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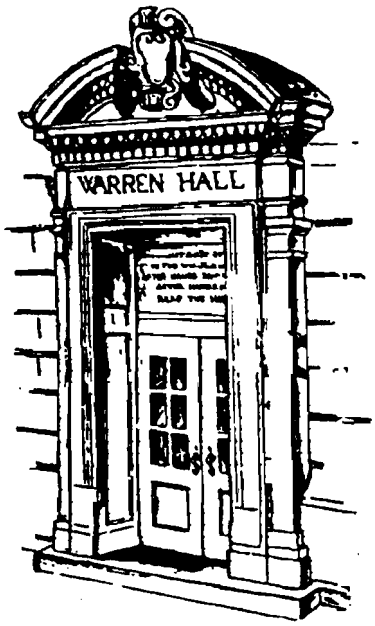

Staff Paper

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Factors Related to the Adoption of rBST Among a Population of Farmers in Ontario County, New York

by

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Factors Related to the Adoption of rBST Among a Population of Farmers in Ontario County, New York

Thomas Lyson, Loren Tauer, and Rick Welsh*

Abstract

A population of 50 dairy farms in Upstate New York was surveyed in 1993 to collect data on the organizational and structural characteristics of their farm businesses and households, including information about their attitudes towards rBST. In the fall of 1994, six months after rBST was approved for general use, this same population of farmers was resurveyed. Findings show that in 1994 one-half of the farmers were using rBST or planned to use it within one year. Compared to non-adopters, farmers who adopted rBST were generally larger, used more advanced dairy technologies, and reported higher production herd averages. Differences in attitudes and goals were also observed. Implications of rBST for the future organizational structure of New York dairies are discussed.

Introduction

The extensive and lengthy debate over rBST before its commercial availability to U.S. dairy farmers in early 1994 is probably unprecedented in agriculture. Concerns about animal health, consumer preferences, food safety, and rural/farm vitality were pitted against the potential benefits of increased milk production. After its safety on animal and human health was verified through experiments, tests, and analyses, rBST was cleared for sale in February of 1994. The economic and social impacts are now unfolding as rBST is being adopted by farmers across America.

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Like other advanced dairy technologies, the extent of the economic and social impacts of rBST depends on how many farmers adopt it, how quickly it is adopted, and how much it increases milk output per cow. Preliminary data on the increase in milk production per cow was obtained from research on the efficacy of the product and animal safety, although some debated whether farmers would be able to obtain the high level of output increases experienced under controlled and exact experimental conditions (Schmidt). The question of potential adoption was explored by ex ante surveys asking farmers if they would use rBST when it became available. These researches were criticized on the grounds that what a farmer articulates he or she may do may be quite different from what they would do once rBST became available.

Adoption rates are influenced by a variety of political, social, and economic forces. Active anti-rBST farm lobbies, consumer watchdog groups, and legislative prohibitions can slow or halt the adoption of rBST. On the other hand, rBST use can be accelerated by educational efforts by the Extension Service, industry promotion efforts that illustrate the benefits of the technology, and a social and economic climate that favors advanced agricultural technologies. While macro-level policies, programs, and protests no doubt operate to enhance or dampen rBST adoption, the ultimate decision to use the technology takes place at the farm level. Individual farm operators take into account not only signals from the political and economic climate, but also their own preferences and socioeconomic circumstances when deciding whether or not to adopt rBST.

Now that rBST is commercially available, these issues are being worked out in the market place, and opportunities exist to assess the adoption and output increases among farmers. Toward that end, we report here the use and experience of rBST among 50 dairy farmers from New York. Because information on adoption and yield increases is only part of the information needed to determine the economic and social impact of this product on specific types of dairy farms, we also examine the relationship between adoption/non-adoption of rBST and variables that measure 1) the use of other advanced dairy technologies; 2) farm structure characteristics; 3) human capital and management orientation; 4) agrarian attitudes; and 5) future plans.

The Survey

The data for this report were collected in a two part process. As part of a study of the changing structure of the dairy industry in the United States, a survey was constructed and completed in 1993 to gather information on New York dairy farmers regarding farm structure, socio-economic characteristics, and use of technology (Welsh). This provided a detailed baseline. These farmers were then re-contacted in September of 1994 to determine whether they have or have not used rBST, their experiences concerning its use, and attitudes concerning its use in the industry.

The original survey was completed by personal interviews. With the assistance of a New York State Cooperative Extension agent, a list of dairy farmers operating farms in Ontario County was obtained. The survey was reviewed by this agent and by an agent of

the Soil Conservation Service. In addition, the survey instrument was pre-tested on a dairy farmer in the county, and corrections and adjustments were made.

