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The Uncertain Economics of the Profitability of rbST

In the last 2 or 3 years, several studies have found that while rbST is an effective technology for increasing milk production, it is not clear whether there is any significant increase in profitability from using rbST (Tauer and Knoblauch, 1997; Stephanides and Tauer, 1999; Tauer, 2000; Folz, 1999; Butler, 1999).

Production Responses to rbST

In theory, as the famous saying goes, rbST should increase the profitability of dairying. Numerous papers in the animal science literature show that, with a few exceptions, use of rbST should increase milk production by 5 – 15 pounds per cow per day of usage. In a recent paper by Bauman, et. al., 340 Dairy Herd Improvement (DHI) herds were used to compare production responses to rbST. 176 herds were control herds (non-rbST users), and 164 were rbST herds. After correcting for management improvements, feed supply, seasonal variation, etc., in both control and rbST herds, the study concluded that milk, fat, and protein production increased significantly in response to rbST. Over the four years since commercial availability, these cows showed an average of 6+ pounds of milk per cow per day for each cow milking on test day, and 8+ pounds of milk per cow per day for each cow milking on test day over the last two-thirds of lactation (mid and late lactation). These represent at least 1,968 pounds of milk, 59 pounds of fat, and 62 pounds of protein per 305-day lactation. As Bauman et.al. point out, these are presumably minimum responses to rbST treatment, because it was assumed that 100 percent of the cows in each herd were treated with rbST. Since most producers do not treat 100 percent of cows, average response rates are much higher than these results indicate.

These results, along with several hundred other controlled experiments and studies indicate that rbST does appear to significantly increase milk production in treated cows. To really appreciate the results of the Bauman et. al. paper, the reader should understand that this study was carried out on entire herds in the field – as opposed to controlled experimental results on individual cows which often exaggerate the response rate.

The Theoretical Economics of rbST

The second step in assessing any technology is to examine the economic feasibility of adopting it. The logic is simple. A new technology may increase milk production, but its cost may outweigh its benefits or returns, thereby making it less attractive to dairy producers. There are a number of ways of increasing milk production efficiency and profitability. A new technology must not only be economically feasible, but it must also be shown to be as feasible, or more so, as other methods of increasing efficiency and profitability.

The economics of rbST can be as simple or as complicated as you want to make it. To estimate the additional profit from using rbST, a dairy producer may simply estimate the additional revenues realized from rbST use, and subtract from that the additional costs associated with supplementing cows with rbST. Let's take a simple, but typical, and perfectly legitimate, example.

If a dairy producer expects 8 pounds of additional milk per cow per day, and the average mailbox price of milk is \$12.00 per hundredweight (cwt.), then the additional revenues from using rbST are \$0.96 per cow per day. If the producer expects to supplement the cow for the recommended 245 days (from 60 DIM to the end of the lactation), then total additional revenue from the extra milk generated by supplementing the cows with rbST would be \$235.20 per cow per lactation.

Now, rbST costs \$5.50 per 14 day treatment. That is about \$0.42 per cow per day. In addition there will be extra feed costs of about \$0.05 per pound of extra milk. If we assume 8 pounds of extra milk per cow per day, then the total extra feed costs will be \$0.40 per cow per day. Therefore, the producer will incur extra costs of \$0.82 per cow per day (\$0.42 for the rbST and \$0.40 for the extra feed).

Subtracting costs from additional revenues, this dairy producer will increase profits by \$0.14 per cow per day, or \$34.30 per cow per lactation. Let us go one step further to put this in perspective. Let us assume that this producer is netting about \$1.50 per cwt. on cows that are averaging 20,000 pounds of milk. Therefore, NET revenue (profit) per cow per year, without rbST, is \$300, from milk alone. Additional revenues from rbST then will increase profits from \$300 to \$334.30 – an 11.4 percent increase in profit. Obviously, it would be higher with a higher response rate.

