Chapter 5

Economic and Policy Impacts of Emerging Technologies on the U.S. Dairy Industry

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Economic and Policy Impacts of Emerging Technologies on the U.S. Dairy Industry

Technologies from the biotechnology era will play an important role in sustaining or accelerating the historical trend of constantly increasing milk output per cow. The new technology likely to have the most to do with this growth is bovine somatotropin (bST). In the following analysis of the economic and policy implications of emerging technologies, special emphasis will be given to bST. As with any analyses, the conclusions are only as accurate as the assumptions made. Of special interest and importance is the assumption regarding the adoption of bST by farmers.

TECHNOLOGY ADOPTION

It is not known when and how many dairy farmers will adopt new technologies, such as bST, once they become commercially available. Several studies of bST either directly address the issue of adoption or make assumptions regarding adoption rates and patterns. In a survey of dairy farmers, Lesser et al. (6) found that about 50 percent of respondents would adopt bST within the frost year of its commercial availability, and that over 80 percent would within 3 years. Most analysts, relying heavily on such studies, have tended to assume relatively rapid adoption of bST (1,4).

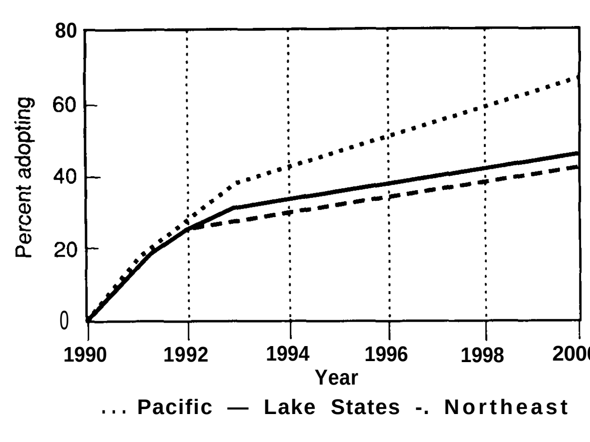
However, the use of surveys to indicate prospective adoption rates of a technology that is not yet available is problematic. For example, information regarding the technology is incomplete. Most of the bST surveys were done several years ago when there was little negative reaction from public interest groups. Moreover, new dairy technologies, as a general rule, have not tended to be adopted rapidly. For example, despite having been available commercially for over 40 years, artificial insemination technology is used only by 65 to 70 percent of dairy farmers. Likewise, Dairy Herd Improvement (DHI) technology, available for 50 years, is used by only 45 percent of farmers (13). In addition, regionally variable patterns of use are associated with both technologies.

This report considers the history of technology adoption by farmers for insight into potential rates of bST adoption. Statistical analyses indicate that the variables most closely (and positively) related to farmer adoption of new technologies (e.g., automatic grain-feeding systems, automatic milking-unit removal, three-times-a-day milking, DHI, and artificial insemination) were milk output per cow and size of herd. Efficiency in the utilization of capital, labor, and feed were also found to be significantly related to technology adoption in particular regions (7).

Using this information, and assuming that adoption of bST would closely parallel that of other technologies, bST technology adoption curves were derived (see figure 5-l). (See app. A for details.) Comparative regional information on the level of adoption after 1,5, and 10 years is contained in table 5-1. The results reflect:

- the tendency of the dairy industry to adopt technologies at different rates regionally;
- the progressiveness of the Pacific region dairy industry compared with that of other regions, including traditional milk production regions; and
- a slower rate of adoption than is indicated by producer surveys of probable bST use, and one that is more typical of past dairy industry technology adoption patterns.

Figure 5-l-Comparative bST Adoption Curves Projected for the Pacific, Lake States, and Northeast Regions



SOURCE: Office of Technology Assessment, 1991.

Table 5-l—Forecasted Adoption Rates for bST Technology, Selected Years, 1991-2000[a]

Region	Percent of farmers adopting		
	1991	1995	2000
Pacific	17%	46%	67%
Lake States	15	35	46
Northeast	15	31	43
Appalachia	15	32	46
Southeast	15	29	39
Southern Plains	13	34	42
Corn Belt	13	25	31

[a]bST is assumed to be commercially available in 1991.

SOURCE: Office of Technology Assessment, 1991.

OTA's analysis indicates that during the first year that bST is commercially available, no more than 17 percent of farmers will use it. After 5 years, bST adoption is forecast to range from 25 percent in the Corn Belt to 46 percent in the Pacific region. After 10 years, bST adoption is forecast to range from31 percent in the Corn Belt to 67 percent in the Pacific region.

NATIONAL AND REGIONAL IMPACTS UNDER ALTERNATIVE DAIRY POLICIES

Future milk-supply prices and dairy farmer returns are determined by the interactions of technology adoption, consumer demand, and dairy policy, as established in the 1990 farm bill. These interactions were captured using a national computer simulation model referred to as LIVESIM with the following assumptions:[1]

* regional adoption curves as indicated in the preceding section;
- output per cow increases 1.5 percent per year in base scenario without bST;
- output per cow increases 1,320 pounds annually with use of bST;[2]
- bST is injected for 150 days annually;
- cost of bST use is $0.30 per cow per day;
- feed efficiency increases by 5 percent due mainly to bST; and
- the minimum level of government purchases by the Commodity Credit Corporation to satisfy food program needs (i.e., school lunch program, etc.) is 3.0 billion pounds annually.

The policy options analyzed included a fixed price support, a price support trigger, and a quota program. It is important to keep in mind that this analysis begins with the industry in relative supply-demand balance and in the absence of strong incentives for either increased or reduced production (10).