Farmers were first contacted by telephone according to their geographic location within the county. Selections were made starting from the Northeast corner of the county and moving south and west until 50 dairy farm households had agreed to participate in the study. Seventy farm households were contacted, with twenty refusals, for a response rate of 71.4%. The reasons most often given for not being willing to participate included "not wanting to fill out another survey" and "planning to retire soon so do not want to be bothered."

The dairy farmers who agreed to participate were interviewed on their farms. Interviews took place from December 1992 through March 1993, and required anywhere from 1.5 to 4 hours to complete. The interviews were performed by three different individuals.

The second contact occurred in August and September of 1994, when one of the original interviewers recontacted the 50 dairy farmers by telephone, and asked a series of questions regarding their use or non-use of rBST. Of the original 50 dairy farmers contacted, 46 completed the follow-up telephone interview. One dairy farm household refused to participate because its members were too busy at the time, two households had left dairy farming, and the fourth household had merged its cows with another herd. (This herd was in the interviewed group).

This sampling design in some ways and circumstances is superior to a random sampling of farmers. Agriculture is reliant on local agronomic, social, and economic conditions for its survival. As Kloppenburg (1991) argues, agricultural production is dependent on locality. Therefore, random sampling farmers without regard to their links to local geographic and social conditions seems inappropriate for studies which deal with on-farm aspects of agricultural production. Choosing farms in a delineated geographic area improves the validity of on-farm studies, since one is essentially controlling for local environmental conditions.

Survey Results

Of the 50 contacts, 46 provided responses to the rBST survey. Of those 46 responding farms, 18 are currently using rBST and 28 are not using rBST, for a 39% usage rate. Of the group not using rBST, 6 had started but stopped using rBST, for a dropout rate of 25%. Some of those 6 used rBST only for a short period of time, or only on a few cows, in their evaluation of the product. Another 5 of the 28 current non-users indicated that they plan to start using rBST within 6 months (4 farms), or within 1 year (1 farm). There was little doubt that these farmers were going to use rBST. Thus, factoring in those farmers who plan to adopt within 6 months, 23 of the 46 farms use or will use rBST, for an adoption rate of 50%.

Adoption research using ex ante procedures quizzing farmer whether they would or would not adopt rBST when it became available, reported adoption rates between 42% and 77% (Yonkers). Many questioned these rapid and high adoption rates because they were unprecedented for other technologies that have been made available to dairy producers (Schmidt). Yet, other ex post surveys of rBST are also showing relatively high adoption rates by farmers. The *Dairy Today* survey, which was mailed in May 1994 to a sample of their subscribers across the country, with 763 useable returns (25% response rate), reported that 21.5% of the respondents from New York and Pennsylvania were using rBST. Another 25% planned to use it within 5 years, for a long-term adoption rate of 47%. In October of 1994, Monsanto (the manufacturer of rBST) estimated that 7% of the farmers in the U.S. were using rBST (Schneider).

The 1993 survey of Ontario County farmers asked whether they would use rBST if it was available. The possible responses then were No; Don't Know; Yes, Probably; and Yes, Definitely. Of the 18 current users of rBST, 5 had indicated that they would definitely use it, 5 that they probably would, 7 didn't know, and one said no. It appears that many at that time had already determined whether or not they would use rBST before it was available, explaining the quick adoption once it did become available. In contrast, of the 28 current non-users, 15 had earlier replied that they would not use it, 9 that they didn't know, and 4 that they would use it. None of the 6 dropouts had indicated that they would

definitely use rBST; their responses were evenly distributed among the other response options.

Most of the farmers surveyed are treating a quarter to a half of their cows with rBST. They appear to have distributed the treatment across all production levels, with a few not treating low producers or high producers. This suggests, that similar to previous new technologies, farmers are experimenting to determine where they will get the highest response. Deciding not to treat low producing cows would be consistent with response experiments which found that low producing cows often did not respond to rBST to the same extent as high producing cows, and not treating the highest producing cows would indicate some caution on the part of those farmers, lest they find that rBST proves detrimental to the health of those prized cows. Interestingly, only 3 of the 18 current users plan to increase the number of cows that they will treat with rBST during the next 12 months. Two of those 3 will increase the number of treated cows by 10%, the other farmer will increase the treated number almost 25%.

