A Decade of Recombinant Bovine Somatotropin: What Have We Learned About the Economics of rBST?

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One of the earliest and most studied biotechnologies is recombinant bovine somatotropin (rBST) a hormone that encourages milk production in cattle. While four companies developed and patented versions of RBST, only Monsanto commercialized the product, Posilac™, in the United States. Released commercially in February 1994, rBST has been examined for consumer reaction, human and animal health concerns, tested for producer adoption and disadoption, blamed for generating production surpluses, and tested for scale neutrality among other activities. However, it seems to be an established product that is largely off of the American consumer radar screen and is commonly used in all milk producing regions of the country.

Marion and Wills wrote an excellent article in 1990 anticipating major issues related to the economics of rBST use on dairy farms. They identified key factors that would determine farm adoption decisions: impact of rBST on milk production per cow, cost of rBST to farmers, returns to management required for farmers to adopt rBST, milk prices, increase in feed costs, and increase in hauling and other variable costs. Shockingly, more than a decade after the introduction of rBST, evidence is scant regarding its economic impact. This paper reviews the results of the literature on rBST. The focus is on the profitability of rBST and explanations for farm behavior.

Milk Production Impact

The milk production impact is perhaps the least controversial aspect of rBST use. Studies consistently have found a positive production impact. Table 1 summarizes the findings of several relevant studies. Bauman et al. utilized the DHI records of 340 herds from the northeast, half of which used rBST, for the years 1990-1998 (four years of rBST) to examine the production response. After controlling for cow age, DIM, and season, they found an average of just over six pounds/cow/day. The average response reached 8 pounds over the last two-thirds of lactation. As not all producers treated all cows, this response underestimates the response of treated cows.

Other studies consistently found herd-level average production response to be positive and significant. The response was generally 6 to 10 pounds per cow per day. Several studies are briefly summarized in Table 1.

Table 1. Production and profit response to rBST, selected studies

Authors	Data	Year(s)	Milk increase	Profit change ($/cow/day)
Bauman et al.	340 DHI herds in Northeast	1990-1998	6 pounds/day (9.3%) (average across all cows)	N/A
Ott and Rendleman	1178 herds across US (NAHMS)	1996	2,983 lbs/cow/year	$126/cow/year
McBride	872 herds across US (ARMS)	2000	11%	
Tauer	New York Business Analysis	1994-1999	Positive and significant	Negative to not statistically different from zero
Foltz and Chang	Connecticut	1998	4,142 lbs/year	-$507/cow/year
Genske	236 dairies	2002	N/A	-$43/cow/year full* +$8/cow/year partial
	254 dairies	2003		-$39/cow/year full +$35/cow/year partial

* "Full" indicates full rBST use according to label while "partial" indicates less than full label use.

While not universally adopted, rBST is generally estimated to have been adopted on about 15 percent of US farms that have about one-third of the dairy cows. These statistics indicate that it is generally farms with large herds that have adopted rBST. Further, surveys that have collected information on rBST intensity, measures as % of herd treated, generally find that not all eligible cows are treated. As we discuss in more detail below, it is likely optimal to treat less than one-hundred percent of the eligible herd.

Table 2. rBST adoption rates

Source	Year	Region	% farms	% cows	% of herd treated
Barham and Foltz	2002	US	15	35	
McBride et al.	2000	US	17	32	47
USDA-NAHMS	1996	US	9.4	--	49.2
USDA-NAHMS	2002	US	15.2	--	59.1

Farm Profitability

Unlike many other technologies that require a large investment in facilities or significant operational changes, rBST is a variable input of production. It is true that there exist some temporal considerations—i.e., it may be desirable to continue use through short-term price changes because dropping off the rBST production curve might have longer-term production consequences. However, the farm decision is fairly straight-forward adopt until the marginal value of the revenues generated by rBST equals the marginal cost of adoption. This decision rule follows from the standard economic assumption of profit maximization. This rule also encompasses both the adopt or not decision as well as relating to the level of adoption. It is, unfortunately, remarkably difficult to assess an individual cows response and cost increases outside of very controlled experiments.

Butler (1999) offered this rule for price and production level with regard to rBST use:

$$NR = (P*MR) – C – (FC*MR),$$

where NR = Net revenues from rBST ($/cwt/day), P = milk price ($/cwt), MR = milk production response from rBST (pounds/cow/day), C = cost of rBST ($/day), and FC = feed costs in $/cwt. A standard exercise (e.g., see Butler 1999 or Fetrow 1999) is to plug in values in what amounts to calculating a break-even required production response or net over feed costs. The break-even point is where NR = 0. Rearranging the equation above reveals that the break-even margin is where (P - FC) = C/MR. If rBST costs $5.50/dose for a two week period, that amounts to $0.42 per cow per day. Also, if the milk production response (MR) is 10 pounds per cow per day, and current milk price is $13.00 per cwt (or 13 cents per pound), then rBST generates a positive return whenever feed costs for the additional milk produced are less than $8.80/cwt. Similarly, if milk price is $13.00/cwt and feed costs $6.00/cwt then rBST generates a positive net return if the response is more than 6 pounds per cow per day.