While these are not stunning figures, they are probably sufficient to convince a dairy producer that rbST is quite a good investment. And, it must be remembered that our example is a very conservative one. No, we have not accounted for potentially extra costs associated with rbST use such as extra labor, administering and keeping records, increased days open, mastitis, lameness, and heat stress. These additional costs may, or may not be significant. Few studies have reported them as significant. In addition, we have not accounted for the increase in feeding efficiencies associated with rbST use that many studies have reported. And our assumptions about response rate and milk prices are very conservative. We might assume that these additional possible revenues offset the additional possible costs. Obviously, if mailbox prices are higher, and feed costs are lower, then returns to rbST would be higher. The opposite is also true. In fact, the prudent producer might adopt a simple rule of thumb that would indicate when rbST use was no longer feasible. The following would probably work in most situations:

$$NR = (MP * RR) - cbST - (FC * RR)$$

Where: NR = net revenues or profit from using rbST
MP = milk price or mailbox price in \$/cwt.
RR = response rate in lbs./cow/day
cbST = cost of rbST = \$0.42/cow/day.
FC = feed costs in \$/cwt. of milk produced.

Collecting terms and rearranging, we get:

$$NR = RR[(MP - FC)/100] - 0.42$$

Let MP – FC (the difference between current milk price and current feed costs per cwt. of milk produced) = D, then, when NR = 0 (the break-even point):

$D = 42/RR$

Thus, for example, if you are expecting a response rate (RR) of 10 pounds per cow per day, then the difference between current milk price and current feed costs needs to be MORE than 42/10 = $4.20 for rbST to remain economically feasible. If current milk prices are, say, $13.50 per cwt., then feed costs need to be LESS than $13.50 - $4.20 = $9.30 per cwt. for rbST to be economically feasible.

Apparently, Monsanto offer a discounted rate of $5.25 per 14 day treatment to purchasers of rbST if they agree to treat more than 50% of their herds. In this case, the daily cost of rbST would decrease to $0.375, and our rule of thumb would then become:

$D = 37.5/RR$

This would have the effect of lowering the breakeven point.

The proposed rule of thumb can also be reversed. That is, it could be:

$RR = 42/D$

In this case, the producer would compute a minimum response rate (RR) given the difference (D) in current mailbox milk price and current average feed costs. If average milk price is $13.50 per cwt. and current average feed costs are $6.50 per cwt., then D would be 7 ($13.50 - $6.50). The minimum response rate (RR) for rbST to remain feasible would be 42/7 = 6 lbs. of extra milk per day, or 5.35 lbs. per day for discounted rbST.

Profitability.

To date, only two studies have been published on the profitability of rbST use on dairy farms. These studies, carried out by Tauer and Knoblauch (1996) and Stephanides and Tauer (1999) on New York dairy farms, found that the use of rbST significantly increased milk production per cow, but the impact on profits was insignificant and not statistically different from zero at any conventional significance level. Stephanides and Tauer conclude that the use of rbST was not profitable, on average, for these farms, and that two years may simply be too short a time period for a thorough understanding of the new technology. Alternatively, they suggest, "rbST use equilibrium may have been reached such that all adoption rent has been extracted". Lesser et. al. suggest much the same and raise the possibility that Monsanto is "extracting much of the rent created by Posilac".

Similar results are suggested in analyzing the comments of producers participating in the California survey (Butler, 1998b). Many producers candidly admit that while the response rate to rbST treatment produces significantly more milk, it is not clear that there is any significant increase in profits. One major problem is that most producers do not have the time, or the technologies, to monitor individual cow feed intake, and therefore do not have any way of calculating profits from rbST use. For most producers, it is pure guesswork. One producer said, "It's difficult to determine the exact response on each cow without daily monitoring…so without computerized daily records, you guess at individual profitability on each cow…while costs continue to increase". And another said, "I have used rbST now for four years. I really believe that when all is said and done, Monsanto makes money on it". While individual comments and opinions about the profitability of rbST use are purely anecdotal, and not a very scientific way of determining profitability, they do tend to support the results found in the New York study.

In their paper, Stephanides and Tauer (1999) pose the question, "Why are these farmers using rbST when it is not generating a profit for them?" While they do not propose to have the answer, they suggest that either dairy producers are still learning how to successfully use rbST, or that "all adoption rent has been extracted". Maybe the fact that rbST increases milk production is sufficient for many producers to conclude that they are achieving what was intended. This is particularly true if there are no noticeable losses associated with rbST use. Maybe the margin is much smaller than our theoretical models would indicate. But since there are other ways of increasing profits, it is indeed puzzling why producers would continue to use rbST if it wasn't generating a significant profit for them.

