rBST Adoption in the United States:

A Retrospective Look at a "Juggernaut" Agricultural Biotechnology

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Executive Summary

The rBST controversy was arguably the most intense recent public debate about an emerging agricultural biotechnology. Eight years after its release, it is abundantly clear that rBST has fallen well short of being a juggernaut technology: nationally only 17% of the cows are treated with it, disadoption rates are substantial, and it has created at most a 3.5% increase in milk production. RBST adoption is size biased with larger farms more likely to adopt the technology, but that bias changes depending on the farm structure in each state.

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Ten years ago, a political firefight was raging in the United States over Monsanto's intent to market recombinant bovine somatotropin (rBST), a genetically engineered hormone that stimulates treated cows to produce more milk. The Food and Drug Administration was enmeshed in a several year review process that produced more documentation than any agricultural technology before or after. Congress was considering legislation that would ban or restrict rBST's release, and eventually did vote to delay rBST's commercial release by half a year until the Executive Branch provided a comprehensive assessment of the technology that sanctioned its introduction (U.S. Government). State legislatures around the country were debating labeling laws that would require milk products to identify whether they came from cows treated with rBST, and Vermont, Wisconsin, and Maine actually passed them, though Wisconsin's was strictly voluntary. Elsewhere (e.g., California), some state agencies tacitly encouraged bottlers and processors to identify products as coming from cows not treated with rBST.

The rBST controversy was arguably the most intense public debate that has ever occurred in the United States about an emerging agricultural technology. Although the battle was bigger than it might have been if that particular agricultural biotechnology had been trotted out after some of the genetically modified crops that were also under development, the opposition was broad and deep in its commitment to block the commercial release of rBST. The breadth came from coalitions that formed at various levels among farmers (especially from populist farm organizations and certain regions of the country), environmental and consumer organizations, and animal welfare activists. The depth came from the intensity of their opposition to this "juggernaut" technology and its anticipated effects on family farms, consumers, the environment, and animal health. And, a large proportion of the debate hinged on what would happen to family farms if rBST were introduced. Ironically, even the very academic positions held by the authors of this paper are a historical product of that era, when the Wisconsin State Legislature created an institute at the University of Wisconsin to address the implications of rBST and other emerging technologies on family farms.

At the core of the debate was the view held by both proponents and opponents that rBST would be very widely adopted, especially by larger dairy farms, because of its highly touted productivity gains, on the order of 20% or more for treated cows. Opponents

then argued that the ensuing expansion of milk production, especially in a broader context of declining federal milk price support programs, would result in disastrous declines in dairy prices and hence ruinous competition for dairy farmers, lots of surplus cheese and butter, and unnecessarily large government payments. Small and moderate-sized family farms were thought likely to be the hardest hit, both because they would be less likely to adopt rBST and they would be more vulnerable to falling prices.

Underlying this dismal picture were several assumptions: high rBST adoption rates, major increases in milk productivity, and a size-biased technology adoption process. A few analysts at the time, such as Larson and Kuchler, warned that rBST adoption could be much less profitable than anticipated, but opponents and proponents, including Monsanto, each had their reasons for sustaining the juggernaut idea, the former to strengthen their dire forecasts and the latter to boost early sales and rapid adoption of the product. Thus, the political debate rarely engaged the possibility that rBST might not be much more than a relatively minor addition to the technology options available to dairy farmers. But, ten years later that is essentially what the research finds.

One often overlooked aspect of the long rBST controversy is that it has served effectively as a huge barrier to entry for all potential competitors to Monsanto. Indeed in the 1980s, several companies including Monsanto, Eli-Lilly, Upjohn, and American Cynamid were working on a form of rBST for the market. Given the tremendous costs that Monsanto incurred to secure FDA approval, no other competitor has attempted to enter. Thus, despite their being a number of potential other sellers of the technology, Monsanto's Posilac™ is currently the only form of rBST on the market.

Not the Juggernaut

Eight years after the release of Posilac™ it is abundantly clear that rBST has fallen well short of being a juggernaut technology. According to Monsanto, in 2002, rBST is used on about 15-17% of the nation's dairy farms. But, farm level numbers understate the actual use of rBST, because they do not account for the size of farms where rBST is adopted. Figure 1 uses data obtained from Monsanto to show rBST's adoption path in terms of the percent of the cows nationally that are on farms where rBST is being used. The initial figure in 1994 was 14%, which doubled by 1997 to 29%. But, over the next five years, rBST adoption growth slowed considerably so that in 2001, 35% of the nation's cows were on farms using rBST.

