Chapter 9

Emerging Technologies, Public Policy, and Various Size Dairy Farms

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Chapter 9

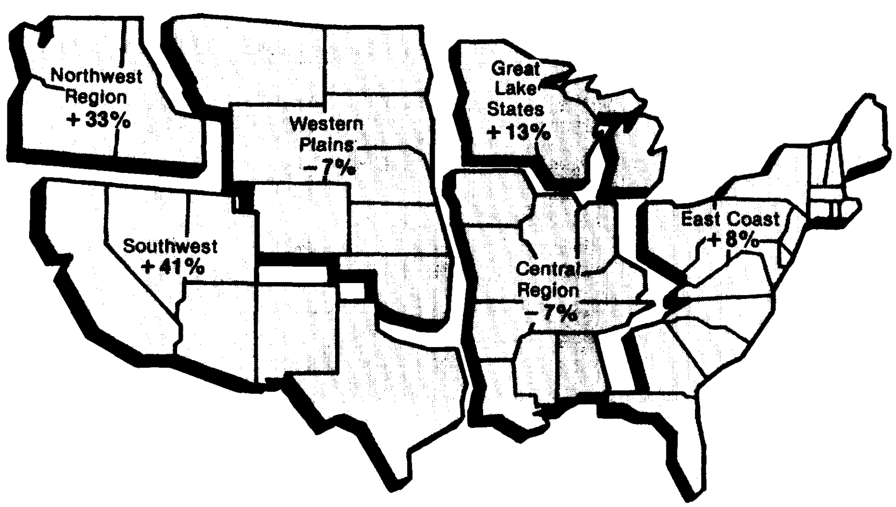
Emerging Technologies, Public Policy, and Various Size Dairy Farms

One of the most controversial areas involving agricultural technology, policy, and structural change in the United States is in the dairy sector. In 1983 the large amount of surplus milk production cost taxpayers approximately $2.6 billion. Emerging technologies promise to dramatically increase milk production per cow by year 2000, from a national average of 12,000 pounds in 1982 to over 24,000 pounds in 2000. As discussed in chapter 3 a reduction of approximately 30 percent in cow numbers will be needed by year 2000 to counteract the effect of the emerging technologies. and the static demand for milk and milk products. Thus the impact of these technologies and policy on the dairy industry will be dramatic. This chapter attempts to provide the foundation for understanding these changes and for analyzing various policies to cope with the dynamic interaction between policy and technological advance,

One of the changes will be a major regional shift in milk production: the Midwest and the Northeast will lose their comparative advantage to the Southwest. During the 1970s milk production increased 41 percent in the Southwest region of the United States, while U.S. milk production increased only 11 percent (figure 9-l). Much of the increased production came from dairies with more than 500 cows, with herds of 1,500 to 2,000 cows being common. Although 303,710 farms in the United States reported having milk cows in 1983, all the milk that sold that year could have been produced by less than 5,000 well-managed dairies with 1,500 cows each.

This chapter examines important economic factors that will affect the trend to fewer and larger dairies and the regional shift in milk production. The first part of the chapter estimates size economies and comparative advantage of milk production for moderate, large, and very large dairy operations in five major U.S. dairy areas. These comparisons provide an indication of the most competitive farm sizes and regions. They are based on returns on investment after all costs are paid, including the regional

Figure 9-1.—How the Dairying Picture Has Changed
(percent change in milk production in various regions from 1970-71 to 1980-81)



SOURCE: U.S Department of Agriculture

replacement of depreciable assets needed to maintain the long-term productive capacity and viability of the farm.

The second part of the chapter develops a beginning financial situation for eight dairy operations in three regions. The ability of these operations to remain solvent and increase net worth over a lo-year planning horizon is simulated under conditions of risk and under alternative policy and technology scenarios. These results provide an indication of how alternative policies affect individual dairy farm operations.[1]

[1]The representative farms were developed and analyzed in the OTA paper "Economic, Policy, and Technology Factors Affecting Herd Size and Regional Location of U.S. Milk Production, " prepared by Boyd M. Buxton.

SIZE ECONOMIES AND COMPARATIVE ADVANTAGE IN MILK PRODUCTION

Dairy Operations Analyzed

Herd size, technologies employed, and practices used in milk production vary considerably throughout the United States. In May 1983 the average herd size for 120,655 producers selling milk to plants regulated by Federal milk marketing orders was 63 cows per farm (table 9-1). However, the average herd size in each State varied from 49 cows in Pennsylvania, to 532 cows in Florida.

The variation in herd size within each State was even more dramatic, Although the average herd size in Florida was 532 cows, the average herd size for the largest 10 percent of the herds in that State was 1,861 cows (table 9-1). Similarly, the average herd size for the largest 10 percent of herds regionally was about 1,700 cows in the Southwest, but only 125 cows in the Great Lake States region. Generally, dairy herds are much larger in the Southwest, Southeast, and Northwest than in the Great Lake States and the Northeast.

From the herd size information in table 9-I, 22 dairies were selected to represent existing herd sizes in five major dairy areas (table 9-2).