Profitability of rbST

The early unfeasibility of rbST may be a clue as to why this technology had such an apparent slow start. In addition, the large amount of time when rbST has not been very feasible may also explain why some studies have concluded that that there is no significant increase in profitability from using rbST.

External economic conditions such as the price of milk and feed costs are important determinants of the feasibility of adopting rbST. For example, when feed costs are high and milk prices are low, rbST is feasible for a much lower proportion of dairy producers than when feed costs are low and milk prices are high (Butler and Carter, 1988, Butler, 1999).

To demonstrate this, we define the *additional* net revenues or profits from using rbST as follows:

$$NR = (MP * RR) - cbST - (FC * RR) \qquad (1)$$

Where: NR = net revenues or profit from using rbST

MP = milk price or mailbox price in \$/cwt.

RR = response rate in lbs./cow/day

cbST = cost of rbST = \$0.50/cow/day.

FC = feed costs in \$/cwt. of milk produced.

Collecting terms and rearranging, we get:

$$NR = RR[(MP - FC)/100] - 0.50 \qquad (2)$$

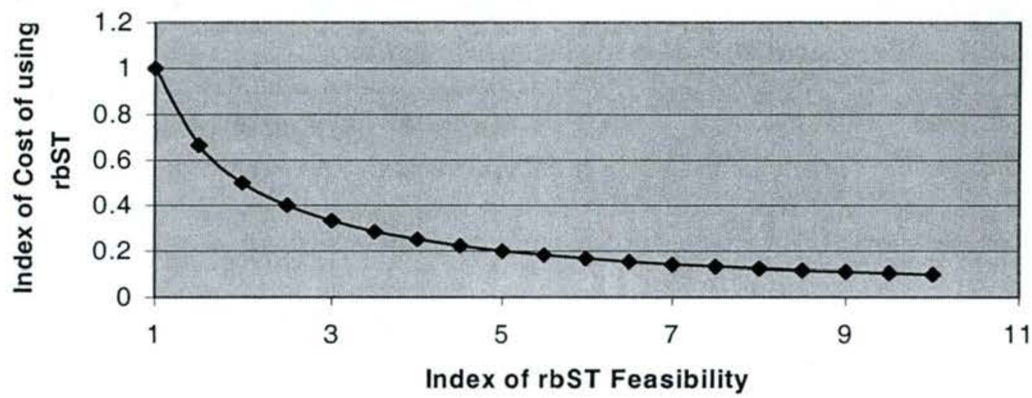
Let MP – FC (the difference between current milk price and current feed costs per cwt. of milk produced) = D, then, when NR = 0 (the break-even point):

$$RR = 50/D \tag{3}$$

Thus, as D, the price differential between milk prices and feed costs, increases, the breakeven response rate (RR) decreases. That is, D will increase as milk prices increase or as feed prices decrease, both of which make it increasingly feasible to use rbST. Thus, as D increases, the more feasible dairy producers find rbST to use.