This level of adoption gives rise to rather moderate estimates of its impact on national milk production. Given that, on average, 50% of the herd is treated with rBST, that means that about 17% of the nation's dairy cows are being injected with rBST. Even with a liberal assumption of 20% production response, that is only a 3.5% boost in total milk production associated with rBST use. That increase is equivalent to a bit more than two years of the secular trend in milk productivity growth over the past two decades associated with other improvements in genetics, nutrition, and management practices. Simply put, these adoption figures are not ones of a juggernaut technology. They are more akin to the kind of

adoption path one might expect for a dairy technology that was only profitable for a relatively small portion of the farmers.

State samples of rBST adoption: What is holding back rBST adoption?

Farm-level adoption and disadoption rates are reported in Figure 2 for samples that were undertaken in different states as part of a USDA regional study of structural change in dairy farming and its impacts on local communities. What is most striking about this figure is that in those the states for which data were gathered on disadoption of rBST, between one-quarter and forty percent of those who have tried rBST no longer use it. In other words, disadoption has been extensive. Moreover, as reported in Barham, Foltz, Moon, and Jackson-Smith, the disadopters look very much like the adopters in terms of farm size and technology use, and they are quite distinct from the non-adopters along those same criteria.

Part of the explanation for this high level of disadoption is likely to be the profits associated with use of the technology. While rBST was shown to be profitable in experiment station trials, simulations, and in the literature distributed by Monsanto, on-farm studies of rBST profitability have not found that farms that use rBST are more profitable than those that do not (Stefanides and Tauer). This modest profitability impact of rBST then appears to be reflected in the relatively high levels of disadoption of rBST. One possibility is that many more of these farmers might have stuck with rBST if it were priced competitively as might have happened had other potential producers of this technology not been dissuaded by the entry barriers associated with regulatory approval.

rBST Adoption Patterns are Size-Biased Within and Across the U.S.

Recent on-farm studies (using data from California, Connecticut, Idaho, Minnesota, New York, Wisconsin, Idaho, Utah, and Texas) show that both larger herd-size (or scale) and higher use of complementary (productivity-enhancing) technologies, such as herd records and improved feeding techniques, strongly increase the likelihood that farmers will try rBST on their herds. In some states, younger and better-educated farmers are also more likely to adopt rBST, but these effects are not as prevalent or as significant as the herd size and complementary technology use factors.

The size bias in rBST adoption is illustrated across different states in Figure 3, which shows the predicted probability of rBST adoption as a function of herd size for data from a number of states. While most of the curves show a strong positive relationship between herd size and probability of adoption, the more extreme degree of size bias occurs in those states, such as Wisconsin, New York, and Connecticut, with smaller average farm sizes whose curves rise more rapidly and to higher levels. Nonetheless, the fact that a significant size bias in rBST adoption is evident across states with quite disparate average herd sizes means that the herd size bias is relative and not absolute. In other words, in Wisconsin where the average herd has about 60 cows, the probability of adoption rises to 50% for farms with 250 cows and to nearly 100% with farms of 500 cows. Meanwhile, in Utah, where the average herd size is about 250,

a 250-cow farm has only a 25% predicted probability of adopting rBST, and a 500 cow farm has only a 50% probability.

This evidence confirms the idea that larger farms are more likely to adopt rBST, but presents the puzzle that what is a "larger farm" is determined relative to other farms in the state, not to some absolute size across states. This puzzle can probably best be explained by the different organization of production across states. It could be that farms that have specialized their labor tasks are more likely to adopt rBST, because such specialization may be critical for managing the herd in a way that makes rBST use profitable. For example, it may be that due to less effort being spent on cropping, nutrient management, and certain types of animal care, a non-specialized family labor farm in the West or South would have, on average, 400 cows while in the Upper Midwest and Northeast a fully integrated, non-specialized livestock and crop cultivation operation might have 75 cows. By contrast, operations that specialized over the different ranges of tasks across those two states might have, on average, 800 and 150 cows, respectively.

What Does This All Mean?

Nearly a decade later, we can say the following things about rBST adoption in the United States. It has not been the juggernaut technology that contending sides imagined it might be. Indeed, its adoption has been limited to a relatively small proportion of the nation's farmers (15%) and to a significant minority but not a majority (35%) of the nation's cows. The overall impact of rBST on milk production levels has been the functional equivalent of two years of secular growth trends in milk productivity associated with other improvements in herd management, genetics, and feeding practices. As such, it would be hard to argue that it has played much of a role in shaping the structure of dairy farming in the U.S.