Table 9-1.—Total Producers and Size Distribution of Herds Selling Milk to Plants Regulated by Federal Milk Marketing Orders, May 1983[a]

		Average herd size (milk cows)				
Region (State)	Number of total producers	All farms	Largest 10°/0	70 to 89°/0	40 to 69°/0	Smallest 40°/0
Great Lake States:						
Minnesota	9,968	53	116	74	49	30
Wisconsin	24,400	54	133	68	52	28
Northeast:						
Pennsylvania	12,928	49	127	66	44	25
New York	13,374	59	162	81	53	27
Southeast:						
Georgia	962	127	343	181	117	54
Florida	352	532	1,861	931	355	133
Southwest:						
New Mexico	176	333	1,832	433	169	32
Arizona	160	510	1,733	714	433	160
California	13	400	1,640	580	253	110
Northwest:						
Idaho	574	135	607	169	90	34
Washington	1,647	127	418	171	108	46
United States	120,655	63	202	82	54	26

[a]The 120,655 farms accounted for about 69 percent of all milk produced in May 1963, but excluded most farms in California and other States where there is no Faderal milk order,

SOURCE: Boyd M. Buxton and John P. Rourke, "Size Distribution of Dairy Farms Marketing Milk Under Federal Milk Orders, " unpublished report, U.S. Department of Agriculture, Economic Research Service, April 1964,

Table 9-2.—Representative Dairies Selected for Preparation of Whole Farm Budgets, by Region and Herd Size

Region/State	Herd size (cows)	Cropland (acres)	Housing facilities (type)	Sun shades	Feed produced	Silage storage (type)	Total labor (W/e)[b]
Great Lake States:							
Minnesota	52	188	Stanchion	No	Most	Upright	2.03
Minnesota	125	449	Free stall	No	Most	Upright	3.30
Northeast:							
Pennsylvania	52	156	Stanchion	No	Forage	Trench	2.2
Pennsylvania	125	375	Free stall	No	Forage	Trench	3.8
Pennsylvania	200	600	Free stall	No	Forage	Trench	5.54
New York	52	156	Stanchion	No	Forage	Trench	2.21
New York	200	600	Free stall	No	Forage	Trench	5.54
New York	600	1,800	Free stall	No	Forage	Trench	14.36
Southeast:							
Georgia	200	400	Free stall	Yes	Forage	Trench	4.5
Georgia	350	700	Free stall	Yes	Forage	Trench	7.84
Florida	350	0	Open field	Yes	None	NA	7
Florida	600	0	Open field	Yes	None	NA	11
Florida	1,436	0	Open field	Yes	None	NA	18
Southwest:							
New Mexico	900	0	Corral	Yes	None	NA	13
Arizona	359	0	Corral	Yes	None	NA	7
Arizona	834	0	Corral	Yes	None	NA	12
Arizona	1,436	0	Corral	Yes	None	NA	16
California	550	0	Corral	Yes	None	NA	9
California	1,436	0	Corral	Yes	None	NA	16
Northwest:							
Washington	140	51	Free stall	No	Silage	Trench	2.96
Idaho	200	400	Corral	No	Most	Trench	5.0
Idaho	550	0	Corral	No	None	NA	10.5

Housing types are:
- Stanchion — A conventional barn with locking stanchions in which cows are milked and fed
- Free *stall* — A covered barn with individual stalls in which cows freely enter and exit.
- *Open field* — A field where cows are kept that is large enough to maintain plant cover.
- *Corral* — A drylot open pen where cows are kept and fed at a fenceline feeder.

[b]Labor in worker equivalents of 2,500 hours annually.

NA—not applicable

SOURCE: Office of Technology Assessment

The 20()-cow Pennsylvania and 600-cow New York dairies exceed the average size of the largest 10 percent of dairies in those States. However, such larger sized dairies exist in these States and will become more prevalent in the near future.

Technologies and Practices

The technologies and practices assumed for each of the 22 dairy operations were based on discussions with dairy producers, university and Government employees, and equipment representatives. The objective of these discussions was to describe efficiently organized dairy operations that use proven technologies and practices for each specified herd size. Therefore, the dairy operations in this analysis are not the average of what now exists, but rather approximate modern sizes and types of operations.

The 52-cow dairies in Minnesota, Pennsylvania, and NewYork use the conventional stanchion barns for housing and milkingcows(table9-2). For larger herds in the Great Lake States, the Northeast, Washington, and Georgia, freestall housing and milking parlors are assumed.

Cows are kept in open corrals throughout the Southwest and on larger Idaho dairies. Sun shades in the corrals are assumed for farms in New Mexico, Arizona, and California (Southwest), but not in Idaho. Cows are milked twice a day in milking parlors and fed at fenceline bunks from a feed wagon or truck.

Open fields with sun shades are assumed for farms in Florida. One-half acre per cow is provialed, allowing fields to remain grass-covered to minimize mud problems. Cows are milked twice a day in a milking parlor. After leaving the milking parlor, they are fed concentrates in a feed barn before being released back to the field. Roughage is fed loose in the open fields.

The source of feed follows the common practice existing in the various States. For New Mexico, Arizona, California, and Florida, most feed is purchased from off the dairy operation. The same is assumed for the 550-cow Idaho dairy. Dairy operations in Pennsylvania, New York, and Georgia purchase most of the concentrates but produce most of the forage used by their dairy herds. All feed is assumed to be produced on farm for the Minnesota and the 200-cow Idaho dairies.

