.

With dairy quality hay currently priced at an average of $90 per ton, income expectations are reduced by 13.3 percent. This reduction may become even larger during the coming winter months if hay prices continue to climb, and they likely will. As shown in table 28, internal rates of return may currently have dropped in excess of one full point, from 6.30 to 5.21 percent. Precise predictions for income resulting under all strategies can be only be calculated by reprogramming the model to reflect increased feed costs following the 1988 drought.

It was this marked change in projected dairy farm income that prompted passage of the Disaster Assistance Act of 1988, which eliminates the cut in milk support price scheduled for 1989. At current feed prices, however, the internal rate of return for the typical dairy remain above five percent. Other sectors of agriculture have survived for years with lower internal rates of return.

Rising feed costs have had a negative impact on net cash farm income as well. The typical Cache Valley dairyman who has not adjusted his management strategy in the aftermath of DTP now earns an average of $6256 less per year than he would have done had alfalfa prices remained

Table 28. Impact of Rising Feed Costs on Net Farm Income

Selected Milk/Feed Price Ratios	2.49 1/	2.06 2/
Internal rate of return	6.30%	5.21%
Net cash farm income	$36,161	$29,905

1/ Initial conditions with hay priced at $60/ton.
2/ Hay priced at $90/ton, support price cuts of $.50/cwt. during 1988, '89, and '90 as originally scheduled.

at $60 this summer. But with a projected income of $29,905 he is still earning 2.26 times the minimum $13,200 required in the data set. Dairymen who have implemented the recommended management strategies are earning substantially more.

CHAPTER 5

CONCLUSIONS

Several conclusions may be drawn from the results of this study. As demonstrated in the previous chapter, the opportunity for profitable expansion exists for many individual dairy farms. These findings explain why cow numbers are increasing again, and why the Dairy Termination Program failed as a long term solution to the surplus problem. Reasonable levels of indebtedness may be increased and additional capital borrowed to enlarge milking herds and expand bulk tank capacities. But this should be done within the constraint of management expertise and existing milk barn sizes.

Clearly there is not room in the market for the dairy industry as a whole to continue expanding as it did prior to DTP. Major investment in new milking parlors or the addition of entire herds within the firm are not advised because of the uncertainty of market outlet for the additional milk produced. Declining milk prices are bringing dairymen into sharp realization of today's surplus situation. Established dairymen, especially those seasoned with management expertise and possessing low debt-to-asset ratios, clearly have a competitive advantage. This study indicates that they can become even more competitive by adopting proven technologies such as feeding balanced rations to optimize milk production.

The Food Security Act of 1985 signals the end of an era. The federal government cannot continue to purchase all surplus milk at a favorable price. Prices are adjusting downward towards the equilibrium

level that can be sustained without artificial government support. As this trend continues, government purchases will be reduced to levels that meet actual government needs. Taxpayer subsidization of the dairy sector above this level of support is an unrealistic goal and is unhealthy for the industry as well. With lower support prices and tougher competition, new entries that found it so easy to start up in the late seventies are likely to be dissuaded from entering the dairy business. Fewer new entries will help ameliorate the surplus problem.

A recent study has shown theoretically that "income-augmenting and risk-reducing farm policies may increase the probability of farmers experiencing partial or total equity losses because of the increased leverage induced by these policies" (Featherstone, Moss, Baker and Preckel, p. 578). Experience in the dairy sector over the past eleven years appears to bear this theory out. Many of the dairymen who were enticed by excessive price support policies to enter the business or to borrow large sums of money to expand their existing operations have since been forced to exit. Their leverage ratios got out of hand. Some left through DTP; others have simply gone broke. Both dairymen and processors must realize that expansion plans should not be based on the strength of favorable support prices. Government purchases must be considered in a broad way to be just a small part of the real national market.

The Dairy Termination Program has exhibited measured success in the short run. Government purchases have declined and are approaching sustainable levels. The massive reduction in national milk cow numbers is bringing the market in touch with reality again. For the first time in ten years, real market prices for milk are beginning to rise. Even

though this may be largely in response to the drought of 1988, it's refreshing to see the increase brought on by natural economic forces working within the free enterprise system rather than artificially contrived economic forces such as those that precipitated the surplus problem a decade ago.

In the long run, the free-enterprise system operates better with fewer government controls. Viewed from the wonderful perspective of hindsight, the dairy surplus problem of the eighties may have been avoided if the support price hadn't been pegged so high ten and eleven years ago. Fears of rapid inflation once anticipated for the eighties have failed to materialize. Conversely, high support prices have tended to subsidize inefficiency. This error in judgement has proven costly to taxpayers and dairymen alike. In shaping dairy policy for the nineties, more emphasis should be given to capitalism and free enterprise. This study demonstrates that as market prices fall, entrepreneurs are motivated to adopt technology and management practices that will lower production costs. Dairymen who fail to improve their production efficiency will eventually be forced to exit the business. Some families may be displaced, but in a broad sense they are likely to find employment in other sectors that will provide them with greater income than they are achieving in the dairy business. Others may look to off-farm employment to meet family living expenses and continue farming part-time as an avocation rather than as a career. Perhaps that's not too bad. The dynamics of capitalism augmented with a market oriented support price provide ample incentive to maintain a viable dairy industry. Dairymen who adapt to change through improved management practices still have an excellent chance for success.

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