Fixed Price Support

This option fixes the price support level at $10.60 per cwt ($0.50 per hundredweight (cwt) higher than the level authorized by the 1990 farm bill) for all years and serves as a useful bench mark for policy option comparisons. In this scenario, the government purchases excess milk, at the support price, in order to clear the market. Without bST, milk production would increase progressively under this scenario from a projected 144 billion pounds in 1990 to 152 billion in 1995 (see table 5-2). With bST, production would increase an additional 4 to 5 billion pounds over the period 1994 to 1998; annual government purchases for food programs would rise as high as 9.0 billion pounds, but generally increase by 3 to 4 billion pounds over the minimum (3 billion pounds) (see table 5-3).

Support Price Adjusted by Trigger

This option, similar to policy from 1985-1990, triggers a price support reduction each time the level of government purchases rises above 5.0 billion pounds annually. This option resembles the assessment option in the 1990 farm bill that effectively will trigger reductions in producer returns as milk price declines. The simulation period begins with a milk support price of $10.60 per cwt. This is adjusted downward in $0.50 per cwt increments in any year that expected government purchases are greater than 5 billion pounds. Without bST, a single price support reduction brings the support price to $10.10 per cwt in 1991. With bST, two price support reductions are triggered; one in 1991 and another in 1993, reducing the price support level to $9.60 per cwt. These price reductions moderate production increases to keep

[1]LIVESIM was developed by D.S. Peel, Department of Agricultural Economics, Oklahoma State University. App. B provides a description of the model and detailed results of the analysis.

[2]The increase in output per cow in a given herd tends to be closer to an absolute number of pounds of milk than to a perCentage increase. Therefore, approximately the same increase in pounds of milk produced pcr cow might be expected in comparably managed herds with cows each producing 12,000 to 20,000 pounds of milk per year.

Table 5-2—Level of Milk Production, With and Without bST, Under Alternative Policy Scenarios, 1990-98
(billions of pounds)

	Policy scenarios					
	Fixed support		Trigger		Quota	
Year	With bST[a]	Without bST	With bST[a]	Without bST	With bST[a]	Without bST
1990	144	144	144	144	144	144
1991	146	144	146	144	146	144
1992	146	143	146	143	145	144
1993	153	150	153	150	148	146
1994	153	149	152	148	150	148
1995	156	152	156	152	152	150
1996	157	153	155	153	155	153
1997	160	155	159	155	157	155
1998	161	157	159	157	160	157

[a]bST is assumed to be commercially available in1991.

SOURCE: Office of Technology Assessment, 1991.

Table 5-3-Level of Government Purchases, With and Without bST, Under Alternative Policy Scenarios, 1990-98, Milk Equivalent (billions of pounds)

	Policy scenarios					
	Fixed support		Trigger		Quota	
Year	With bST[a]	Without bST	With bST[a]	Without bST	With bST[a]	Without bST
1990	3.0	3.0	3.0	3.0	3.0	3.0
1991	7.3	5.3	7.3	5.3	7.3	5.3
1992	4.3	3.0	3.0	3.0	3.5	3.0
1993	9.0	5.7	6.8	3.8	3.4	3.0
1994	6.0	3.0	3.0	3.0	3.1	3.0
1995	7.0	3.0	3.0	3.0	3.0	3.0
1996	4.8	3.0	3.0	3.0	3.0	3.0
1997	5.3	3.0	3.0	3.0	3.0	3.0
1998	3.6	3.0	3.0	3.0	3.0	3.0

[a]bST is assumed to be commercially available in 1991.

SOURCE: Office of Technology Assessment, 1991.

Commodity Credit Corporation (CCC) purchases near the 3.0-billion-pound minimum (see table 5-3).

Milk Production Quota

Several proposals have been made to improve supply control in Federal dairy policy. Quota systems utilized in California and Canada, for example, have been suggested for use nationally in the United States. While these systems differ in their implementation, each results in a much stronger opportunity for management of excess dairy production. In the simulation model, control of milk production is accomplished by reducing the number of cows in a herd. In practice, these reductions might be triggered by a two-tiered pricing system or some other mechanism that provides disincentives for producing over quota levels.

The quota policy is designed to maintain government purchases at or near the minimum government use target of 3.0 billion pounds. The quota is adjusted downward any year CCC purchases exceed 3.0 billion pounds. The price support remains at $10.6O per cwt; however, the market price is allowed to adjust as under the other options. The quota yields a much stabler market price, one that is generally higher than that under the trigger option. However, with bST a tendency still exists for the price to rest at the support level. The quota avoids the high level of government purchases necessary under the fixed price support scenario (see table 5-3).

Regional Impacts

Substantial controversy has arisen over the potential regional impacts of bST and other emerging technologies. The results of this analysis suggest a continuation of current trends toward greater concentration of production in the Pacific region and the largest decline in the Corn Belt. Shifts in future market shares will be largely a function of differences in rates of adoption of bST and other technologies. The more rapid rate of bST adoption predicted for the Pacific region will increase its market share even faster than the historical trend.

Regional shifts in production patterns could be moderated by changes in farm policy. The market mechanism, as reflected in the trigger price support mechanism, places the greatest pressure on higher cost producers and regions. The freed price support blunts the price declines associated with supply increases, thus providing a degree of protection to higher cost regions. Quotas tend to freeze production patterns. Thus, the regional impacts of bST and other technologies could be reduced through the adoption of a quota policy. However, by freezing production patterns, quotas discourage efficiency. The benefits of the quota tend to be capitalized in fixed-asset values, thus raising costs, particularly to new entrants to the industry (i.e., new entrants must buy quota from current dairy operators). And, because dairy farmers would not want to see a valuable asset (quota) lose its value, it would also be difficult to discontinue a quota policy.