Costs and Returns

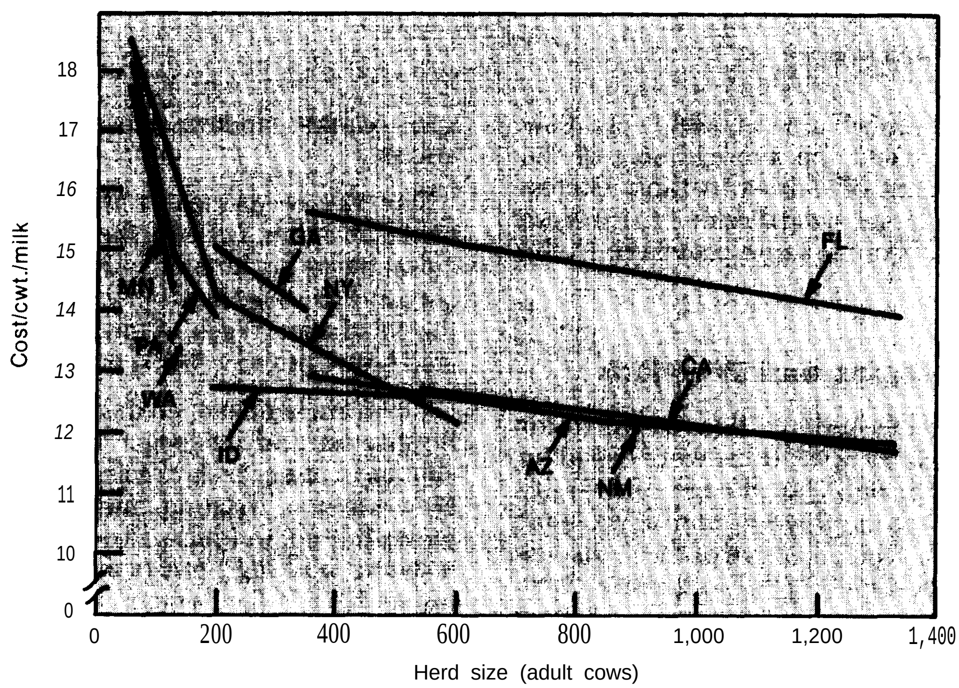
The specialized dairy operations considered in this chapter receive all revenue from the dairy enterprise. Milk sales are the single largest source of revenue, but the sale of cull cows, bull calves, and replacement heifers are also important. The prices received for milk delivered to plants vary from one State to another, largely reflecting the classified pricing policy of Federal and State milk orders and the proportion of milk used as fluid in the various States.

Costs are divided into operating and ownership costs. Operating costs include purchased feed and a wide range of expenses such as farm repairs, hired and operator labor, utilities and fuel for the dairy herd, and veterinary and breeding fees. Annual ownership costs include depreciation, property taxes, and insurance premiums.

Based on the above, the estimated costs per cow for assets required on the 22 dairies are illustrated in figure 9-2. These costs reflect an amount sufficient to replace wornout assets when needed and thus reflect an amount needed to maintain the long-term viability of the operation.

In calculating relative rate of return for these dairies, milk prices received by dairy operators were assumed to be those prices received in

Figure 9.2.–Total Cost per Hundredweight of Milk by Herd Size and State, 1982



SOURCE. Office of Technology Assessment.

1982. The price level varies from $12,70 per hundredweight (cwt) in Idaho to $16.40 in Florida. The difference in price between States is due in large part to pricing policies under Federal and State milk marketing orders. States with relatively high prices are areas where milk used as a fluid beverage is priced relatively high and is a relatively large share of total sales.

Given the above assumptions, costs and returns for the 22 operations were calculated (figure 9-3). The rate of return ranged from — 2.15 percent on the 52-cow New York dairy to about 15.72 percent for the 1,436-cow Florida and 900-cow New Mexico dairies. z The differences are due mostly to herd size. The differences between New Mexico, Arizona, and Florida (relatively high return) and California (relatively low return) in part reflect differences in milk prices.

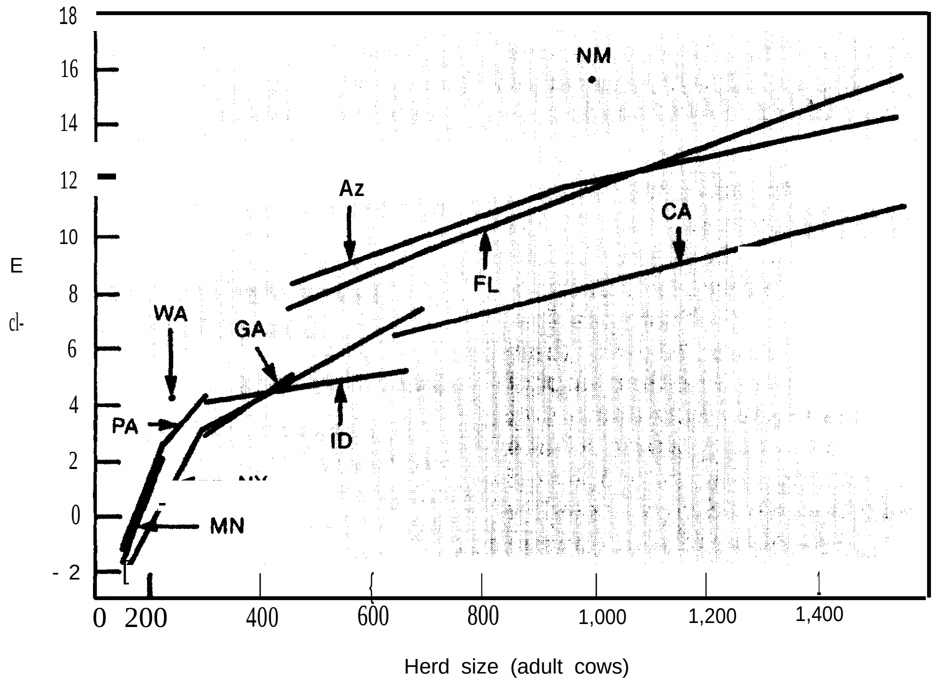
Note that the rate of return for the 600-cow New York dairy was favorable compared with that for herds of similar sizes in other States. The differences between the 600-cow Florida, 600-cow New York, 550-cow California, and 550-cow Idaho dairies are in part related to differences in milk prices.

