

THE ADOPTION OF rBST ON WISCONSIN DAIRY FARMS

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Adoption of rBST on Wisconsin dairy farms has been modest, and is limited by farm operations: (1) finding rBST disadvantageous given their moderate scale and lack of use of technologies and practices that improve its efficacy; (2) using alternative production systems that make rBST use less likely; and (3) working with handlers that market dairy products to consumers from cows not treated with rBST.

Key words: adoption; dairy farm technologies; recombinant bovine somatotropin; rBST; size-bias.

Two strikingly disparate articles on the economics of recombinant bovine somatotropin (rBST) use on US dairy farms ran side by side in this journal in 1999. Fetrow (1999), for example, argued that since its commercial introduction rBST “has been very rapidly adopted by the commercial dairy industry,” while Butler (1999) argued that the relatively few *ex post* studies of rBST indicated that “the adoption of this technology has been slow to moderate.” Similar contrasting quotes were presented on the performance of rBST on US dairy farms, with Fetrow offering a more positive evaluation of rBST than Butler.

As with any other technology, the adoption patterns of rBST and its impacts on the performance of dairy farms are fundamentally empirical questions, ones whose answers require evidence from large, random samples of real dairy farms, not from scenarios and representative models of farms. Butler aptly notes that surprisingly few farm surveys on rBST use have been reported in the years following rBST’s approval, and notably only Butler of the aforementioned authors makes much use of survey evidence in presenting his arguments on the economics of rBST use.

This paper builds on Butler’s implicit suggestion for more empirical analysis by examining rBST adoption patterns among Wisconsin dairy farmers, who account for about 20% of the nation’s dairy farms. We use data from several statewide mail surveys done in the 1990s by the Program on Agricultural Technology Studies on large, random samples of farms, using a modified Dillman (1978) method. These surveys generated response rates of about 60%, and based on farmers’ responses our inquiry examines the following four questions about rBST use and performance:

- Has the pace of rBST adoption in Wisconsin been rapid at the farm level, or in cow numbers?
- Is adoption scale neutral, as asserted by some analysts (e.g., Fetrow, 1999)?

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- What technologies and management practices are closely associated with rBST adoption?
- How has rBST adoption affected the performance of the dairy sector?

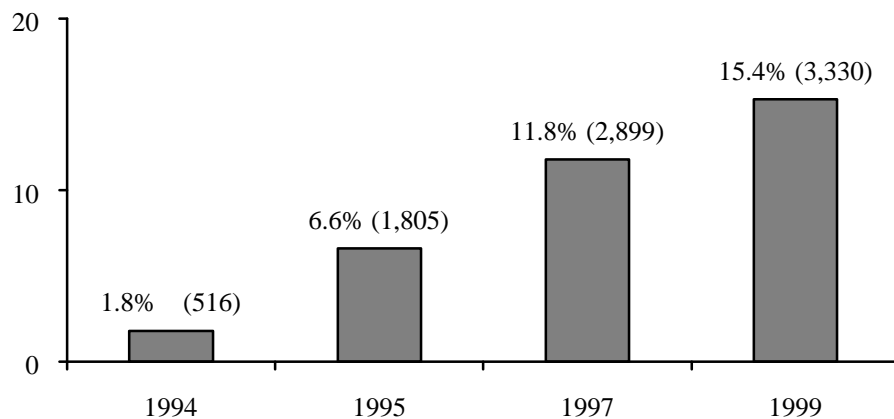
For each of these questions, we believe empirical evidence from other dairy producing states generally confirms the findings we report for Wisconsin. This confirmation should not be surprising; the basic characteristics of Wisconsin's 21,000 dairy farms embody in terms of herd size, technologies, and management practices the full range of dairy farms found elsewhere.

The Pace Of rBST Adoption In Wisconsin

In the spring of 1999, five years after rBST's commercial introduction, 15.4% of Wisconsin farmers were using rBST in their herds. This adoption rate is more than double the 6.6% level in 1995, and about a 30% increase compared to the 11.8% level of 1997. If rBST were a technology that farmers had known little about prior to commercial introduction, then a 15% adoption rate within five years might conceivably be viewed as rapid but by no means could it be called "very rapid." Yet, because of the controversy surrounding rBST's regulatory approval, by the time sales commenced in 1994, Wisconsin farmers (and consumers, for that matter) were almost universally familiar with the technology (Nowak & Barnes, 1988; Barham, 1996; Barham *et al.*, 1995; Douthitt, 1991).