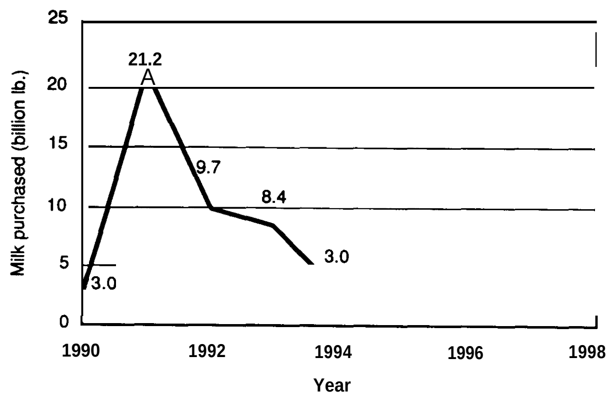
NATIONAL IMPACTS UNDER ALTERNATIVE DEMAND AND SUPPLY SCENARIOS

Many claims have been made concerning the potential adverse health impacts of milk produced with bST. While these claims remain unsubstantiated, consumer perceptions can be more important than reality in determining market demand. As indicated previously, initiatives to label milk produced by cows receiving bST could create a perception that consumption of this milk may not be desirable. Since policy needs to be designed considering the full range of potential developments, two scenarios regarding reduced milk consumption were analyzed. One of these involved a substantial but temporary reduction in demand followed by recovery to a smaller long-term reduction. The second involved a large permanent reduction.

Small Demand Reduction

The small reduced-demand scenario drops per-capita demand by 10 percent (about 55 pounds) in 1991,5 percent in 1992 (i.e., demand increases from 1991 to 1992), and 2.5 percent permanently thereafter. The effects of these reductions are CCC purchases totaling 21.2 billion pounds (14.5 percent

Figure 5-2—Projected Impact of a Temporary Demand Reduction on Government Milk Purchases Under Trigger Price Policy, 1990-98



SOURCE: Office of Technology Assessment, 1991.

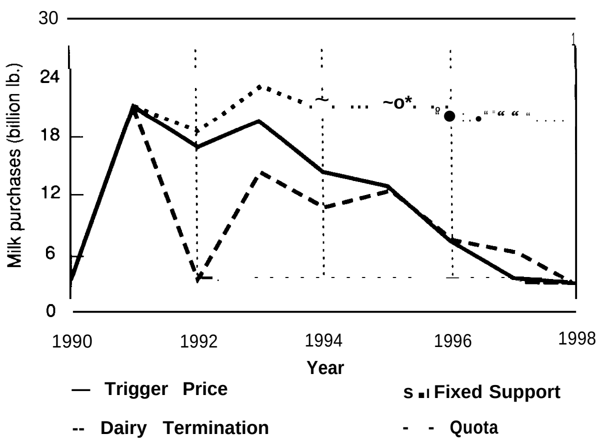
of production) in 1991, 9.7 billion pounds in 1992, and 8.4 billion pounds in 1993 (see figure 5-2). The analysis assumed a continuation of the trigger milk-price support policy. The support trigger decreases the price support level down to $9.10 per cwt in 1994. In 1994, the industry begins to stabilize at the 3.0-billion-pound minimum purchase level. Even though government purchases are exceedingly high for 3 years, the trigger mechanism seems to accommodate a small demand reduction quite well.

Large Demand Reduction

The second reduced-demand scenario assumes a permanent 10-percent reduction in per-capita consumption. If the price support is sustained at $10.60 per cwt under the fixed support scenario, CCC purchases continue at a level that approaches or exceeds 20 billion pounds of production through 1998 (see figure 5-3). This would exact a high cost to the government.

While the trigger mechanism copes reasonably well with a small permanent consumption reduction, the industry has difficulty adjusting to a large permanent demand reduction scenario with this mechanism. The support price must be triggered down to $7.60 in 1997 in order to bring CCC purchases to below 4 billion pounds. Such a low support price would make it difficult (impossible) for even the best managed dairy farms to avoid economic losses. As indicated in figure 5-3, for each of the years 1991 to 1995, the CCC is purchasing at least 12 billion pounds (at least 8 percent of the milk supply).

Figure 5-3—Projected Impact of a 10-Percent Permanent Demand Reduction on Government Purchases Under Alternative Dairy Policies, 1990-98



SOURCE: Office of Technology Assessment, 1991.

Under this reduced demand scenario, a dairy termination program might be considered as an alternative to the severe price support reduction discussed above. A termination program involves a one-time buyout of dairy cows, to be implemented when government purchases reach a certain level. In the model, the level was established at 15 billion pounds annually. When government purchases reach this level, enough dairy cows would be liquated the following year to eliminate the excess production.

Such a termination policy would be triggered in 1992 because at least 21 billion pounds of CCC purchases would have occurred in 1991 (see figure 5-3). The herd kill to bring CCC purchases down to the minimum 3.0 billion pounds would be 1.3 million cows (13.1 percent of the herd). In the process, cow prices would fall by $6.11 per cwt (12 percent) with a 6. l-percent drop in beef cattle prices. (See app. B.)

Once the termination is completed, milk production bounces back and CCC purchases exceed 14 billion pounds in the next year (1993). This result is similar to that of the 1986 Dairy Termination Program. The lowest producing cows on average are liquated from the industry. The higher producing cows remain, providing the industry with the capability of responding to increased prices. Another termination probably would not be feasible because of the high cost associated with the program and the tendency of farmers to bid up the cost of selling out. However, the support price still would decline to $7.60 per cwt in 1998—a year later than under the trigger option without the termination program, once again verifying that termination programs do not result in permanent reductions in supply.