The highest average milk yield increase response that any farmer reported was 23%, and the lowest was 10%, with an average around 15%. This is in line with experimental results, where high and low responses were reported, with an average response of those experiments in the teens (Muller). Eight of the farmers reported no increase in forage consumption, and the other 10 farmers reported that the increase in forage consumption of treated cows was in the neighborhood of 5 to 10%. The same consumption increase

rate was given for grain and concentrates. Since the production of additional milk with rBST use requires additional feed consumption, it is believed that the farmers not indicating an increase in feed usage have simply not been able to correctly measure the additional feed consumed, although these farmers keep production records and balance feed rations to the same extent as those farmers reporting feed usage increases. There was also no difference in milk yield increase between those reporting feed usage increases and those not reporting feed usage increases.

The reason farmers were using rBST was straightforward, the returns exceeded its cost, as indicated by 12 of the 18 users. The others indicated a myriad of reasons, many dealing with profitability of rBST use. When asked about the disadvantages of rBST, not a single respondent indicated that it was too costly. Since we did not inquire at what price they would cease to use rBST, this response in itself is insufficient information to justify a price increase. Four of the 18 users indicated that the extra labor required to use rBST was a disadvantage. Only 3 were worried about consumer concerns, 2 about cow health, and 2 about milk surplus or low milk prices. The remaining 7 responses were combinations of disadvantages which included some of those listed above.

Five of the 18 current users indicated that they experienced health problems from the use of rBST, but they were still using it. Of those five, two reported feet problems; one, thin cows; one, mastitis; and one, breeding difficulties. A number of the dropouts also indicated that health problems or concerns were one reason they stopped using rBST.

Some of these health problems may have occurred even without the use of rBST, but the respondents associated them with the use of rBST.

The respondents had a factual assessment of the number of rBST users in Ontario County. Of the 46 respondents, 25 indicated that many, if not most, of the dairy producers in the county were using rBST, and another 16 felt that some were using rBST. Only 2 did not think many farmers were using rBST, and 4 indicated no knowledge of rBST use by others. At the same time, 28 felt that rBST was not a good thing for the industry in New York or in the USA. Six thought it was a good development, 4 believed it would have no effect, and 8 were undecided.

Analysis of factors related to adoption

A number of statistical techniques are available to differentiate between adopters and nonadopters of rBST. The most common procedure utilized in previous ex ante rBST studies was a dichotomous logistic model, where the dependent variable is whether the farmer indicated he or she would adopt or not adopt, and the independent variables were characteristics of the farm and farmer (Yonkers). Although individual responses were to adopt or not to adopt, and thus that observed variable would have a value of one or zero, the estimated statistical models give the probability of adoption, bounded between one

and zero, conditional upon the characteristics of the farm and farmer. Mathematically, the form is: $P_i = 1/(1+\exp(B_i*X_i))$, where P_i is the probability of adoption for farmer i, and exp is the exponential operator for the natural number, X_i is the vector of characteristics for farmer i, and B_i is the vector of estimated coefficients for those characteristics.

Separate regressions were estimated to determine the relationship between adoption, and five separate factors: 1) previous use of technologies, 2) farm structure, 3) human capital and management, 4) agrarian attitudes, and 5) future plans. These 5 factors were measured using the set of variables defined in table 1. The functions were estimated using the LOGISTIC REGRESSION technique from SPSS/PC+. This procedure uses a maximum likelihood procedure to estimate the coefficients of the model. The results are reported in tables 2 through 6.

Maybe the best predictor of technology adoption is the previous adoption of other technologies. Of course, farmers do not adopt every new technology, but rather selectively adopt those technologies suitable and desirable for their own business. Seven different types of technologies were used as explanatory variables under the logistic regression labeled "Use of advanced dairy technologies". Some of these technologies, such as artificial insemination, have been around for a number of years; others, such as use of computers, are much more recent.

Except for predipping of teats, the use of all previous technologies had a positive effect on rBST adoption, but only the use of artificial insemination and computers are statistically significant (table 2). The use of teat dipping, forage testing, ration balancing, or scheduled veterinarian visits, often considered indicators of a progressively managed farm, had little statistical impact on whether these farms had adopted rBST.

Of the variables defining the farm structure logistic regression, only milk production per cow had a statistical significant impact on adoption of rBST, with farms having higher producing cows, being more likely to use rBST (table 3). Although the number of cows has a positive impact on adoption, it is not statistically significant because of the other characteristics in table 3. If adoption is estimated as a logistic function of cows alone, the impact is positive ($\beta = .01$) and statistically significant at the .04 level. This supports the argument of Tauer, that although rBST may in principle be size or scale neutral, farmers with higher producing herds would be greater users of rBST than farmers with smaller or lower producing herds. It appears that the type of milking system does not determine the adoption of rBST, nor does size as measured by the amount of land operated.

