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Technology choice and the economic effects of a ban on the use of antimicrobial feed additives in swine rations

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Abstract

The use of antimicrobial feed additives (AFAs) in animal rations has come under review recently in Europe and the US. A recent evaluation of the economic impact of a ban on AFAs on the US pork industry suggests that on average changes in productivity and fixed costs would result in increased costs and prices as producers adjust to the new regulation. These effects will vary among producers. Producers with high quality management and modern buildings would experience smaller costs from a ban. Also, new marketing technologies that support traceback of product to producers and additional compensation for pork produced without AFAs allow producers to capture price premiums to compensate for higher costs resulting from reduced use of AFAs. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Introduction

The US pork industry routinely adds antibiotics to rations of weaned pigs both to prevent illness before symptoms emerge and to increase growth rates. US pork producers are currently permitted to use 29 over the counter antibiotics and chemotherapeutics in feed (NRC, 1999, Tables 2–6 & 2–7). Of these, five are listed and only as growth promotants (bambermycin, efrotomycin, oleandomycin, penicillin, and virginiamycin) while 7 are listed both for growth promotion and "various infections" and 17 only for infections. Recommended concentrations in feed vary greatly as well as withdrawal times. These products improve feed conversions and rate of gain, and they reduce morbidity and mortality in growing pigs (Cromwell, 1991; Hayes, 1981). They also are said to increase sow productivity and reduce the incidence of mastitis and agalactia (Cromwell, 1991). Recent survey evidence indicates that their use is relatively widespread in hog production. For 1995, 92.7% of all grower/finisher pigs received antibiotics in feed (USDA APHIS, 1996). Antibiotic drugs are currently used in 90% of starter feeds, 75% of grower feeds, more than 50% of finishing feeds and at least 20% of sow feeds in the US (Dewey, Cox, Straw, Bush, & Hurd, 1999, reporting data from NAHMS).

The use of antimicrobial feed additives (AFAs) has come under review due to concerns that antibiotic resistance developed in food animals might be transferred to humans; for example, see CAST (1981), EC (1999), Institute of Medicine (1989), NRC (1980), NRC (1999) Swann (1969), SOU (1997) and WHO (1997). European and US scientists disagree about their use, with scientists in Europe tending to favor a ban and scientists in the US tending to oppose such a measure. However, there are also strongly opposing opinions on both sides of the Atlantic, which demonstrates a continued intense debate about the antibiotics issue.

The US and Europe have approached the safety and health issue of AFAs differently. Although the practice is under scrutiny by federal regulators, restrictions in the US are likely to depend on scientific evidence showing a link between feed use of antibiotics and antibiotic resistance in humans. The European community uses an alternative to scientific research known as the precautionary principle. This alternative allows regulators to restrict food industries so long as there is a possibility that harm might emerge. As a result, the European Union (EU) is in the process of restricting use of subtherapeutic antimicrobials used as feed additives (growth promoters) (EC, 1999). Current EU regulations

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state that antimicrobials used in either human or in veterinary therapeutic medicine are prohibited from use as feed-additive growth promoters in livestock (Hayes, 1999). Sweden implemented a ban on over-the-counter feed antibiotics in 1986. Similar bans were enacted in Norway in 1992, in Finland in 1996 for grower-finishing hogs, in Denmark in 1998, and in Poland and Switzerland in 1999 (Backstrom, 1999).

There is some evidence that US consumer concerns about antibiotic-free pork (and meats) are increasing. In a national survey of *Better Homes and Gardens* (2000) subscribers, 20.3% of respondents chose antibiotics-free pork when asked which type of pork they would likely purchase assuming similar price. This rate was higher than for pork produced using animal-friendly (welfare-friendly and free-range pork) systems at 18.3%, and for pork produced using environment-friendly (organic and sustainable pork) systems at 16.9%. In the same survey, respondents indicated a willingness-to-pay of \$0.10–\$0.25 per pound for pork produced using animal-friendly and environment-friendly production systems.

In this paper we summarize recent research designed to evaluate the impact of a ban on AFAs on the US pork industry (see Hayes, Jensen, Backstrom, & Fabiosa, 1999). As we conducted this research, we became aware of the ways in which the presence and use of alternative technologies so profoundly influenced the results. The purpose of this paper is to explain and explore the ways in which one set of technologies might allow a market-based alternative to a ban, and how a second set of technologies might allow some producers to profitably avoid the use of subtherapeutic antibiotics.

2. Sweden's experience

Sweden banned over-the-counter feed antibiotics in 1986. The ban was supported by both consumer groups as well as by many farmers who had grown increasingly skeptical towards the use of AFAs. The Swedish agricultural trade union, the Federation of Swedish Farmers (LRF), asked for a voluntary ban on such antibiotics in 1985 (Stahle, 1997), which was made law in 1986. At the same time, veterinarians' rights to prescribe preventive and therapeutic medications remained intact. At the time of the ban on AFAs, the Swedish pork market was heavily regulated. Shortly following this ban, a new animal welfare law was implemented in 1988. The net increase of consumer costs was estimated to be about \$0.12 ± 0.06/kg retail meat (SEK 8.10/US \$), half of which was due to the antibiotics ban and half to animal welfare legislation (Jonasson & Andersson, 1996; Stahle, 1998).