If a quota were imposed in 1992 with the objective of bringing CCC purchases back down to the minimum 3.0 billion pounds, 12.2 percent of the dairy herd (1.2 million cows) still would be sent to market (slaughtered) in order to reduce the herd to about 8.8 million cows. This compares with 1.3 million cows slaughtered under the termination program. Under the quota, the dairy cow price falls 8.1 percent (compared with 12.0 percent under the termination program) while the beef cattle price falls by 4.3 percent (compared with 6.1 percent under the termination program). Perhaps more important, the quota program effectively controls milk supply. (See app. figure B-13.)

This analysis suggests that if a large permanent reduction in demand occurred, changes in dairy policy would most likely be needed. A fixed support price policy would be too costly and a trigger price policy or producer assessments would be too severe to producers. The policy alternatives are a termination program or a quota. A termination program is costly and does not result in permanent reductions in supply. A quota program does effectively control supply and, compared to the termination program, is less costly. Benefits of a quota tend to be capitalized into fixed asset values, thus raising the costs to new entrants and making it difficult to discontinue the quota policy. Thus, consideration should be given to observing CCC purchases over a 2-year period, as opposed to 1 year, before a quota is implemented. This would help to determine whether demand reduction is permanent or temporary.

Large Supply Increase

Previous survey-based analyses of the impact of bST typically assume a considerably higher rate of adoption than this study predicts, based on past adoption patterns. If bST results in a 15-percent increase in the milk supply in the first year, instead of the 5-percent increase used in the above analysis, CCC purchases rise to at least 20 billion pounds. Large supply increases could be realized not only through rapid adoption of bST, but also as firms that participated in the 1986 Dairy Termination program reenter the market beginning in 1991.

The impact of a 15-percent supply increase would be similar to that of a 10-percent permanent demand reduction, i.e., CCC purchases equal 20 billion pounds in the first year (see app. figure B-12). In both instances, it takes 5 years for the price support trigger mechanism-even with a price support as low as $7.60--to bring CCC purchases down from 20 billion pounds to no more than 10 billion pounds. The problems of managing large government purchases over such a long period suggests the need to consider production management options. Here again, the termination program only reduces production temporarily with substantial negative impacts on beef prices. Quotas are effective at controlling production but also negatively affect beef prices, although not to the same degree as a single termination option.

FARM LEVEL IMPACTS

The combined impacts of emerging technologies, dairy policies, regional differences in production costs, and long-term industry trends can be more easily visualized at the level of individual dairy farms. Representative farms are briefly described in table 5-4. The parameters of representative farms were originally developed for OTA in 1985 and have since been continuously updated by Agricultural and Food Policy Center faculty and staff at Texas A&M University. The farms are simulated with and without bST adoption utilizing the FLIPSIM model.[3]

The farm level impacts of the three policy scenarios-fixed support price, trigger, and quota —were analyzed over the period 1989 to 1998. It was assumed that the same farm program provisions operated over the 10-year period. The initial analyses were conducted assuming no change in demand. Subsequently, alternative demand assumptions were analyzed (1 1).

Alternative Dairy Policies

The analysis indicates that once bST becomes available, there will be strong incentives to adopt the technology. Regardless of the region, the payoffs from bST adoption are substantial. For example, with the trigger price policy, the 52-cow Upper Midwest dairy, a typical, moderate-size dairy farm in this region, enhances its chance of survival (probability that the farm will remain solvent through 1998) from 58 to 74 percent by adopting bST once it becomes available (see table 5-5). The same is true for large dairies (see table 5-6). Nonadopters of bST have more problems surviving and, therefore, are more likely to exit the industry.

Tables 5-5 and 5-6 provide insight into competitive conditions in the dairy industry and the reasons for regional shifts in milk production patterns. Regardless of size, Upper Midwest farms have problems realizing sufficient earnings to achieve a reasonable return on equity, compete, and survive. While Northeast farms perform better, they too were found to be at a disadvantage relative to the Pacific and Southeast farms.

These results raise questions about the advisability of State laws placing a moratorium on the use of bST. Dairy farmers located in States that have put a moratorium on adoption will be placed at a substantial disadvantage relative to those in unrestricted States. If moratoriums are imposed in regions where farm survival probabilities are already low (relative to other regions), the impact of a moratorium can be particularly severe.

Policies and the choice between bST adoption or nonadoption operate together to impact survival in a number of ways (see table 5-7). Higher earnings resulting from the fixed price support increase the probability of survival for a 125-cow Upper Midwest dairy and the chances of a 5-percent return on initial equity. However, even with adopting bST, net worth continues to erode.

Surprisingly, perhaps, the quota program performs worse than either the trigger price or the freed price support. This is because the quota price objective is the same as the freed price support ($1O.6O) and because restrictions on output curb-b expansion and raise costs per cwt. Thus, if a quota is to be imposed, the price objective must be sufficiently high to offset the effects of lower production (higher production costs per cwt) or producers could be worse off.

The absolute economic payoff from bST adoption is about the same under a trigger price policy and a

[3]FLIPSIM ~&~ developed by J.W. Richardson, Department of Agricultural Economics and C.J. Nixon, Department of Accounting, Texas A&M University (12). App. C provides a description of the model and detailed results of the analysis.

Table 5-4—Summary Characteristics of Representative Moderate-Size and Large Dairy Farms, by Region

Characteristic	Upper Midwest		Northeast		Southwest[a]		Southeast	
	Moderate	Large	Moderate	Large	Moderate	Large	Moderate	Large
Cow numbers	52	125	52	200	350	1,500	200	1,500
Output/cow (pounds)	16,850	16,850	17,940	17,830	18,590	19,690	15,340	15,310
Total asset value ($000)	470	940	608	1,395	1,097	3,858	1,569	7,723
Land value ($000)	133	295	274	640	118	492	813	4,591
Percent of feed raked	63	60	50	46	0	0	25	2

[a]Includes farms from both the Pacific and Mountain USDA production regions.