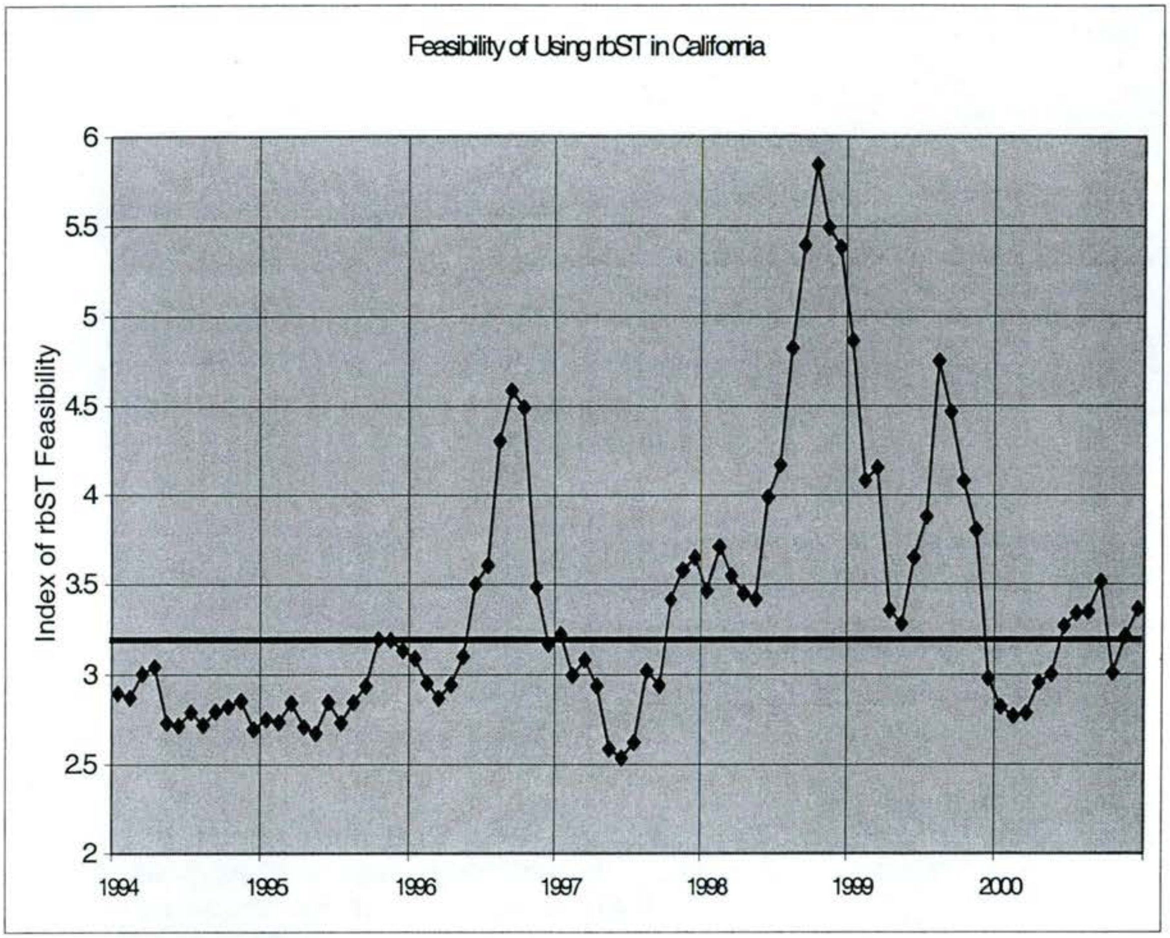
We can use this relatively simple approach to create an index of demand for rbST and an index of the feasibility of using rbST. Since an increase in D increases the feasibility of using rbST, then 1/D can be thought of as the cost of using rbST. As 1/D increases, the feasibility of using rbST decreases. Similarly, since an increase in the breakeven response rate (RR) decreases the feasibility of using rbST, then 1/RR can be thought of as an increasing index of the feasibility of using rbST. As 1/RR increases, the feasibility of using rbST increases. These are shown in Figure 1.

FIGURE 1
Demand for rbST



As pointed out earlier, rbST increases milk production by 5 – 15 lbs. per cow per day, with an average shown in almost all studies of around 8lbs/cow/day. Using equation 3, a response rate of 8lbs/cow/day implies a D (the price differential between milk prices and feed costs) of $6.25 for minimum feasibility. Therefore, if we use this level as a minimum feasible point for most producers, the resulting index of rbST feasibility is 3.125. That is, below an index of 3.125, most producers would consider rbST to be infeasible. Applying this index to California data using the average monthly milk price and the average feed costs, from 1994 – 2000, results are shown in Figure 2.