Following the ban, there was a reduction of total use of antibiotics. By 1998, the tonnage (including "potency factors") of animal antibiotics in Sweden was only 30% of the tonnage of active substance used in 1984 (Greko, 1999). The Swedish experience showed that there was an increase in post-weaning diarrheas and hence in post-weaning piglet mortality following the withdrawal of the subtherapeutics antibiotics in feed. In addition, changes in feed efficiency led to longer times for feeder pigs and finisher pigs to gain weight. The impact of the ban was smallest in farms that followed good hygiene practices, and almost all of the farmers who survived the initial problems switched to some form of all-in–all-out nursery batch production. Farmers also changed feed mixtures to reduce the chance of diarrheas in the young pigs.

3. Likely effects of a ban in the US

Although the Swedish conditions differ from those in the US in many respects, the Swedish experience with banning antibiotics in feed provides a useful foundation to understanding the possible effects of a ban in the US. In our earlier work, results from the Swedish experience, along with known technical parameters, practices used in the US, and other expert opinion were used to estimate the likely effects of a ban of AFAs in swine rations in the US (Hayes et al., 1999). These results were compared with the base case, or results with no change in AFA use.

Based on information gathered during a visit to Sweden and Denmark, and from other sources, we assumed that a ban would increase mortality and decrease feed efficiency. The age at weaning would increase by one week because the US practice of early weaning (2–3 weeks) is dependent on antibiotics in the starter feed and a ban would likely require a delay in the age of weaning. The number of days in the period of weaning to feeder pig (for pigs up to 50 pounds) would increase by five days, and the feed efficiency for the feeding and finishing stages would decline by 1.5%. Post-weaning mortality would increase by 1.5 percentage points, and mortality for fattening-finishing pigs would increase by 0.04%. There would be some changes in productivity of the sows, and we assumed that piglets per sow would decline by approximately one per year (4.82%) due to the increased age at weaning. Veterinary and therapeutic costs, net after the deduction of the cost for feed additives, would increase by \$0.25 per pig.

Changes in fixed costs would be required for additional space for the nursery and finishing periods because of the additional time after weaning. Also, we assumed that restricted feeding would be needed in order to reduce nutritional stress. It is important to mention that Swedish and Danish experts do not link restricted feeding to the ban on AFAs; the Europeans have used restricted feeding for other reasons. The assumptions of the need for additional space (for \$1.12

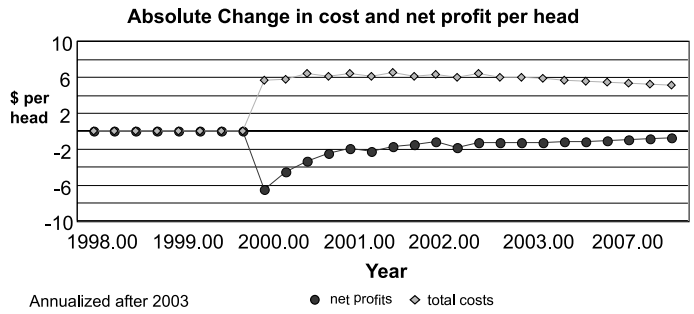

Fig. 1. Projected change in costs and net profit per head over time.

billion) and investment in facilities for restricted feeding (for $300 million) imply a total cost for required changed space of about $1.42 billion (Hayes et al., 1999). The fixed costs were depreciated over 10 years.

By using input price data, behavioral parameters, and the technological changes, our model allows us to simulate the expected changes over a 10-year period following the implementation of a ban. Fig. 1 summarizes the results for costs and profit over a 10-year period. Under "most likely" assumptions, costs would increase initially due to increased variable costs and fixed costs. Costs per head increase by $6.05 in the first year and by $5.24 per head at the end of the projection period. Over time, farmers adjust to higher feed costs and the changes in sow productivity and pig mortality. Producers cut back on production and reduce sow inventories. As a result of smaller supplies, the retail price equilibrium increases by 2.21%. The higher prices allow farmers to cover more of their costs. The combined effect of higher prices, smaller supplies, and higher costs leads to reduced losses. The decline in net profit per head of $4.17 in the first year reaches a shortfall in net profit of $0.79 per head at the end of the projection period, or slightly lower than $0.01 per pound of pork. The estimated retail price increases $0.052 cents per pound.