SOURCE: Office of Technology Assessment, 1991.

Table 5-5—Impacts of bST Adoption on t he Economic Viability of Moderate-Size Representative Farms, Assuming No Change in Demand for Milk Due to bST, Trigger Price Policy, by Region, 1989-98 (in percent)

Measure of impact	52-cow Upper Midwest		52-cow Northeast		350-COW Southwest		200-COW Southeast	
	Non-adopter	bST adopter	Non-adopter	bST adopter	Non-adopter	bST adopter	Non-adopter	bST adopter
Probability of survival[a]	58%	74%	100%	100%	95%	97%	100%	100%
Probability of earning 5-percent return on equity	58	74	100	100	95	97	100	100
Probability of increasing equity[b]	0	0	3	3	60	79	13	24
Present value of ending net worth as percent of beginning net worth[c]	16	29	72	77	109	128	76	89

[a]Chance that the individual farm will remain solvent through 1998, i.e., maintain more than a 10-percent equity in the farm.
[b]Chance that the individual farm will increase its net worth in real 1989 dollars through 1998.
[c]Present value of ending net worth divided by initial net worth indicates whether the farm increased (decreased) net worth in real dollars.

SOURCE: Office of Technology Assessment, 1991.

Table 5-6—impacts of bST Adoption on the Economic Viability of Large Representative Farms, Assuming No Change in Demand for Milk Due to bST, Trigger Price Policy, by Region, 1989-98 (in percent)

Measure of impact	125-cow Upper Midwest		200-COW Northeast		1 ,500-COW Pacific		1,500-cow Southeast	
	Non-adopter	bST adopter	Non-adopter	bST adopter	Non-adopter	bST adopter	Non-adopter	bST adopter
Probability of survival[a]	95%	99%	100%	100%	100%	100%	100%	100%
Probability y of earning 5-percent return on equity	90	95	99	100	100	100	100	100
Probability of increasing equity[b]	8	12	43	53	100	100	88	99
Present value of ending net worth as percent of beginning net worth[c]	57	69	92	102	195	214	129	147

[a]Chance that the individual farm will remain solvent through 1998, i.e., maintain more than a 10-percent equity in the farm.
[b]Chance that the individual *farm* will increase its net worth in real 1989 dollars through1998.
[c]Present value of ending net worth divided by initialnet worth indicates whether the farm increased (decreased) net worth in real dollars,

SOURCE: Office of Technology Assessment, 1991,

Table 5-7—impacts of bST Adoption on the Economic Viability of Representative Large (1 25-cow) Upper Midwest Farms Under Alternative Dairy Policies, Assuming No Change in Demand for Milk, 1989-98 (in percent)

	Trigger price		Fixed price support		Quota	
Measure of impact	Non-adopter	bST adopter	Non-adopter	bST adopter	Non-adopter	bST adopter
Probability of survival[a]	95%	99%.	99%	100%	85%.	92%.
Probability of earning 5-percent return on equity	90	95	95	98	67	78
Probability of increasing equity[b]	8	12	11	18	2	3
Present value of ending net worth as percent of beginning net worth[c]	57	69	67	78	37	46

[a]Chance that the individual farm will remain solvent through 1998, i.e., maintain more than a 10-percent equity in the farm.
[b]Chance that the individual farm will increase its net worth in real 1989 dollars through 1998.
[c]Present value of ending net worth divided by initial net worth indicates whether the farm increased (decreased) net worth in real dollars.

SOURCE: Office of Technology Assessment, 1991.

freed support price policy for the representative dairy farms (see table 5-8). Increasing the price of milk by maintaining the milk support price at its current level does not greatly increase the economic incentive to adopt bST, but that incentive is significantly lower if a quota is in effect. This suggests that the rate of bST adoption would be slowed by imposing a quota rather than continuing the trigger price policy.

Alternative Demand and Supply Scenarios

Potential reductions in demand due to consumer concern over bST would reduce the economic payoffs from using this technology. The most significant result of such demand reduction is reduced economic viability of all dairy farms, and particularly of those in the Midwest. For example, the economic payoff for bST adoption is $10,300 for the 125-cow dairy in the Upper Midwest if there is no decrease in milk demand. If demand decreased slightly, the economic payoff falls to $9,200 and if the demand decrease is large, the economic payoff declines to $6,900. Thus, the incentive to adopt and the rate of adoption would be reduced if milk demand declines.

The adverse impacts of reduced demand could be countered by either a termination program (in the event of a small reduction in demand) or by a quota (if larger reductions in demand occurred).[4] However, even with reduced demand, there would be strong incentives to adopt bST for all farms in all regions. For example, with a continuation of the trigger policy, a 52-cow Upper Midwest dairy's probability of survival declines to 40 percent under a small decrease in demand; adopting bST boosts survival probability under this scenario to 48 percent (see table 5-9). Similar trends hold true for the larger dairies (see table 5-10). Thus, the economic payoff for bST adoption is positive; those who adopt bST will experience greater probabilities of survival and

Table 5-8—Comparison of Average Annual Economic Payoffs From bST Adoption for Eight Representative Dairy Farms Under Three Alternative Dairy Policies, Assuming No Change in Milk Demand, 1989-98a (thousands $)

	Policy scenarios		
Region/size	Trigger price	Fixed support	Quota
Lake States:			
Moderate	3.9	4.1	2.4
Large	10.3	10.9	7.0
Northeast:			
Moderate	3.4	3.6	1.0
Large	15.8	16.6	8.8
Southwest:			
Moderate	26.5	26.6	18.3
Large	90.5	91.7	61.2
Southeast:			
Moderate	21.9	22.8	17.2
Large	166.4	166.3	132.0

[a]Economic payoffs from bST are the average annual change in net cash farm income between a nonadopter and a bST adopter over the 1989 to 1998 planning horizon. The payoff is net of the cost of bST, the added transportation costs for milk, and the additional feed.