FIGURE 2



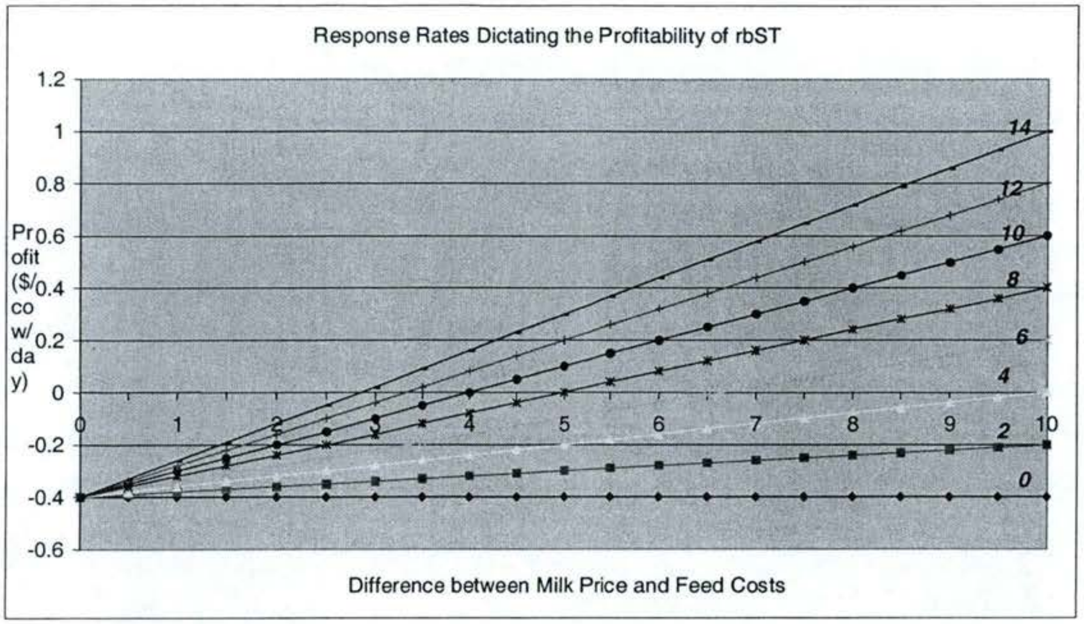
Of the 84 months from January 1994 to December 2000, rbST was feasible only 43 months, or 51% of the time. rbST does not appear to be very feasible for most of 1994 and 1995, most of 1997, and about half of 2000. A number of studies are finding that while rbST is an effective technology for increasing milk production, it is not clear whether there is any significant increase in profitability from using rbST (Tauer and Knoblauch, 1997; Stephanides and Tauer, 1999; Tauer, 2000; Folz, 1999; Butler, 1999). The early unfeasibility of rbST may be a clue as to why this technology had such an apparent slow start. In addition, the large amount of time when rbST has not been very feasible may also explain why some studies have concluded that that there is no significant increase in profitability from using rbST.

Milk Prices, Feed Costs and Response Rate

From Equation 2, it is clear that the profitability of rbST is dependent on just two variables: D, the difference between milk prices and feed costs, and RR, the response rate to rbST. We already know the cost of rbST, so it becomes a constant. This rule is immutable. That is, regardless of the milk price or feed costs, the level of profitability of rbST is always determined by the difference between them, and the relevant response rate.

Using equation 2, we can calculate the various levels of profitability of rbST. These are shown in figure 3.

FIGURE 3



In figure 3, profit in $ per cow per day is measured along the vertical axis, while D, the difference between milk price and feed costs is measured along the horizontal axis. The numbers along the right hand side of the figure correspond to the response rates from 0 to 14 pounds of milk per cow per day. Any response rate below 5 lbs. per cow per day is obviously not going to very profitable for dairy producers using rbST. At 5 lbs. per cow per day, the difference between milk price and feed costs must be $8 per cwt. or more. That means milk prices must be quite high to make rbST profitable. Even at 6 lbs. per cow per day, the difference between milk price and feed costs must be $6.50 per cwt. or more. At a response rate of 8lbs. per cow per day, or more, the difference between milk price and feed costs at $5 per cwt. promises a much better profit picture for users of rbST.

The above simple "rule of thumb" to ensure that rbST treatment is profitable assumes that producers know the actual response rate to rbST, actually adjust the feeding regimen to ensure that the cows get sufficient feed to produce the extra milk, and that the difference between the milk price and feed costs is sufficient to ensure that rbST is actually profitable.