Summary and Conclusions

- Investment or replacement cost per cow is less on larger farms.
- For herd sizes that characterize dairy farming in each region, investment per cow is less for the large dairy operations in the Southwest, Northwest, and Southwest than for the Great Lake States and Northeast regions.
- The larger dairies with 500 cows or more are more profitable than smaller dairies. Dairies in New Mexico, Arizona, and Florida are

New Mexico, Arizona, California, Idaho, and Washington costs and returns were based on the current subsidized irrigation costs for water to produce alfalfa hay. If the irrigated water were priced to reflect actual costs more closely, which are about three times the subsidized costs, the rate of return would be 2 to 3 percentage points below the rates shown in figure 9-3 for these States. For details of this analysis see Boyd M. Buxton, "Economic, Policy, and Technology Factors Affecting Herd Size and Regional Location of U.S. Milk Production, " paper prepared for the U.S. Congress, Office of Technology Assessment, 1985,

Figure 9-3.—Long-Term Rate of Return to Investment by Herd Size and State



SOURCE Office of Technology Assessment

more profitable than their counterparts in Minnesota and the Northeast.

- Although costs are highest in Florida, the relatively high price received for milk provides a competitive return. The profitability of California and Idaho dairies is adversely affected by lower milk prices than those of New Mexico, Arizona, and Florida dairies.
- Strong economic pressure exists for herds to grow larger in all regions. This will continue the trend to fewer and larger dairies.
- The relatively favorable rate of return of large-scale dairy farming in the Southwest, Southeast, and Northwest regions will likely result, over the long term, in a continued shift in milk production to those areas. Those areas will likely increase their relative share of total U.S. milk production, placing increased competitive pressure on the traditional Great Lake States and Northeast dairy areas.

ECONOMIC IMPACTS OF EMERGING TECHNOLOGIES AND SELECTED POLICIES FOR VARIOUS SIZE DAIRY FARMS

The preceding section considered the long-term relative rates of return of different size dairies in five regions. Implicit in the analysis is that the real production costs will remain constant and the support price cannot be permanently above or below the price level that will balance supply and demand. Under the present purchase-type price support program, decisions to set support prices above the long-term market clearing level would, in the long run, have to be modified. Otherwise, the Government expenditures would grow to a level unacceptable to policy makers. This means that alternative support levels must reflect market conditions in the long run.

This section considers the economic impacts of selected policy decisions on dairy operations over a 10-year period. Panelists at the OTA animal technology workshop discussed in chapter 2 identified likely new technologies that would be available over the next 10 years, their adoption rate by the industry, and their impact on milk production per cow. They found that the adoption of new technology would reduce the real cost of producing milk. In turn, lower real costs of production would be reflected in lower milk prices. Eight of the 22 dairy operations analyzed in the previous section were selected for analysis about the impact of alternative technologies and policies. Three of the five regions are represented: Great Lake States, Southeast, and Southwest.

A Firm Level Income Tax and Farm Policy Simulator used in the previous crop farms analysis, and discussed in detail in appendix E, was used to simulate the eight dairy operations for selected policy and technology scenarios for 10 years, beginning in 1983. The planning horizon was simulated 50 times (iterations) using a different set of: 1) random milk, cull cow, and replacement cow prices; 2) feed costs; and 3) milk production per cow for each iteration. At the end of each iteration, values for present value of net returns (revenue minus cost over lo-year period) and ending net worth, long-term and intermediate-term debt, equity-to-asset ratio, internal rate of return, and net farm income were calculated. The results of OTA's analysis are discussed in further detail in appendix F.

Farm Policy, Tax Policy, and Technology Scenarios

Base Scenario

The base scenario assumptions were those considered most likely over the 10-year planning horizon and are summarized in the following sections.

Technology.—The impact of productivity gains achieved through new technologies and management practices are largely reflected in increased milk production per cow and reductions in the real cost of producing milk. In the longer run, lower production costs are largely passed on to consumers through lower milk prices. Dairy farmers who adopt technology and achieve productivity gains are able to compete and remain financially solvent, whereas those farmers that cannot will likely become insolvent.

The pooled knowledge and judgment of the above-mentioned panel at the OTA workshop identified the most likely new technologies and adoption rates and productivity gains over the 1983-92 period. Although milk production per cow is expected to increase for all herd sizes in all regions, the panel expected operators of larger herds within each region to adopt new technology more rapidly than operators of smaller herds. While the 125-cow dairy is considered very large in Minnesota, it would be considered very small in California, Arizona, or Florida. However, operators of the very large 125-cow Minnesota dairies are expected to adopt new technology as rapidly as operators of the very large 1,436-cow dairies in California and Florida (table 9-3).

Milk production per cow is expected to continue a long-term trend by increasing 1 percent annually for all herd sizes (table 9-4). New technology likely to increase milk production above this long-term trend was grouped into three main categories: 1) information and nutrition, including such technologies as computer management and feeding systems, communication and information systems, improved environmental management, and feed additives;[3] 2) bovine growth hormone (bGH); and 3) other biotechnologies, including embryo transplants and sexing, genetic engineering, and pest and disease control.

Information and nutrition technologies are expected to increase milk production per cow an additional 1.8 percent annually, starting in 1983 for very large dairies, in 1985 for large dairies, and in 1987 for medium dairies (table 9-4).

[3]Information and nutrition technologies were grouped together because their availability y to dairy farmers will come at about the same time, Information technologies will account for a1,2-percent annual increase and nutrition technologies 0.6-percent annual increase for a total of a 1.8-percent annual increase.