SOURCE: Office of Technology Assessment, 1991.

[4]Small and large demand reductions are the same as explained in the previous section. A small demand reduction assumes that milk demand would decrease 10 percent in 1991, 5 percent in 1992 (i.e., demand increases from 1991 to 1992), and 2.5 percent each year in 1993-1998. A large demand reduction assumes that milk demand would decrease 10 percent in each year 1991-1998,

Table 5-9—impacts of bST Adoption on the Economic Viability of Moderate-Size Representative Farms, Assuming Small Decrease in Demand for Milk Due to bST, Trigger Price Policy, by Region, 1989-98 (in percent)

	52-cow Upper Midwest		52-cow Northeast		350-COW Southwest		200-COW Southeast	
Measure of impact	Non-adopter	bST adopter	Non-adopter	bST adopter	Non-adopter	bST adopter	Non-adopter	bST adopter
Probability of survival[a]	40%	48%	100%	100%	88%	94%	99%	100%
Probability of earning 5-percent return on equity	40	48	100	99	88	94	89	94
Probability of increasing equity[b]	0	0	1	2	35	51	4	9
Present value of ending net worth as percent of beginning net worth[c]	3	10	65	70	79	99	58	71

[a]Chance that the individual farm will remain solvent through 1998, i.e., maintain more than a 10-percent equity in the farm.
[b]Chance that the individual farm will increase its net worth in real 1989 dollars through 1998.
[c]Present value of ending net worth divided by initial net worth indicates whether the farm increased (decreased) net worth in real dollars.

SOURCE: Office of Technology Assessment, 1991.

Table 5-10—Impacts of bST Adoption on the Economic Viability of Large Representative Farms, Assuming Small Decrease in Demand for Milk Due to bST, Trigger Price Policy, by Region, 1989-98 (in percent)

	125-cow Upper Midwest		200-COW Northeast		1,500-COW Pacific		1,500-COW Southeast	
Measure of impact	Non-adopter	bST adopter	Non-adopter	bST adopter	Non-adopter	bST adopter	Non-adopter	bST adopter
Probability of survival[a]	85%	91%	100%	100%	100%	100%	100%	100%
Probability of earning 5-percent return on equity	68	82	98	99	100	100	100	100
Probability of increasing equity[b]	2	7	26	45	96	98	65	86
Present value of ending net worth as percent of beginning net worth[c]	40	50	86	95	162	180	110	127

[a]Chance that the individual farm will remain solvent through 1998, i.e., maintain more than a 10-percent equity in the farm.
[b]Chance that the individual farm will increase its net worth in real 1989 dollars through 1998.
[c]Present value of ending net worth divided by initial net worth indicates whether the farm increased (decreased) net worth in real dollars.

SOURCE: Office of Technology Assessment, 1991.

economic success than nonadopters. The positive economic payoffs for bST adoption are greater under the dairy termination program than under the trigger price policy. Thus, bST adoption would be accelerated even with declining milk demand if a termination program were introduced in lieu of the trigger price policy.

The supply impacts estimated by the LIVESIM model in the previous section were based on past adoption practices, not farmer survey results, which indicate higher adoption for bST. If the survey results are accurate predictors of adoption then a large increase in supply would occur. Unless supply controls such as a dairy termination program or a quota are imposed, adverse impacts on economic viability would be substantial (see app. tables C-12 to C-17).

Enhancing the Survival of Traditional Farms

Results of the preceding analysis indicate that smaller, less efficient, farms will have difficulties realizing sufficient earnings to achieve a reasonable return and survive even with the adoption of bST. Northeast farms perform better, in part, because they receive higher Federal milk marketing order prices. Farms that do not adopt bST will feel even more severe impacts.

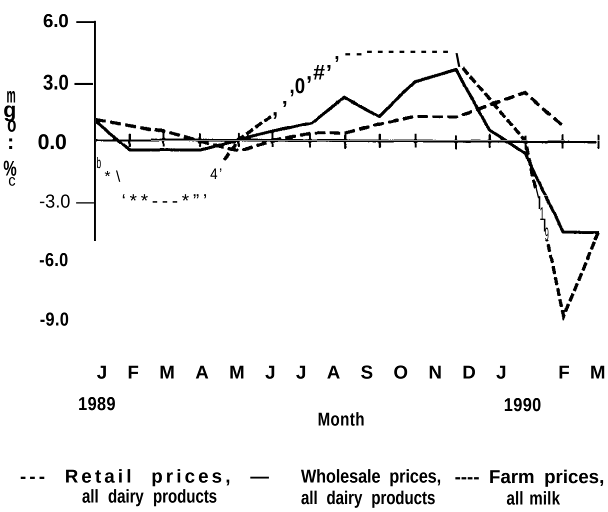
The economic viability of smaller farms may be enhanced by changes in scale of operation, progressiveness in technology adoption, research and extension, and dairy policy. The following provides a brief discussion of the importance of each item.