4. Impact of management and production technologies on the results

As we stated in our earlier paper (Hayes et al., 1999) the results were based on technical assumptions from the Swedish experience and should be viewed with caution. Also, the results are ascribed to an "average" producer and hence mask wide differences that exist across farms. The experience in Sweden indicated that the better managed farms, with tighter management control (e.g., all-in–all-out production for farms with continuous production systems), fared better. We would expect the same results to occur in the US. Because high-quality management and modern buildings are partial substitutes for antibiotics, a ban would have a disproportionate impact on producers with below-average management skills and with older buildings. Some large-scale US operations operate using all-in–all-out three-site production. Pigs are moved together in large groups and are never co-mingled. This system requires enormous numbers of sows on one site so that the weekly batches of weaned pigs are large enough to fill modern finishing houses and nurseries. This production system is not common in Sweden because the presence of so many sows under single ownership is not common or politically acceptable. [1] Company research from one of the large US producers (Stoeker, 1999) suggests that the net benefit from the use of AFAs is only $0.25 per animal. This value is much smaller than that found in Sweden and than our estimated impact on the average US producer. In other words, a ban in the US market would have a much more severe impact on operations that do not use all-in–all-out three-site production mechanisms. These producers would therefore be the ones forced to make the most adjustment to adapt to a ban.

5. Impact of marketing technologies on the results

One of the difficulties associated with the use of the Swedish experience to project US impacts is that the structure of the Swedish pork industry is very different from that in the US. Swedish pork producers control most of the packing sector and through their union could negotiate with both the government and with consumer groups. One outcome of this structure is that the Swedish producers and consumers could (and did) negotiate a compensation for pork producers to offset the additional expense associated with the ban. Our work on the impact of the ban in the US suggests that although consumers do eventually pay for the additional cost, this pass-through would take several years and

[1] Some attempts have been made in Sweden to operate sow pools wherein several smaller sow herds coordinated their activities to accomplish some of the technical advances of the larger three-site US operations. However, at the time of our visit these herds had not eliminated all of the health problems associated with the co-mingling of young pigs.

would occur only because some producers would reduce production or would be forced out of business. In other words, the compensation that occurred in Sweden would not be possible under the perfectly competitive system that characterizes the US market.

Paradoxically, the unusual structure of the Swedish market also allowed the development of a technology that may provide a market-based solution that could solve the problem in the US. This technology allows the pork consumer to key in a set of digits found on the retail pack and use the World Wide Web to trace the pork back to a page showing a picture of the producer and specifics on how the pork was raised. See, for example, http://www.healthy-tasty.com/. The technology involves record keeping on individual animals and on a slaughtering system that keeps meat cuts from each animal together rather than collecting the same cut from numerous animals, as occurs in the US. The Swedish "trace" technology is not currently available in the US, but recent analysis suggests that US consumers would be willing to pay as much as $0.40 per pound for the assurances and product characteristics such a technology would bring. See Hayenga et al. (2000).

The technology was introduced in Sweden because costs associated with development could be passed on to consumers. After Sweden joined the EU it agreed to allow pork in from other EU members, and Swedish farmers found that they could use the trace mechanism to retain market share within Sweden and to capture a price premium in the UK market. The system has recently been mandated in other EU countries (where it is called traceback), and these farmers have also begun to create branded identity-preserved products. See, for example, http://www.tasteofthewest.co.uk/meat.htm.

The evidence we obtained from our study of a ban on AFAs did not explicitly address consumers' willingness-to-pay for pork produced without the use of AFAs. To date, the (niche) market in the US is small. And, along with other conservative assumptions, the model did not account for a change in consumer preferences. Consumer preferences in the US may change. And, very importantly, consumer response may occur in export markets; US producers are very sensitive to changes in these markets. The trace (or traceback technology) has the potential to completely alter the structure of US and world pork markets.

The current commodity system that is used in the US and much of the rest of the world involves the co-mingling of meat from many farms with no attempt to link the producer with particular consumer demands. Under this system there is no premium for those producers who create a more attractive product, and there is no penalty for those who produce a substandard product. If the trace technology becomes widespread in the US, a market-based solution might emerge. Consumers who prefer and are willing to pay for attributes such as compliance with animal welfare rules or antibiotic use would simply buy the pork brand that offered these attributes.

If convincing evidence became available that suggested a link between subtherapeutic antibiotic use and antibiotic resistance, more consumers would chose pork from animals where these products were not used. Consumers would internalize the trade-off between cost and possible antibiotic resistance, and only those producers who could profitably switch to production mechanisms that did not require antibiotic use would do so. Under these circumstances, a government mandate would only be needed if there were additional external effects caused in the consumption of pork produced using AFAs. [2] Under such a market scheme, if some producers shifted to production methods that did not use AFAs, the larger three-site production units would provide most of the antibiotic-free pork and more traditional operations would produce pork using antibiotics in feed.

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[2] That is, if the evidence suggested that the antibiotic resistance acquired by one consumer via consumption of pork products could be passed on to other consumers via cross-infections.

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