Table 9-3.-Very Large, Large, and Moderate Herd Sizes, by State

	Herd size (milk Cows)[a]		
State	Very large	Large	Moderate
Minnesota.	125	[b]	52
California	1,436	550	
Arizona	[b]		359
Florida , ...	1,436	600	350

[a]Size groups based on market order data as found in Boyd M. Buxton and John P Rourke, "Size Distribution of Dairy Farms Marketing Milk Under Federal Milk Orders," unpublished report, U S Department of Agriculture, Economic Research Service, April 1984
[b]Dairies for these herd size groups were not simulated

SOURCE Off Ice of Technology Assessment

Bovine growth hormone is expected to increase milk per cow 25.6 percent when adopted. This jump in milk production is expected to continue after the adoption of bGH in 1987 by operators of very large dairies, in 1988 by operators of large dairies, and in 1989 by operators of medium dairies. The favorable economic incentives suggest a more rapid adoption than other technology groups once bGH is available.

Increased feed costs per hundredweight of milk due to bGH is estimated at $4.49 for California, Arizona, and Florida dairies and $3.59 for Minnesota dairies. About 90 percent of the increased feed cost would be for concentrates, and 10 percent for forage. The cost is less in Minnesota because concentrate prices are lower there than in other States (Kalter, 1984).

The other biotechnology group, which includes embryo transplants, genetic engineering, and pest and disease control, is expected to increase milk production per cow an additional 0.5 percent annually, starting in 1987 for very large dairies, in 1989 for large dairies, and in 1991 for moderate dairies (table 9-4).

Table 9-5 summarizes the expected milk production per cow for various size herds in three regions, given the above technology assumptions,

Milk Prices.—The base scenario assumes the support price specified in the Dairy and Tobacco Production and Stabilization Act of 1983. The 1984 price likely will be 32 cents lower than the 1983 price, reflecting a 50-cent reduction in the support price on December 1, 1983. The Government purchases of surplus dairy products

Table 9-4.-Year-to-Year Percentage Increase in Milk Production per Cow for Three Technology Groups, by Herd Size, 1983.92

		Information and nutrition			Bovine growth hormone			Other biotechnologies		
Year	Trend	Very large	Large	Medium	Very large	Large	Medium	Very large	Large	Medium
1983	1.0%	1.80/0	o	0	0	0	0	0	0	0
1984	1.0	1.8	0	0	0	0	0	0	0	0
1985	1.0	1.8	1.80/0	0	0	0	0	0	0	0
1986	1.0	1.8	1.8	0	0	0	0		0	0
1987	1.0	1.8	1.8	1.80/0	25.60/o	o	0	0.5%	o	0
1988	1.0	1.8	1.8	1.8	0	25.60/o	o	0.5	0	0
1989	1.0	1.8	1.8	1.8	0	0	25.60/o	0.5	0.5 "/0	o
1990	1.0	1.8	1.8	1.8	0	0	0	0.5	0.5	0
1991	1.0	1.8	1.8	1.8	0	0	0	0.5	0.5	0.5 "/0
1992	1.0	1.8	1.8	1.8	0	0	0	0.5	0.5	0.5

[a]Percentage increases are for specified year and are maintained in all subsequent years. Percentage increases are above 1982 Production Per cow levels of 147.1cwt in Minnesota, 165.7 cwt in California and Arizona, and 131.1 cwt in Florida.

SOURCE: Office of Technology Assessment, Animal Technology Workshop, Washington, DC, April 1964; and Robert J. Kalter, et al., *Biotechnology* and the *Dairy Industry: Production* Costs and *Commercial Potential of the* Bovine *Growth* Hormone, AE Research 64-22 (Ithaca, NY: Cornell University Department of Agricultural Economics, December 1964).

Table 9-5.—Milk Production per Cow for Most Likely Technology Scenario, 1982-92 (hundredweight)

	Minnesota		California and Arizona			Florida		
Year	Very large	Medium	Very large	Large	Medium	Very large	Large	Medium
1982	147.1	147.1	165.7	165.7	165.7	131.1	131.1	131.1
1983	151.2	148.6	170.3	167.3	167.3	134.8	132.4	132.4
1984	155.5	150.0	175.1	169.0	169.0	138.6	133.7	133.7
1985	159.9	151.5	180.1	173.0	170.0	142.5	137.5	135.0
1986	164.3	153.1	185.1	178.6	172.0	146.4	141.3	136.5
1987 ...., . .	169.0	157.2	190.4	183.6	177.1	150.6	145.3	140.1
1988	225.4	161.7	253.8	188.7	182.1	200.8	149.3	144.1
1989	232.9	166.4	262.3	252.0	187.4	207.5	199.4	148.3
1990	240.7	221.9	271.0	260.0	260.0	214.5	206.1	197.8
1991, ...	248.6	229.3	280.0	269.1	258.3	221.6	212.9	204.4
1992	256.8	237.1	289.3	278.0	267.1	228.9	219.9	211.3

SOURCE Office of Technology Assessment.

are assumed to be high enough through 1985 and 1986 to trigger a 50-cent drop in support price on April 1,1985, and again on July 1,1985, as specified in the above-mentioned 1983 Act. This price is projected through 1986.

From 1987 to 1992 the dairy support price is expected to be reduced 50 cents per year as long as the estimated variable milk production costs, given assumed technological changes and associated declines in real costs, are less than market prices in the previous year. It is expected that the 50-cent-per-hundredweight declines will occur through 1992,[4]

Financial Characteristics.—The likelihood of a particular dairy remaining solvent under alternative policies is directly affected by its initial financial characteristics. The characteristics of most importance include the value of assets, cash reserves, debt, net worth, equity, and family consumption needs. A policy change can have quite different implications for the operator of a dairy with a high level of debt than one with a low level of debt.

The average financial situation that exists on the eight dairies of the size and location selected are shown in table 9-6. The averages were approximated from a U.S. Department of Agriculture farm financial surveys Equity ranged from 69 to 76 percent of total assets. In contrast to

[4]These assumptions approximate the actual policy for dairy as specified in the Food Security Act of 1985.