Using similar techniques, Fetrow generated a table of potential rBST profits that implied that it was profitable at a milk production response of 5 pounds or more per day. He estimated a $305 return per cow per year at a 10 pound per day response. Ott and Rendleman used this method to calculate recommended use on 73 percent of cows to generate an increase in milk production of 2,983 pounds per cow per year and herd-level returns by $126 per cow per year. These budget examples seem fairly clear—rBST should pay for most producers and most cows. Unfortunately, empirical examples seem to contradict these stylized examples to a degree.

Tauer (2001) examined the profit impact of rBST on a panel data set of New York dairy herds. He found that while rBST had an unambiguously positive output impact, the average farm was losing about $100 per cow. Tauer concluded that while the output response was easily observed, it was difficult for farmers to determine whether that increased milk production translated to profit. Stefanides and Tauer (1999) examined a panel data set of 211 New York dairy farms from 1993-95. Farm size, productivity, and education of the principal operator were the most important explanatory variables influencing adoption. Barham, Jackson-Smith, and Moon (2000) examined the adoption

of rBST on Wisconsin dairy farms. They note that while the per-unit cost of injecting cows with rBST tended to be constant over different herd sizes, the actual distribution of adoption was extremely sized biased. Further, the size bias appeared to be growing over time for the Wisconsin dairy farms examined. The average 1999 herd size of rBST adopters was 149 cows compared to 58 cows for non-adopters. Foltz and Chang (2002) examined the adoption, and dis-adoption, of rBST across Connecticut dairy farms. While also finding that rBST use was associated with significantly less profit per cow, Foltz and Chang found that younger and more educated farmers, as well as larger herds, were significantly more likely to be adopters.

Explaining Lack of Profitability

There are many potential explanations for the seeming contradiction described thus far. To be concise: why does the empirical evidence contradict the budgets? And, more importantly, why would farmers continue to use a technology that is not profitable? We discuss and examine several possibilities including that costs above feed cost exist that decrease the net returns, that the average profitablity is not an adequate description across all farms, and that farmers focus on production maximization rather than profit maximization.

The most obvious explanation for the discrepancy between the stylized example and the empirical results is that one is incorrect. Let us briefly consider each in turn. The stylized example is necessarily simple. It almost certainly underestimates the cost of rBST by only considering feed costs. Empirical studies back the contention that average feed cost declines with rBST use as the cows maintenance requirement are spread over more units of milk production. However, the example assumes that there is no increase in labor to treat the cows, facilities to treat the cows, labor to provide and handle the extra feed, veterinary and medical costs, and replacement costs. While it may be the case that some farms do not see any increase in these costs, it is simply unreasonable to assume that they are zero in all cases. The difficulty in calculating these costs on farm lies in the inability to track all costs—especially for an individual cow in a with or without rBST situation.

The inability to track all costs might lead some producers to focus on the production response. Thus, farms may be maximizing production rather than profits. As rBST produces more milk with the single largest cost being feed, in situations where the milk price is high and the feed price is low, maximum production may be a fine rule of thumb.

Herd size and facilities play key roles in rBST adoption and potentially on profitability. Past research findings indicate that farm size, productivity, and operator education positively influence adoption. Further, the results summarized above indicate that averaged *across herds* rBST adoption was not profitable. Considering the rBST valuation distribution *across cows* might tell a very different story. This framework highlights a short-coming of previous research which focused on profitability at the herd level only. By regressing the rBST use by herd on average profit per cow in each herd, the parameters find the average relationship across herds (or producers). If we recognize that rBST is injected into individual cows rather than the whole herd (or the producer) it

is entirely possible that the average response would be positive profits. However, this argument about average profits still indicates that some herds are losing money voluntarily by utilizing rBST.

One must also be careful in interpreting the results. Notice that most found no statistically significant difference in profits between those farms using rBST and those that did not. This means that they were also not losing money with rBST—not simply not making money. It is possible that the farms using rBST would have had less net income without using the hormone. This explanation is somewhat discredited by a study performed Tauer (2004) that controlled for these factors and found that the farms would have performed better financially without rBST.

The work by Genske is very illuminating with regard to explaining profitability. He found that farms that used rBST at less than the full recommended amount made positive profits that were greater than those that used a full dose as well as those farms that did not use rBST. This is consistent with past national surveys that found that producers consistently used rBST on less than all eligible cows. Ott and Rendleman estimated an optimal use rate of 73 percent to maximize production. The profit maximizing level is almost certainly less than the production maximizing level. These results clearly indicate that farmers should be careful in choosing dose and intensity level.

Summary

From a decade of research on rBST some clear patterns can be ascertained. Larger farms use rBST. These larger farms have newer, more expensive technologies that accompany increasing herd size. A significant production response can be expected from rBST. However, the profit response is less clear. The implication is that the manager's pencil should be sharp in analyzing rBST use as it is likely to vary over time with price changes and across herds depending on costs and facilities.

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