The adoption percentages depicted in figure 1 also appear to be flattening out. Note first that the rate of growth in adoption has slowed over time – from an 80% change between 1995 and 1997 to a 30% change between 1997 and 1999. Second, the number of new rBST adopters is growing even more slowly -- adding roughly 1,300 adopters the first year, 1,100 between 1995 and 1997, and only 440 between 1997 and 1999. Meanwhile, the proportion of Wisconsin dairy cows treated with rBST has risen somewhat faster, from 15% of all milk cows in 1997 to about 20% in 1999. Nonetheless, this figure, and estimates of perhaps 25-30% of milk cows treated nationally, are still far less than Hallberg and Fallert's (1995) national projections of more than 50% by the year 2000.

Figure 1: Percent (Number of Farmers) of Wisconsin Dairy Farms Using rBST.



What is not apparent in figure 1 is the fact that more than half of the 3.6% increase in the aggregate adoption rate between 1997 and 1999 was accounted for by the disproportionate exit of non-rBST users rather than an increase in new rBST users. As dairy farm numbers decline, low rates of rBST use among older retiring farmers can produce perceived increases in overall adoption rates that are

more reflective of demographic shifts than dynamic technological change. Relatedly, new dairy farm entrants appear to also adopt rBST at lower than average rates in Wisconsin (Buttel *et al.*, 1999). At the same time, 1997 survey results suggested that an additional 5 percent of Wisconsin dairy farms disadopted rBST between 1994 and 1997 (Barham, Jackson-Smith, & Moon, 2000).

Producer ambivalence and marketing conditions also limit rBST adoption. Surveys of dairy farmers indicate high levels of concern with rBST's impacts on animal health, dairy prices, and consumer backlash (Barham *et al.*, 1995). At the same time, retailer concerns with consumer reactions have led to a system of dairy product labeling and agreements that require farmers in Wisconsin and elsewhere to sign affidavits declaring they are not using rBST on their farms. In 1995, 33% of Wisconsin dairy farmers signed such an agreement with their milk handler (*ibid.*).

Is rBST Adoption Scale Neutral?

As discussed further below, the answer is decidedly not, in spite of the fact that the actual process of injecting cows with rBST has no implicit technical scale bias (i.e., per-unit costs tend to be constant over different sized herds). Table 1 demonstrates the persistent and deepening size-bias in rBST adoption on Wisconsin dairy farms. In 1999, for example, 75% of the herds over 200 cows were using rBST, compared with only 5% of the herds under 50 cows and 15% of the herds between 50 and 99 cows. Because about 85% of Wisconsin dairy herds had less than 100 cows, it is true as Fetrow (1999) suggests that more than half of the herds using rBST had less than 100 cows, but that belies the actual extreme size-bias of rBST adoption.

Table 1: Percent of Farms Using rBST in Wisconsin by Size of Milking Herd (Percentage, 1999).

Size Categories	1995	1997	1999
1 to 49 Cows	2.2	3.3	5.3
50 to 99 Cows	10.4	13.9	15.3
100 to 199 Cows	20.8	30.1	34.9
200 + Cows	46.7	48.3	75.0
All Dairy Farmers	6.6	11.8	15.4

Note. From Program on Agricultural Technology Studies, University of Wisconsin, Madison.

The average herd size of rBST adopters in Wisconsin in 1999 was 149 cows compared to 58 for non-adopters. Similar size biases are evident in Texas (Saha, Love, & Schwart, 1994), California (Zepeda, 1990; Butler, 1995), and Connecticut (Foltz & Chang, 2000).

What Technologies And Management Practices Are Associated With rBST Adoption?

As Fetrow (1999) explains, effective rBST use depends on careful feed and herd management to insure that the cows can make efficient use of the stimulus to milk production provided by the hormone. As a result, it should not be surprising that rBST adoption is higher on farms deploying a host of other productivity-enhancing practices. These include the use of total mixed ration (TMR) equipment, regular feed-ration balancing, herd production record keeping, and regular veterinarian services. Table 2 summarizes the use of various production technologies by rBST users and non-users across a range of herd size categories. The results suggest that rBST adopters in all size categories are far more likely than non-adopters to use other productivity-oriented management practices. In herds with over 50 cows, over 90 percent of rBST users balance rations, have regular herd health checks, and keep production records on individual cows. On herds over 100 cows, over 90 percent also use a TMR.