Summary of financial characteristics of dairy farms were estimated from farm financial summary data provided by Neil Peterson, Economic Research Service, USDA,

Table 9-6.—Financial Characteristics Assumed for Eight Dairy Operations in Four States

	Minnesota		Arizona	California		Florida		
Financial characteristics	52	125	359	550	1,436	350	600	1,436
Value of:								
Cropland and farmstead ($1,000)	293.4	679.1	39.4	160.0	312.0	262.5	450.0	1,074.0
Buildings ($1,000)	92.7	176.7	192.8	284.4	512.6	87.9	108,9	211.7
Farm machinery ($1,000)	104.1	159.0	120.3	183.1	303.0	114.6	180.0	260.7
All livestock ($1,000)	77.9	181.4	599.6	960.7	2,505.0	525.5	981.4	2,344.3
Off-farm investments ($1,000)	5.5	13.1	0	0	0	0	0	0
Beginning cash reserves ($1,000)	12,0	62.5	89.8	137.5	35.9	70.0	212.0	505.5
Debt ($1 ,000)	268.3	302.4	297.7	464.3	1,130.0	303.7	461.9	944.6
Initial net worth ($1 ,000)	417.1	969.4	744.2	1,261.3	2,537.5	756.9	1,464.7	3,343.0
Equity ratio (fraction)	0.71	0.76	0.71	0.73	0.69	0.71	0.76	0.76
Family living								
Minimum ($1,000)	20.0	25.0	25	27	30	25	27	30
Maximum ($1,000)	32.0	35.0	30	38	40	30	38	40
Marginal propensity (fraction)	0.3	0.4	0.3	0.4	0.4	0.35	0.4	0.4
Off-farm income ($1,000)	0	0	0	0	0	0	0	0

SOURCE Office of Technology Assessment

replacement values used in the previous section, the value of buildings and machinery are market values; it was assumed that each asset was about half depreciated.

Results Expected.—Under the base scenario, it was expected that a well-managed dairy of average size would about break even after paying expenses and farm overhead and making withdrawals for family living. It was also expected that well-managed dairies in all regions should be able to survive under a continuation of the current program. Farms that were not in a position to realize most of the economies of size in dairying would be gradually forced out of business. In other words, an extension of current policy would force dairies to compete on the basis of cost and efficiency.

Results Obtained:

- All dairies except the 52-cow Minnesota operation were able to increase their real net worth over the lo-year planning horizon (table 9-7). The 52-cow dairy experienced a 42-percent reduction in net worth.
- The larger the dairy, the greater its financial success. Dairies in Florida and the Southwest were more profitable than dairies in Minnesota, The Florida dairy benefited greatly from higher milk prices.
- The 52-cow dairy had the lowest probability of survival (74 percent), owing to having the highest unit cost of production. It lost an average of $22,000 annually in net farm income.

A Crop Acreage Reduction Program

The present feed grain program was assumed through 1985. From 1986 to 1992 a 15-percent set-aside with a 5-percent diversion for corn, cotton, rice, sorghum, and wheat was assumed. This program results in dairy feed prices being 9-percent higher than those under the base scenario.

Results Expected.—Feed cost would represent about 50 to 60 percent of total costs per cow. A crop program that results in a 9-percent higher feed cost is roughly equal to a 5-percent reduction in the price of milk. This would have an adverse impact on a dairy's ability to increase net worth, reduce debts, and achieve as high an internal rate of return as under current policy. In the short run, dairies that raise most of their feed would be less directly affected. The probability of survival would probably be reduced for dairies operating at or below the break-even point under the current policy because they would be unable to absorb the higher feed costs.

Table 9-7.—Comparison of Continuation of Present Policy (Base Scenario) on Dairy Farms From Various Regions

Dairy herds	Probability of survival	Beginning net worth	Ending net worth	Average net cash income	Average net income
Minnesota:					
52 COWS	74 "/0	$ 417,000	$ 240,000	$–7,000	$–22,000
125 COWS	100	969,000	1,120,000	49,000	20,000
California:					
550 cows	96	1,261,000	2,055,000	101,000	10,000
1,436 COWS	98	2,538,000	7,332,000	628,000	449,000
Arizona:					
359 cows	96	744,000	1,296,000	77,000	14,000
Florida:					
350 cows	96	757,000	1,004,000	41,000	–6,000
600 COWS	100	1,465,000	2,453,000	153,000	83,000
1,436 COWS	100	3,343,000	9,257,000	759,000	635,000

SOURCE Office of Technology Assessment.

Results Obtained:

- The associated higher feed prices had the greatest adverse financial impact on dairies that purchased most of the feed from off the farm. For example, compared with that of the current policy, the average annual net farm income of the 1,436-cow California dairy declined 62 percent, from $449,000 to *$171,000.*
- The probability of survival was reduced for all dairies except the 1,436-cow Florida dairy and the 125-cow Minnesota dairy.
- There was relatively little impact on Minnesota dairies, where most feed is raised at the dairies.

No Crop Programs

There is much discussion of a desire to move to more market-oriented crop programs. Removing all price supports and income supports would increase the variability of feed prices, subjecting the dairyman who purchases feed to greater risk. For this scenario the Commodity Credit Corporation (CCC) loan, farmer-owned reserve (FOR), and target price provisions were eliminated for all years in the planning horizon (1983-92). This increased the variability in feed costs facing dairy operations. The impact of this variability was evaluated.

Results Expected.—Feed prices paid by dairies would be higher in some years but lower in other years. Over time, high and low price years would be expected to balance out, leaving a surviving dairy about as prosperous as it is under the current policy. However, the cost associated with possible borrowing to tide a dairy over periods of high feed costs might be expected to affect somewhat adversely its ability to retire debt and increase net worth. Dairies under tight financial conditions under current policy would be expected to have a lower probability of survival without crop programs because they would be less able to absorb the effects of periods of relatively high feed prices. This would be less a problem for dairies in a relatively strong financial position under current policy because they would be better able to absorb these shocks.