Moderate rBST adoption rates can be explained in part by the fact that a sizable proportion of farmers who have tried rBST have since decided to stop using it. While some might argue that these disadopters could adopt again, interviews with Wisconsin farmers suggest that disadopters are not inclined to return to the technology. And, econometric studies from elsewhere underscore this view by finding no significant impacts of rBST adoption on dairy farm profitability. The slowing down of rBST adoption in the U.S. can also be explained by the significant differences between adopters and non-adopters of rBST in terms of herd size and complementary technology use.

rBST appears to be a technology that has a place especially on larger farms that have already invested in complementary productivity-enhancing technologies. But, rBST adoption also seems unlikely to grow much in the years ahead without major changes in the price of the technology, the structure of dairy farming, or the price of milk that attract back disadopters and make adoption attractive for those that have not yet adopted rBST. It seems safe to say now that rBST will be remembered in the historical annals of agricultural biotechnologies as the juggernaut that was not.

For Your Information:

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Stefanides, Z. and L. Tauer. "The Empirical Impact of Bovine Somatotropin on a Group of New York Dairy Farms." *Amer. J. Ag. Econ*. 81 (February 1999): 95-102.

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Figure 1.
Percentage of Cows Nationally in Herds Treated with rBST (1994-2001)

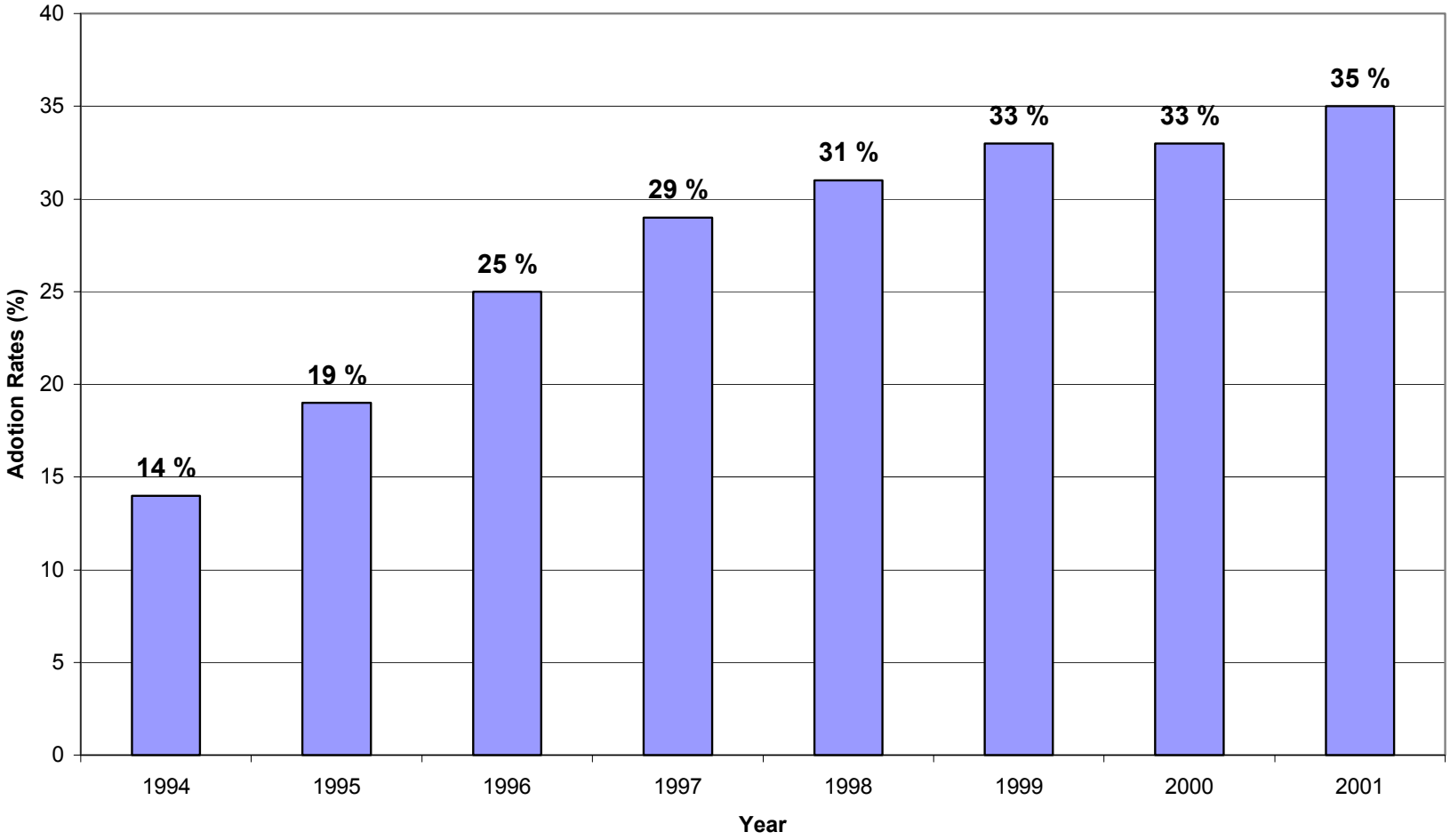
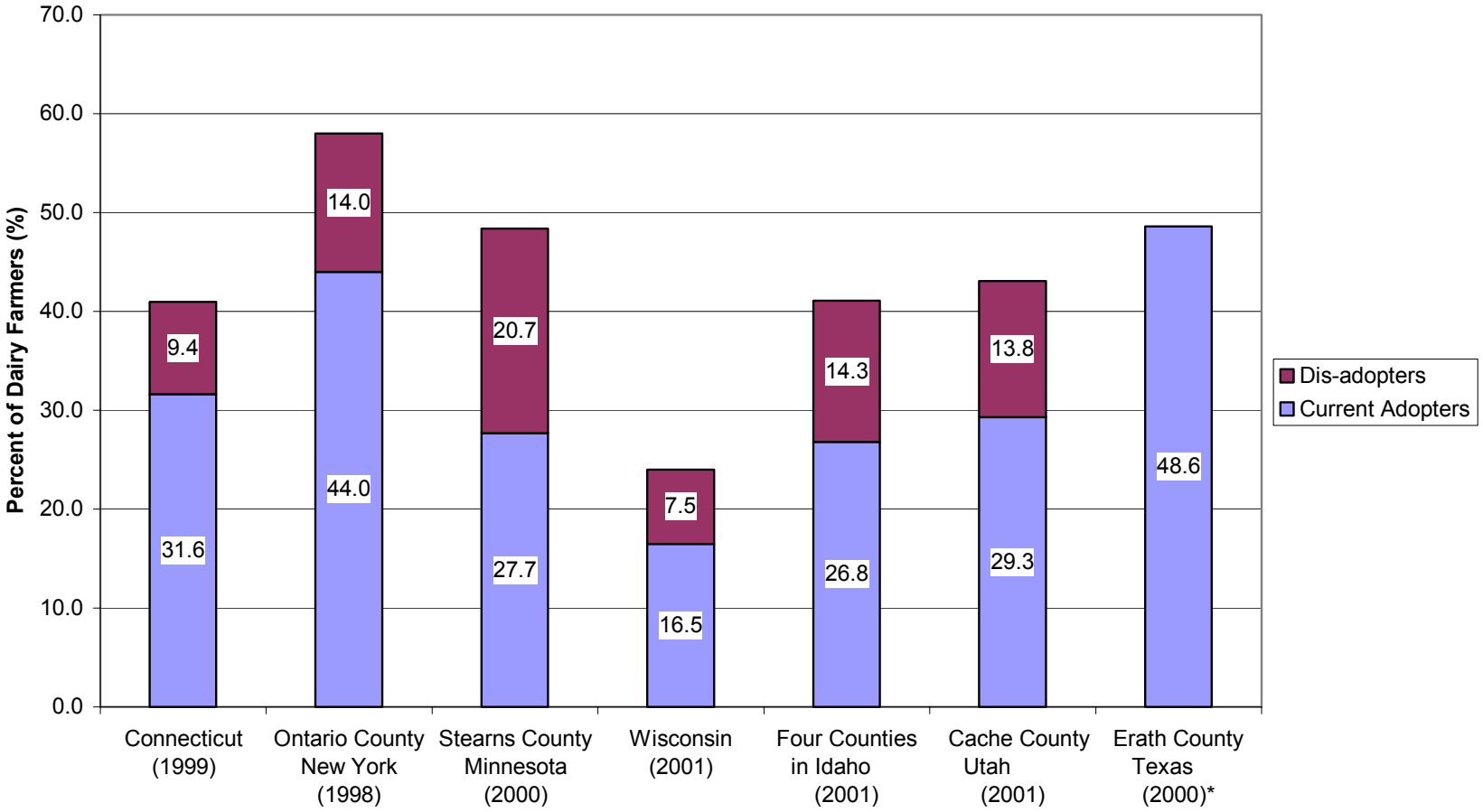


Figure 2.
Adoption & Dis-adoptions of rBST by State Sample



* Dis-adoption rates are not available in Texas.

Figure 3
Predicted Probability of Adopting rBST by Herd Size