The association of rBST with other productivity-enhancing technology use helps to explain the size bias in rBST adoption. Adopters of rBST appear to have a certain production system orientation that gives rise to the use of a whole package of technologies, facilities, and management practices, most of which reward rBST use. This view is reinforced by the fact that rBST adopters in Wisconsin are also far more likely than non-adopters to be rapidly expanding their herds and investing in large-scale parlor-freestall milking operations (Barham, Jackson-Smith, & Moon, 2000). Since many of these high-productivity technologies, facilities, or management practices have strong technical, investment, or labor scale biases, their differential adoption profiles and their association with rBST use affect the scale neutrality of rBST adoption.

Table 2: Adoption (A) and Non-adoption (NA) of Various Milk Production Practices by Herd Size in Wisconsin (Percentage, 1999).

rBST Adoption	TMR		Veterinary Service		Herd Productivity Record		Balanced Feed Rations	
	A	NA	A	NA	A	NA	A	NA
1 – 49 cows	35.3	6.6	70.6	50.2	88.2	36.6	58.8	41.3
50 - 99 cows	70.0	27.1	90.2	71.6	92.0	60.5	98.0	74.8
100 – 199 cows	93.1	50.0	93.1	79.6	93.1	58.5	100.0	90.7
200 + cows	95.2	57.1	93.1	58.5	95.2	42.9	100.0	85.7
All	75.2	19.7	89.8	62.2	92.3	48.9	93.2	60.5

Note. From Program on Agricultural Technology Studies, University of Wisconsin, Madison.

While understanding the adoption of corollary technologies helps to explain the size-bias in rBST use, it can also address the potential for future growth in rBST adoption. As well over 60% of Wisconsin

dairy farms do not use at least two of the associated productivity-oriented technologies from table 2, this is likely to prevent a rapid growth in rBST adoption any time soon. At the same time, the increased use of management-intensive rotational grazing (MIRG), which relies on pastures as a primary source of forage for animals in the grazing months, will also discourage rBST use for some farmers. Management-intensive rotational grazing farmers tend to use fewer of the corollary technologies, especially those associated with maximizing milk output. Statewide, 23% of Wisconsin farmers in 1999 used MIRG, a 300% increase over 1993, and for them rBST adoption in 1999 was just 9.4% (Ostrom and Jackson-Smith, 2000).

How Has rBST Adoption Affected The Performance Of The Dairy Sector?

As shown in table 3, milk production per cow among rBST adopters is about 25% higher than it is among non-adopters. However, controlled studies of farms adding rBST into existing production systems show the average increase in per cow milk production levels to be about 10% (Butler, 1999). Thus, only about 40% of the productivity gap shown in table 3 between rBST adopters and non-adopters would be directly attributable to the use of rBST. The rest is probably associated with genetics and other management practices. Assuming that 20 percent of Wisconsin cows receive rBST, and that production is boosted by 10 percent, we estimate that the introduction of the technology is responsible for a 2 to 3 percent increase in gross milk production in Wisconsin (and the United States) over the first 5 years of use. Given the highly inelastic demand for milk, the price depressing impact of a one-time increase of 2-3% in supply would be around 8%. However, over the past five years, any reasonable analysis of supply-side changes would find other factors, such as the long-term secular trend in productivity improvements and the expansion of high productivity operations in the western US, to be far more influential on prices received for milk by producers than was the introduction of rBST. In other words, the rather moderate pace of rBST adoption in Wisconsin and elsewhere has meant that this new technology has not proven to be the industry juggernaut that proponents and opponents envisioned prior to its introduction.

Table 3: Productivity of Wisconsin Dairy Farms by rBST Adoption Status (1999).

	Current User	Non-user
Rolling Herd Average (lbs per cow)	22,947	19,129
Milk shipped per lactating cow per day (lbs)	71.7	57.4

Note. From Program on Agricultural Technology Studies, University of Wisconsin, Madison.

Concluding Remarks

To understand the adoption and dairy farm performance outcomes associated with new agricultural biotechnologies, farmer surveys are crucial to determine not only actual levels of use over time but also the factors associated with those decisions. This paper shows that over the first five years of its commercial availability, rBST adoption on Wisconsin dairy farms has been rather modest. Certainly, it has fallen far short of the robust adoption predictions made when the technology was originally released (Raboy & Simpson, 1993; United States Government, 1994). The main factors inhibiting broader rBST adoption in Wisconsin are as follows. First, the majority of farm operations may not find it advantageous to adopt rBST given their moderate scale and their lack of use of other

technologies and practices that might maximize rBST benefits. Second, a substantial subset of operations are using an alternative production system (rotational grazing), that is based on minimizing feed expenditures, making rBST use less likely. Third, some operations work with milk processing firms that overtly discourage rBST use to satisfy a sizable segment of the consumer market that wants dairy products from cows not treated with rBST. In addition, although representative farm models have suggested that there should be significant financial returns to rBST use, recent empirical studies of dairy farms have found no significant impacts of rBST use on profitability (Tauer & Knoblauch, 1997; Stephanides & Tauer, 1999). These factors combine to limit the extent of rBST adoption on Wisconsin and US dairy farms and seem likely to continue to do so.