Results Obtained:

- The increased variability in feed prices, associated with eliminating all crop programs, had little financial impact on all dairies compared with the results under the current policy. Average net present value declined less than 2 percent for all dairies.
- Increased price risk did not reduce the probability-of survival for any of the farms.

Fifty Cents Reduction in Price

All the assumptions of the current policy were retained except that mean milk prices were assumed to be reduced 50 cents per hundredweight and the variability of milk prices was assumed to have increased. This scenario was included in the analysis because of the current high level of Government stocks and program costs.

Results Expected.—Lower support prices would be expected to affect adversely the dairies' net incomes as well as their survival and growth. The dairies most adversely affected would be those that were already in financial difficulties under the base policy.

Results Obtained:

- All farms, compared with results for the current policy, were negatively affected. All farms experienced losses in net farm income, net present value, and net worth compared with results under current policy.
- The largest dairies in each region experienced little reduction in the probability of survival.
- The greatest adverse impact was on the smallest Minnesota dairy, where the probability of survival declined from 74 to 58 percent and the probability of a positive net present value declined from 26 to 18 percent. Other dairies that were adversely affected included the smaller Florida and California dairies, Therefore, reduced price supports would force many small dairies out of business.

No Dairy Program

All assumptions of the base scenario were retained except that milk price variability was assumed to have increased, Milk price was expected to fall to the estimated average variable cost for the most efficient dairies until 1990. Price was then expected to recover in 1991 and 1992 until in 1992 the price would be equal to the average total cost for the most efficient operations. However, with no price support program, the actual price may be either above or below the average price. The model randomly selects milk prices from a distribution that may be as much as 20 percent above or 25 percent below the mean price.[6]

Results Expected.—Without a dairy price support program there would be no guaranteed price floor. In some years milk prices would be higher, while in other years they would be lower than under current policy. However, they would still fluctuate about the long-term equilibrium price. Over time, favorable and unfavorable prices should balance out, meaning that the ability of a dairy to increase net worth, repay debt, and achieve a favorable internal rate of return would not be seriously affected. However, the probability of survival for dairies in tight financial situations would be adversely affected.

Results Obtained:

- The probability of survival fell for all farms, with the greatest reduction experienced by the moderate farms analyzed. The lowest probability of survival was 22 percent for the 52-cow Minnesota dairy (table 9-8).
- Ending net worth declined significantly on all farms except for the very large farms in California and Florida. For example, net worth declined 73 percent for the 52-cow Minnesota dairy and 37 percent for the 550-cow California dairy.
- Average net income was negative for all farm sizes except for the very large dairies in California and Florida.
- Very large farms were the only farms able to survive under no price support program.

Supply Control

All assumptions of the base current policy were retained except that mandatory quotas were assumed to be imposed on dairies. Quotas equal to 96.5 percent of a producer's normal production would, over time, be expected to maintain milk prices $1 above those under current policy. Herd size would be reduced about 4 percent in order to reduce milk production 3.5 percent, assuming that poorer-than-average cows would be culled in complying with the quota.

Results Expected.—The financial performance of all dairies would likely be improved as a result of permanently higher milk prices, despite those dairies having to reduce total milk produced within the designated quota, The probability of survival would increase along with a greater ability to reduce debt and increase net worth for dairies existing at the time the pro-

[6]The variation of milk prices without a dairy price support program was developed from the following study: Cameron S. Thraen and Jerome W. Hammond, *Price Supports, Risk Aversion and U.S. Dairy: An Alternative Perspective of the Long-Term Impacts,* Economic Report ER83-9, Department of Agricultural and Applied Economics, University of Minnesota, June 1983.

Table 9.8.—Comparison of No Milk Price Support Program on Dairy Farms From Various Regions

Dairy herds	Probability of survival	Beginning net worth	Ending net worth	Average net cash income	Average net income
Minnesota:					
52 COWS	22 "/0	$ 417,000	$ 114,000	$ ⁻19,000	$ –38,000
125 COWS	98	969,000	835,000	6,000	–21 ,000
California:					
550 cows	62	1,261,000	800,000	– 72,000	– 166,000
1,436 COWS ... , ...	96	2,538,000	4,418,000	187,000	7,000
Arizona:					
359 cows	42	744,000	276,000	– 55,000	– 121,000
Florida:					
350 cows	36	757,000	317,000	– 49,000	– 97,000
600 COWS	72	1,465,000	1,268,000	–23,000	–97,000
1,436 COWS	100	3,343,000	6,625,000	366,000	242,000

SOURCE: Office of Technology Assessment.

gram is implemented. However, this economic advantage could be capitalized into the quota value, thereby eroding the advantage for new entrants or producers that would have to purchase quotas to expand milk production.

Results Obtained:

- Probability of survival was increased for all farms of all regions (table 9-9). The 52-cow Minnesota dairy experienced the largest increase in the probability of survival, from 74 percent under the base scenario to 92 percent,
- Average net present value increased for all dairy farms. The 52-cow Minnesota dairy increased from –$61,000 to $13,000,
- Ending net worth was increased for all dairies, owing to retained earnings and repayment of debt.
- Net farm income for Minnesota dairies was increased by at least **$8,000** compared to the base scenario. These dairies previously had the lowest income.