- *Scale of Operation--Generally,* larger farms experience lower costs of production. Studies now in progress indicate that in the Upper Midwest and Northeast, economies of size have resulted in the establishment of larger herds that have the potential to realize even more economies of size involved in dairying. Farms with herds larger than 125 cows in the Upper Midwest and 200 cows in the Northeast will be more likely to lower their costs of production and compete than smaller operations.
- *Technology Adoption--A* key to achieving the economic benefits of a new technology is to adopt it early. The traditional milk production regions have a history of lagging behind other regions in adopting new technology. This study has shown that, based on experience, the Upper Midwest and Northeast regions will lag behind the Pacific region by more than 20 percent in the adoption of bST Ways must be found to encourage producers in these regions to adopt new technology earlier to enhance their probability of economic success.
- *Research and Extension-Little,* if any, emphasis is given to conducting research and providing extension services to different-size farms. Small, moderate, and large farms each have their own unique problems, particularly from a management perspective. Research is needed on developing management strategies for each farm size. Extension strategies also need to be developed to assist farmers in technology adoption so they can receive more of the benefits of new technologies. Laggards in technology adoption receive little economic pay-off.
- *Dairy* Policy--Based on this study’s analysis, a fixed support price policy provides farms in the traditional milk-producing regions with higher earnings that increase their probability of survival and the chance of earning a 5-percent return on equity. However, even with this policy, net worth continues to erode for these farms. Thus, the support price may need to be increased. This is, of course, more costly in terms of government expenditures. An alternative would be to target these farms for a higher support price-but it still will be more costly and administratively complex compared to other alternatives. However, if substantial progress were made on the items discussed above possibly no change in policy would be needed.

BENEFICIARIES OF TECHNOLOGICAL CHANGE

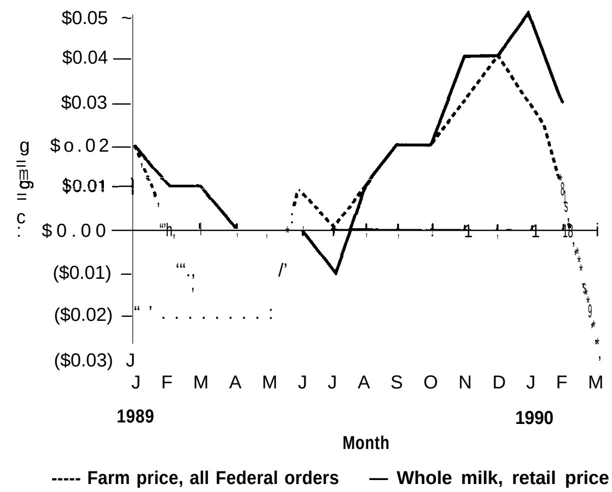
The issue of who benefits from technological change is not new but is relevant to this study. The farm-level results indicate that bST adopters are better off than nonadopters. First adopters, moreover, are the greatest beneficiaries of any technological change. They receive a relatively high price for their product and realize the cost reductions resulting from bST use. As more farmers adopt, the market price falls, which makes the consumer the ultimate beneficiary. As the market price falls, farmers who do not adopt may be forced out of business.

Figure 5-4—Dairy Price Indexes at Three Market Levels (change from prior month)



SOURCE: Compiled from U.S. Department of Agriculture dairy statistical data by Andrew Novakovic, *Dairy Marketing Notes*, 1990, No. 2, Department of Agricultural Economics, Cornell University, Ithaca, NY.

Figure 5-5-Farm and Retail Prices of Beverage Milk Per Half Gallon (change from prior month)



[a]This is the producer price for fluid milk (Class 1) averaged overall Federal milk marketing orders.

SOURCE: Compiled from U.S. Department of Agriculture dairy statistical data by Andrew Novakovic, *Dairy Marketing Notes*, 1990, No. 2, Department of Agricultural Economics, Cornell University, Ithaca, NY.

Questions have been raised regarding whether consumer prices do, in fact, decline as producer prices fall. Some groups opposing the approval of bST have attempted to show that retail milk prices do not fall as producer prices decline and, therefore, consumers do not benefit from the technology (3). A review of the relevant data on producer prices received and retail dairy prices paid do not support this contention.

Novakovic (8) made a comparison of the changes in dairy prices at the farm, wholesale, and retail levels for 1989 through 1990. Figure 5-4 illustrates the monthly changes in average aggregate farm, wholesale, and retail dairy prices converted to an index where 1982 to 1984 = 100. The graph shows a change in each index from one month to the next. (A line on the graph below (above) 0.0 indicates prices fell (rose) compared to the prior month.)

The data show that farm, wholesale, and retail prices did follow each other. There are, however, differences in the volatility of change. Farm prices are the most volatile while retail prices are the least. Declines in farm prices are reflected in smaller declines at retail. However, this is true on the up side as well. Farm prices increased the most from mid 1989 to the end of 1989 and retail prices increased the least.

A review of actual price changes for fluid milk and manufactured products, i.e., cheese, provides a more insightful analysis (8).[5] The pattern in figure 5-5 is similar but not identical to figure 5-4. That is producer and retail prices for fluid milk did follow one another up and down.[6] Producer prices, however, decreased more than retail prices in the first half of 1989 and increased less in the second half. Some buoyancy exists to retail milk prices relative to farm prices in reflecting declines in farm prices.

Price changes in cheese markets offer a similar but more responsive change (see figure 5-6). Note that producer prices lag wholesale prices by 1 month and retail prices have a 2- to 4-month lag in reflecting wholesale price changes. For example, the largest

[5]Percentage changes are not the best way to compare farm, wholesale, and retail prices. When expressed in a common unit of measurement (e.g., dollars per cwt of milk), the farm price will obviously be a smaller number than the retail price. Thus taking a percentage of a smaller number is less than an equal percentage of a larger number. Part of the seemingly lower volatility in prices higher up the marketing channel is a result of comparing index or percentage changes.

[6]The same result was found by Outlaw et al. (9) in a more recent analysis.