The adoption of any new technology requires the ability to comprehend the impact of that technology on the business and then to implement it successfully. Therefore, education, experience, and knowledge of the business are important characteristics. The impact of these on the adoption of rBST is reported in the logistic regression of human capital and management (table 4). There, it appears that age of the operator is not important (as a

Table 1. Variable Definitions for Logistic Regressions

Variable	Definition	Mean
ABST	Adoption of rBST (Yes (1); No (0))	.50
	--- Use of Advanced Dairy Technologies ---	
USEAI	Artificially inseminate (Yes (1); No (0))	.54
USEPRE	Predip teats (Yes (1); No (0))	.78
USEPOST	Postdip teats (Yes (1); No (0))	.92
USETST	Test forage 3 or more times a year (Yes (1); No (0))	.78
USEBAL	Balance rations 4 or more times a year (Yes (1); No (0))	.76
USECOM	Use computers on farm (Yes (1); No (0))	.38
USEVET	Veterinarian visits on regular schedule (Yes (1); No (0))	.90
	--- Farm Structure ---	
COWS	Total milk cows (includes dry cows)	137
ATOT	Total acres owned and rented	769
PARLOR	Milking parlor (Yes (1); No (0))	.08
TRANSFER	Stanchion with transfer (Yes (1); No (0)) (Residual is stanchion with pipeline)	.56
RHAVG	Rolling herd average (lbs.)	19,086
	--- Human Capital and Management ---	
AGEOP	Age of operator	44
LTHS	Less than high school diploma (Yes (1); No (0))	.06
COL	Two-year or more college degree (Yes (1); No (0)) (Residual is high school diploma)	.42
COSTCWT	Knows cost of producing milk (Yes (1); No (0))	.38
	--- Agrarian Attitudes ---	
BSTGOOD	BST is good for the dairy industry (Yes (1); No (0))	.12
FLLIFE	Farming as a way of life (Important or Very important (1); Neutral ,Unimportant or Very unimportant (0))	.76
FLMNGT	Challenge to your management skills (Important or Very important (1); Neutral ,Unimportant or Very unimportant (0))	.86
FLCARRY	Maintain a family tradition (Important or Very important (1); Neutral ,Unimportant or Very unimportant (0))	.64
FLLAND	Responsibility of land stewardship (Important or Very important (1); Neutral ,Unimportant or Very unimportant (0))	.72
	--- Future Plans ---	
CHMILK	Will increase milk production (Yes (1); No (0))	.96
CHBUYLD	Will buy more land (Yes (1); No (0))	.35
CHGRAMOR	Will increase grain production (Yes (1); No (0))	.20
CHFORMOR	Will increase forage production (Yes (1); No (0))	.53
CHGRAZE	Will rotational graze (Yes (1); No (0))	.16
CHNEW	Will diversify production (Yes (1); No (0))	.33
PERCOWS	Percentage increase in cows planned for next five years	25%

Table 2. Logistic Regression Results for Use of Advanced Dairy Technologies

Variable	Estimate	S.E.	Wald Statistic	(signif.)
USEAI	3.62	1.36	7.12	(.008)
USEPRE	-1.15	1.58	.53	(.467)
USEPOST	9.61	67.17	.02	(.886)
USETST	.91	1.55	.35	(.557)
USEBAL	.55	1.68	.11	(.742)
USECOM	2.81	1.32	4.55	(.033)
USEVET	8.68	72.23	.01	(.904)
Constant	-21.41	98.62	.05	(.828)
Correct predictions	89%			
Model Chi Square	36.58			
N = 46				

Table 3. Logistic Regression Results for Farm Structure

Variable	Estimate	S.E.	Wald Statistic	(signif.)
COWS	.01	.01	1.92	(.166)
ATOT	-.001	.0008	2.26	(.132)
PARLOR	-7.30	47.37	.02	(.878)
TRANSFER	.69	1.10	.40	(.528)
RHAVG	.0005	.0002	6.85	(.009)
Constant	-11.10	4.26	6.78	(.009)
Correct predictions	76%			
Model Chi Square	24.92			
N = 46				