Dairy producers, like many in agriculture, operate in a fairly risky environment. Producers who use rbST work in a relatively uncertain environment. There are currently at least four major uncertainties associated with the adoption and use of rbST. These are:

a. Response Rates to rbST treatment
b. Milk Prices
c. Feed Costs
d. Monitoring of actual costs and returns to rbST

Dairy producers who adopt rbST must first assume a certain level of response to the treatment. The assumed response rate will then dictate the additional feed that is required to ensure that the cows actually produce the additional milk after treatment with rbST. Rather than adjusting the feed regimen every day, or week or month, it is likely that a producer will simply assume a certain response rate to rbST and ensure that the extra feed is available to the treated cows. This changes the profitability calculation that must be made. Recall that the *additional* net revenues or profits from using rbST are as follows:

$$NR = (MP * RR) - cbST - (FC * RR) \quad (1)$$

Where: NR = net revenues or profit from using rbST
MP = milk price or mailbox price in \$/cwt.
RR = response rate in lbs./cow/day
cbST = cost of rbST = \$0.50/cow/day.
FC = feed costs in \$/cwt. of milk produced.

Now however, it is assumed that the dairy producer does not adjust the feeding regimen according to the actual response rate, but simply feeds to an *expected* response rate. Thus, our equation for *additional* net revenues or profits from using rbST is as follows:

$$NR = (MP * RR) - cbST - FC \quad (4)$$

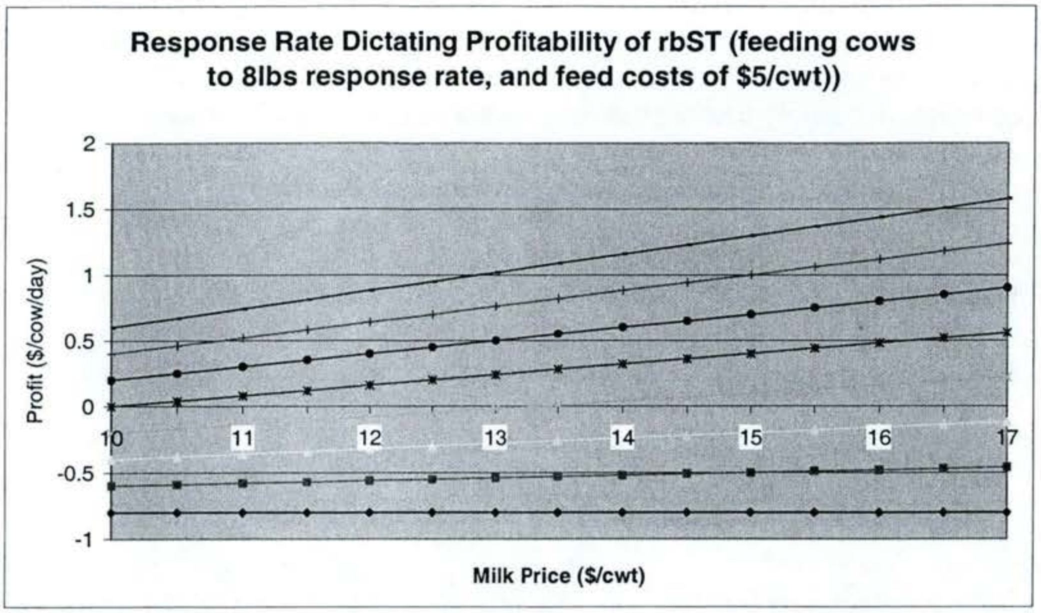
where the variables are the same as above.

The new rule shown in equation 4 makes it slightly more difficult to neatly summarize the expected net revenues or profitability from using rbST because now profitability is determined by 3 variables: milk price, feed costs and response rate, each of which can vary innumerable times. Calculated profitability rates are shown in figure 4 assuming that producers feed to an *expected* response rate of 8 lbs. per cow per day and feed costs are \$5 per cwt.

In figure 4, profitability is once again measured on the vertical axis, while milk price is measured on the horizontal axis. With feed costs at \$5 per cwt., a response rate of 5 lbs. per cow per day would again appear to be a minimum response rate for most producers since milk prices would have to exceed \$16 per cwt. for rbST to be profitable. And once again, a response rate of 8lbs. per cow per day would appear to be a minimum desirable response rate to ensure that rbST generated a profit. Clearly if feed costs are higher than \$5 per cwt. then milk prices or response rates would have to be correspondingly higher.