Adoption patterns of other agricultural biotechnologies will be shaped by similar farm-level concerns, such as size, associated technologies, and alternative production systems that do not match well with the technology, as well as by marketplace considerations. Reasonable debates about adoption paths and effects of these technologies can be had, but one thing is for certain: the more empirical evidence from random samples of farms that can be marshaled, the more likely we are to advance our understanding of agricultural biotechnology use patterns.

References

- Barham, B.L., Jackson-Smith, D., and Moon, S. (2000). Use and implications of bovine somatotropin for the Wisconsin dairy sector in the 1990s (PATs Research Report No. 9). Madison, WI: University of Wisconsin.
- Barham, B.L. (1996). Adoption of a politicized technology: bST and Wisconsin dairy farmers. American Journal of Agricultural Economics, 78 (4), 1056-1063.
- Barham, B.L., Buttel, F.H., Jackson-Smith, D., McNichol, J. and Wood, S.D. (1995). The political economy of rBST adoption in America's dairyland (ATFFI Technical Report No. 2). Madison, WI: University of Wisconsin.
- Buttel, F.H., Jackson-Smith, D., Barham, B., Mullarkey, D., and Chen, L. (1999). Entry into Wisconsin dairying: Patterns, processes, and policy implications (PATs Research Report No. 4). Madison, WI: University of Wisconsin.
- Butler, L.J. (1999). The profitability of rBST on US dairy farms. AgBioForum, 2(2), 111-117. Available on the World Wide Web: <http://www.agbioforum.org>.
- Butler, L.J. (1995). rBST and industrial dairying in the Sunbelt. Paper presented at the 1995 American Academy for the Advancement of Science Meetings, Atlanta, GA.
- Dillman, D. (1978). Mail and telephone surveys: The Total design method. New York: John Wiley and Sons.
- Douthitt, R. (1991). Recombinant bovine growth hormone: A Consumer's perspective (LaFollette Issues). Madison, WI: University of Wisconsin.
- Fetrow, J. (1999). Economics of recombinant bovine somatotropin on US dairy farms. AgBioForum, 2(2), 103-110. Available on the World Wide Web: <http://www.agbioforum.org>.
- Foltz, J. and Chang, H.H. (2000). The adoption of rBST on Connecticut dairy farms. Storrs, CT: University of Connecticut.

- Hallbert, M. and Fallert, R. (1995). rBST, federal dairy policy, and the future of the dairy industry. Paper presented at the 1995 American Academy for the Advancement of Science Meetings, Atlanta, GA.
- Nowak, P. and Barnes, R. (1988). Social impacts of the adoption of bovine somatotropin by the Wisconsin dairy industry: An Exploratory study. Madison, WI: College of Agriculture and Life Sciences, University of Wisconsin.
- Ostrom, M. R. and Jackson-Smith, D.B. (2000). The use and performance of management intensive rotational grazing among Wisconsin dairy farms in the 1990s (PATs Research Report, No. 8). Madison, WI: University of Wisconsin.
- Raboy, D. and Simpson, T. (1993). The Implications of bST for consumers, farmers, and taxpayers: A Survey of the economic literature and additional analysis. Washington, D.C.: Patton, Boggs, and Blow.
- Saha A., Love, H.A., and Schwart, R. (1994). Adoption of emerging technologies under output uncertainty. American Journal of Agricultural Economics, 76(4), 836-46.
- Stephanides, Z. and Tauer L.W. (1999). The empirical impact of bovine somatotropin on a group of New York dairy farms. American Journal of Agricultural Economics, 81(1), 95-102.
- Tauer, L.W. and Knoblauch, W.A. (1997). The empirical impact of bovine somatotropin on New York dairy farms. Journal of Dairy Science, 80, 1092-1097.
- Unites States Government. (1994). The use of bovine somatotropin (rBST) in the United States: Its Potential effects (A Study Conducted by the Executive Branch of the Federal Government). Washington, D.C.: United States Publishing Office.
- Zepeda, L. (1990). Predicting bovine somatotropin use by California dairy farmers. Western Journal of Agricultural Economics, 15(1), 55-62.