Table 4. Logistic Regression Results for Human Capital and Management

Variable	Estimate	S.E.	Wald Statistic	(signif.)
AGEOP	-.008	.037	.05	(.824)
LTHS	-6.89	34.89	.04	(.843)
COL	1.36	.77	3.13	(.077)
COSTCWT	2.27	.82	7.62	(.006)
Constant	-.90	1.71	.27	(.601)
Correct predictions	78%			
Model Chi Square	17.80			
N = 46				

Table 5. Logistic Regression Results for Agrarian Attitudes

Variable	Estimate	S.E.	Wald Statistic	(signif.)
BSTGOOD	9.60	37.20	.07	(.796)
FLLIFE	-2.04	.97	4.42	(.036)
FLMNGT	.63	1.36	.22	(.642)
FLCARRY	-1.24	.82	2.29	(.130)
FLLAND	.31	.85	.14	(.712)
Constant	1.31	1.66	.63	(.428)
Correct predictions	76%			
Model Chi Square	16.87			
N = 45				

Table 6. Logistic Regression Results for Future Plans

Variable	Estimate	S.E.	Wald Statistic	(signif.)
CHMILK	8.07	42.74	.04	(.850)
CHBUYLD	.08	.82	.01	(.926)
CHGRAMOR	-.57	1.05	.29	(.588)
CHFORMOR	-.66	.80	.68	(.410)
CHGRAZE	-2.19	1.24	3.12	(.077)
CHNEW	.30	.87	.12	(.733)
PERCOWS	4.79	2.34	4.17	(.041)
Constant	-8.20	42.73	.04	(.848)
Correct predictions	65%			
Model Chi Square	14.92			
N = 46				

possible proxy for experience), but that a college education leads to greater adoption, as well as does a greater knowledge of the economics of the business, as reflected by knowing the cost of production.

The logistic regression of agrarian attitudes shows clearly that whether a farmer believes rBST is good or harmful for the dairy industry does not influence whether he or she adopts rBST (table 5). Those that strongly feel farming is a way of life had a propensity not to adopt rBST. The other variables defining various agrarian attitudes had little impact on the decision of whether to adopt or not adopt rBST.

Finally, the variables included in the logistic regression measuring future plans do not explain much of the adoption of rBST (table 6), except for farms that plan to rotational graze (who did not adopt rBST), and those that plan to increase the number of their cows (who adopted rBST).

The predictive power of the 5 regressions varied, although all correctly predicted over 65%. The model relating past adoption of technologies to the adoption of rBST, not surprisingly, had the greatest correct prediction of 89%. Apparently, a good indicator of technology adoption is the adoption of previous technologies.

Summary and Conclusions

Although initial adoption rates for rBST nationwide were in the 10% range (Schneider), we found that about half of the farmers in our population had adopted it or were about to adopt it within 6 months of its introduction. This is a high adoption rate for any

technology and especially dramatic for one such as rBST which has been surrounded by controversy. In this paper we examined how several sets of factors related to the farm business and characteristics of the farm operator were associated with the decision to adopt or not adopt rBST.

Farmers who adopted or planned to adopt rBST as part of their farming systems tended to use other advanced dairy technologies as well, especially artificial insemination and personal computers. Also, adopters operated larger farms with higher herd averages, had more formal education, and calculated the cost per hundredweight of milk produced. Adopters also tended to view farming as a business operation rather than as a "way of life." Finally, adopters were more likely to plan to increase the size of their herds and less likely to consider low input technologies such as rotational grazing.

Overall, the data suggest that there are at least two distinct production trajectories within the population of farmers surveyed. Farmers on one trajectory accept the latest production boosting technologies and use these technologies to orient their farming systems towards business goals. Factors related to this business trajectory include more formal education, larger farms, more cows, and higher herd averages.

Farmers on the other trajectory hold to the belief that "farming is a way of life". These farmers appear more skeptical of technologies available to boost production. Their farms

tend to be smaller in size and have fewer cows. Also, they are more open to adopting lower-input technologies such as rotational grazing.

If our conjecture is correct and there are distinct dairy systems operating in New York (and perhaps elsewhere), our study raises a number of important questions with respect to dairy technology development and transfer, extension programming, milk marketing, dairy farm sustainability, and policy formation. A segmented system of producers means that the "one size fits all" assumption that has guided much of technology development should be re-examined.

If rBST fits only one segment of the dairy community, then it is important to look at the characteristics and conditions associated with the segments that have not, for whatever reasons, adopted the technology. To simply write off non-adopters as "laggards" and/or "poor managers" is to tacitly accept a set of assumptions about the direction of future research and extension activities. At a time when the forces leading toward increased homogenization and standardization of production agriculture are mounting, it is important to examine what might be lost in the process.

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