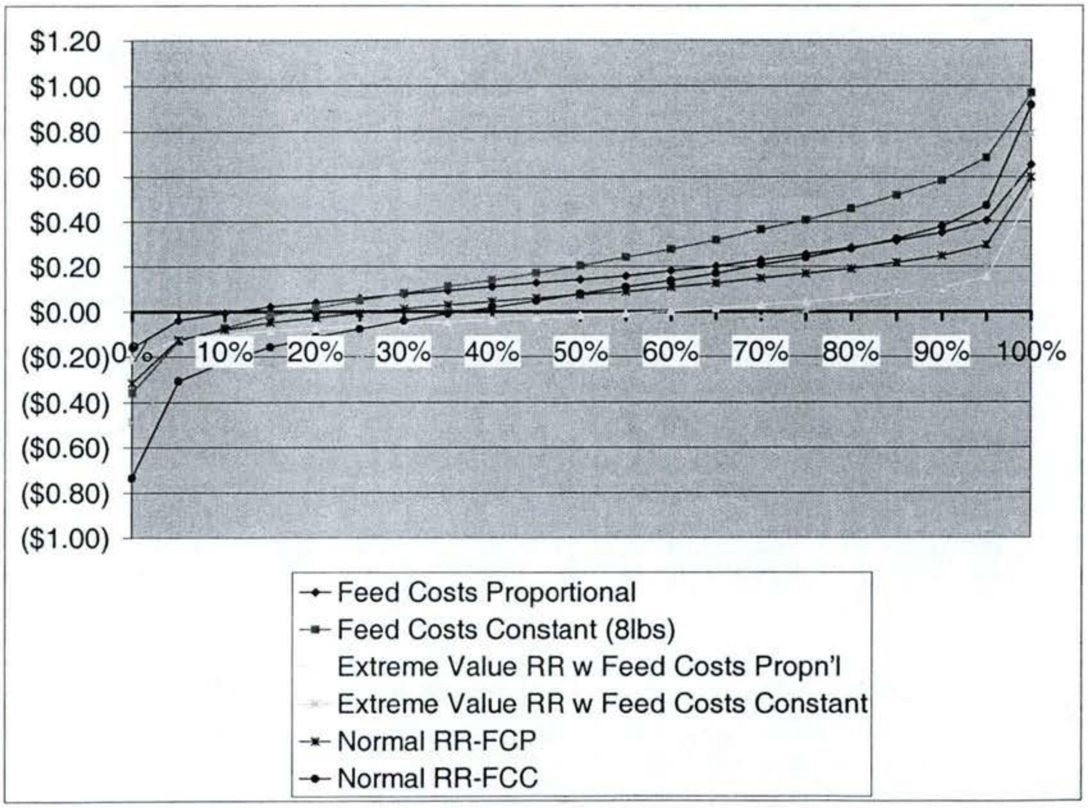
In order to account for the fact that response rates, as well as milk prices and feed costs, are uncertain and risky variables, and to allow a better evaluation of equation 4, we designed a simulation of the profitability of rbST. Using a simulation program called Crystal Ball™, a simple program was established that allows milk prices, feed costs and response rates to vary according to known distributions of each variable. Each simulation

FIGURE 4



was run over 2000 iterations and the resulting percentiles of profit per cow per day were plotted. These are shown in Figure 5.

FIGURE 5



In figure 5, the profitability of rbST is plotted on the vertical axis while the percentile of net profit per cow per day is plotted on the horizontal axis. As can be seen, depending on the assumed distribution of response rates the relative profitability of rbST can be seen to vary over a wide range.

The idea of the exercise is to determine whether or not producers are more at risk if they adjust feed costs regularly in proportion to the actual response rate they get from rbST, or whether they are better off simply feeding to an *expected* response rate. In each case, the *expected* response rate is set to 8lbs. per cow per day, but feed costs and milk prices are allowed to vary according to their known probability distribution.