Income Tax Changes

All assumptions of the base scenario were retained except that more restrictive Federal income tax provisions were included, such as the following:

- Machinery, livestock, and buildings were depreciated using the straight-line cost recovery method.
- First-year expensing provisions were eliminated for all depreciable items.
- Maximum investment tax credit provisions were eliminated.
- The maximum annual interest expense that

Table 9.9.—Comparison of Supply Control Program on Dairy Farms From Various Regions

Dairy herds	Probability of survival	Beginning net worth	Ending net worth	Average net cash income	Average net income
Minnesota:					
52 COWS	92%	$ 417,000	$ 310,000	$–2,000	$ ⁻14,000
125 COWS	100	969,000	1,190,000	59,000	33,000
California:					
550 cows	96	1,261,000	2,349,000	161,000	76,000
1,436 COWS	100	2,538,000	8,543,000	812,000	653,000
Arizona:					
359 cows	96	744,000	1,486,000	112,000	54,000
Florida:					
350 cows	98	757,000	1,164,000	67,000	25,000
600 COWS	100	1,465,000	2,681,000	201,000	137,000
1,436 COWS	100	3,343,000	10,038,000	877,000	769,000

SOURCE Office of Technology Assessment

could be used to reduce taxable income was $15,600.

- The operator must sell obsolete machinery on disposition rather than trading it in on new replacements, thus forcing recapture of excess depreciation deductions.

Results Expected.—These tax policy changes would have an adverse impact on the ability of a dairy to reduce debt, increase net worth, and, if in a tight financial situation, reduce the probability of survival. All tax changes would increase the tax liability, reducing the net income of the operation and leaving less for debt retirement and increases in net worth.

Results Obtained:

- Eliminating the tax benefits increased tax liabilities and reduced the net present value and net worth for all farms, These reductions, however, were relatively small—in the range of 1 to 10 percent.
- The increased tax liabilities were not large enough to reduce significantly the probability of survival.

Technology Scenarios

The milk price assumption of the base scenario was retained for the two technology scenarios discussed below. It should be recognized that milk prices would be expected to be higher than the base scenario prices if productivity gains from the designated technologies did not materialize, Therefore, the adverse effect of these technology scenarios is overstated,

No *Information and Nutrition Technology.*—The 1.8-percent annual increase in production per cow attributable to information and nutrition technology was excluded from the base assumption for this scenario. The financial performance of all dairies would be adversely affected under this scenario, For the very large farms the per-cow increase in 1982 milk production by 1992 was only two-thirds as much as under the base scenario.

No *Bovine Growth Hormone.—The* 25.6-percent jump in milk production when bgh is adopted was excluded from the base assumption for this scenario. The financial performance of all dairies was expected to be adversely affected under this scenario compared with the base scenario. For the very large dairies, the increase in 1982 milk production per cow by 1992 was assumed to be only 40 percent as much as under the base scenario.

Results Expected.—The expected impact of not adopting these technologies was to affect significantly the financial performance of the dairies. The probability of survival and all measures of financial performance would decline compared with the base scenario.

Results Obtained.—Large decreases in net farm income, net present value, and ending net worth were experienced for all dairies compared with results from the base scenario.

Financial Stress Scenarios

The assumed beginning financial conditions for four of the eight dairies were changed to reflect high-debt operators and new entrants. Debt load was doubled to reflect high-debt situations, For new entrants all equipment was assumed to be new, which increased both the initial value of the machinery and the total debt load.

Two policies were considered for high-debt dairies. One was to subsidize interest rates on all debt so that the effective rate for all loans paid would be 8 percent rather than the higher rates used in the current policy, The second was to restructure the debt by converting a portion of intermediate debt into long-term loans and/or to extend the length of intermediate-term loans. In the second case, interest rates, total debt loads, and other assumptions of the high-debt dairies remained the same as in the base scenario.

The impact of higher feed costs and of eliminating the dairy price support program was evaluated for new entrants with a high-debt position. The results obtained included the following:

- The probability of survival for any dairy depends greatly on its initial financial position. Dairies with high debt and new entrants with high debt had significantly lower probabilities of surviving than dairies with initial financial situations assumed under current policy.

- Neither interest subsidies nor opportunities for debt restructuring greatly improved the chances of high-debt dairy farms remaining solvent.
- The probability of survival for both Minnesota dairies was zero for all policy scenarios. The implication is that high-debt producers in this region cannot survive, even under the current dairy policy,

Summary and Conclusions

- Policies and technologies that are favorable for dairy provide greater financial opportunities for large rather than small dairies.
- Policies that adversely affect the dairy industry such as higher feed costs, fewer income tax benefits, and no dairy price support program will negatively affect small dairies more than larger dairies.
- The major advantage enjoyed by larger dairies is more related to the efficiency of operation than to specific dairy policies.
- There will be a continued trend to fewer and larger dairies in all regions. Milk production can be expected to continue to increase in the lower cost regions of the Southwest and West.
- Traditional dairy regions will continue to experience increased competitive pressure from larger scale, more efficient producers in other parts of the United States. Substantial restructuring of dairies in the Great Lake States and the Northeast will be required for those dairies to compete.
- Emerging technologies need to be transferred to moderate-size dairy farms at a much earlier time in the technology adoption process for these farms to survive.
- Dairy price supports must be sufficiently flexible to adjust to the increased production and lower costs spurred by technological change. This could be accomplished either by adjusting the price support level to changes in production costs per unit of output or by adjusting the level of CCC purchases.
- Current geographic price alignment systems in Federal milk marketing orders are becoming increasingly outdated. A comprehensive study is needed of changes required to modernize the Federal order system in light of technological changes.

CHAPTER 9 REFERENCE

Kalter, Robert J., et al., Biotechnology and the *Dairy Industry: Production Costs and Commercial Potential of the Bovine Growth Hormone,* A.E. Research 84-22 (Ithaca, NY: Cornell University Department of Agricultural Economics, December 1984).