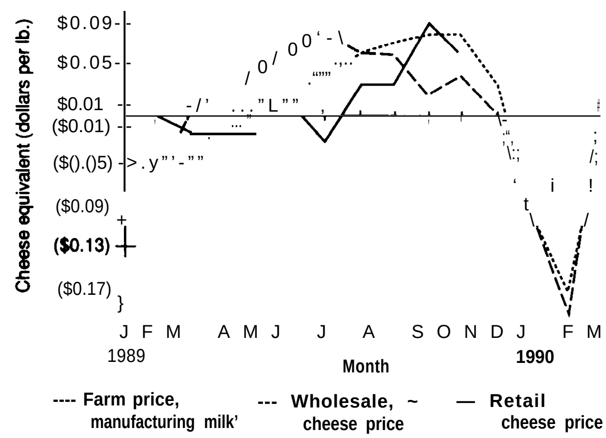
increase in wholesale cheese prices begin in May. Retail price increases began to increase in August and peaked in October. By then wholesale prices were increasing at a more modest rate while retail prices were increasing by the largest amount. Examining just the October data, it would be difficult to justify a 9-cent increase in retail prices by a 2-cent increase in the wholesale price. It can, however, be justified by the 5 months of 4- to 8-cent monthly increases in wholesale prices that occurred prior to October. Also note that in the second half of the year, the increase in producer prices was substantially greater than the increase in retail prices. These results are similar to other research in this area. Kinnucan and Forker (5) found the same asymmetric relationship between farm and retail dairy prices. This phenomena is found in other agricultural industries as well.[7]

This analysis indicates that prices of dairy products to consumers are reflective of changes in supply and demand factors in the market. Individual dairy products such as milk and cheese do respond to price changes differently, reflecting the specific forces at work in each of their respective markets. Retail milk prices follow farm price increases but seem to be relatively slower in reflecting farm price declines. On the other hand, cheese prices are responsive to farm price changes and may even start falling before producer prices. Thus, technological change that lowers farmers' production costs will eventually be reflected in the market and the corresponding savings passed on through lower prices to the consumer, the ultimate beneficiary.

INTERNATIONAL TRADE PROSPECTS

Speculation exists that adoption of new technologies, such as bST, will enhance the U.S. position in international milk markets. The U.S. dairy industry primarily focuses its marketing efforts on the domestic market. It has had limited success in international markets. This has been due to a number of factors including: difficulties in identifying markets, monetary policies, import restrictions, and political uncertainty in many countries. Moreover, the world market price for dairy products is lower than the U.S. price—largely because of the use of

Figure 5-6-Farm, Wholesale, and Retail Prices of Cheese (change from prior month)



[a]The farm price is the Minnesota-Wisconsin price which is also the Class III (manufacturing) price in Federal milk marketing orders.
[b]The wholesale price is the National Cheese Exchange (NCE) price for 40 lb block of cheddar.

SOURCE: Compiled from U.S. Department of Agriculture dairy statistical data by Andrew Novakovic *Dairy Marketing Notes, 1990, No. 2,* Department of Agricultural Economics, Cornell University, Ithaca, NY.

subsidies to increase export sales from competing countries.

Cost-reducing technologies, such as bST, can improve the United States competitive position in international milk markets, but alone are not sufficient. An encompassing strategy that at a minimum identifies promising new markets, benefits from favorable monetary policies, addresses export subsidies and import restrictions, as well as supports research to provide cost-reducing technologies for the industry will be needed.

POLICY IMPLICATIONS

The dairy industry is familiar with and has gained strength from technological change. The constant adoption of new technology has resulted in a relatively uniform annual increase in output per cow in the range of 1.5 to 2.0 percent annually. Emerging technologies in the 1990s, especially bST, may temporarily accelerate that rate of increase, putting the industry on a higher output-per-cow growth path.

The impact of bST on the dairy industry is heavily weighted by the rate of adoption of the new

[7]Hahn (2), for example, found that the farm, wholesale, and retail prices for beef and pork show significant evidence Of asymmetric price interaction. That is, prices display greater sensitivity to price-increasing shocks than to price-decreasing shocks.

technology. Experience in adoption of dairy technologies suggests slower rates of adoption than has been predicted by farmer survey. However, this analysis still indicates substantial economic incentives for, and payoffs from, adoption of bST. The analysis also indicates that States placing a moratorium on the use of bST run substantial risk of damaging the economic viability of their dairy farmers.

The rates of adoption indicated by past technology adoption trends suggest that a mechanism that allows producer returns to decline as CCC purchases increase, i.e., a trigger policy or producer assessment (as provided for in the 1990 farm bill) could effectively adjust supply to meet demand without exceedingly large inventory accumulations. However, if sharp demand reductions were to accompany the introduction of bST, supply management policies such as production quotas or termination (buy-out) programs may be required. Termination programs, such as the one implemented in 1986, are costly and not effective in reducing supply over a period of time. Production quotas can effectively control supply. However, quotas do result in freezing regional production shifts and since the quota has an economic value, make it more costly for new entrants into the industry.

Regardless of farm size or region, there will be strong economic incentives to adopt bST. However, Upper Midwest farms adopting the new technology still will have problems realizing sufficient earnings to achieve a reasonable return on equity, compete, and survive. Northeast farms perform better but they too are at a disadvantage relative to the Pacific and Southeast farms. For farms not adopting the new technology the dilemma will be even more severe. These results raise questions about the advisability of State laws, especially in the Upper Midwest, that place a moratorium on the use of bST. To enhance the economic viability of farms in these regions changes in scale of operation, progressiveness in technology adoption, research and extension policy, and perhaps dairy policy may be required.

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