ECONOMIC CONSEQUENCES OF A NITRITE BAN ON U.S. AND OHIO HOG FARMERS

(An Analysis For Extension Audiences)

E. Dean Baldwin and Bobby D. Van Stavern*

Because of potential health hazards, the USDA may ban nitrite use in the meat processing industry. A nitrite ban without an alternative substitute may cause disequilibrium within the meat industry. Farmers and meat processors will substain increased costs as they transfer resources from one enterprise to another.

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Introduction

In a 1970 article appearing in Nature, Drs. William Lijinsky and Samuel Epstein called for a reduction or removal of nitrites from the diet [3]. These authors cited the possible reaction of nitrite with aminines to form nitrosamines as a potential human health hazard. In testimony before the Senate Subcommittee on Executive Reorganization and Government Research of the Committee on Government Operations, these and other scientists testified that nitrites could cause mutations and cancer in man. Other scientists have claimed that nitrites may cause headaches, changes in brain wages, and death.[1/]

Because of these accusations, the USDA may ban the use of nitrites in the processing of meats. USDA is concentrating its investigation on the bacon industry, which makes the widest use of sodium nitrite. Bacon manufacturers must demonstrate that the use of nitrites will not result in the formation of carcinogenic nitrosamines in any sample of bacon that is prepared for food. To date, heating bacon to 350 degrees results in 20 parts per billion of nitrosamines in some samples [6].

Problem

Nitrites were used initially to process meat and to prevent the formation of botulism spores, a deadly poison. Secondary effects of nitrites were

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1/ Notice of Proposed Rule Making - Nitrate, Nitrites and Salt - USDA Annual and Plant Health Inspection Service (9CFR Parts 318 and 381).

identified after the turn of the century. The red color of cured meat including bacon was found by Kisskalt to be formed in the presence of nitrite. Chemists and meat scientists determined that meat flavor changes were linked to nitrite oxide, which was formed from nitrite during the curing process.[2/] Research linking cancer in man to nitrites was initiated in the 1960's. During the last decade, the industry has participated with the FDA and USDA to define the nature and danger of nitrites and to determine substitutes which will reduce the cancer dangers to man.[3/]

Based on investigations by the meat industry, it is concluded that a real and viable alternative to nitrites is likely to be found, but it appears that the marketability of such a product is six to ten years in the future. The substitute product should maintain the color, texture, and taste of bacon and must prevent the growth of botulism spores. Salting, dessication, freezing, heating, irradiation, and chemical technologies do not meet the above requirement.

If a viable substitute is not available and nitrites are banned, bacon may disappear from the grocery shelves. Pork bellies which were used in the bacon curing process would be diverted as trimmings for sausage [6]. Unless consumers would directly substitute sausage for bacon, sausage prices and prices paid to farmers would decline and hog production would decrease. Since a third of the corn produced in the United States is fed to hogs, a prohibition on nitrites would be in the longer term decrease the demand for corn. Banning of nitrites will affect the economic activity and choices of consumers, retailers, wholesalers, processors, and producers.

2/ Notice of Proposed Rule Making - Ibid (9CFR, Parts 318 and 381).

3/ Statement by Dr. John Birdsall, Director of Scientific Activities, AM to Senate Small Business Committee, January 14, 1977.

Objectives and Methodology

To clarify the proposed loss for extension audiences, this paper specifies an economic and analytical framework for analyzing the impact of the ban on the U.S. and Ohio farm sectors. A theoretical analysis is used to explain the economic impact of the ban on U.S. and Ohio swine producers. Supply and demand elasticities and formulas are incorporated into the analysis to evaluate changes in farm prices, total revenues, and hog supplies [7]. The analysis also provides implications for consumers.

The following assumptions were specified:

1. Nitrites are banned and there are no viable substitutes.
2. Bacon disappears from the grocery shelf.
3. All pork bellies are processed into sausage.
4. The elimination of one pound of bacon increases the supply of sausage by 0.9 pounds.
5. The demand elasticity for pork products is -.75 [2].[4/]
6. The supply elasticity at the farm level is .4 [2].
7. Sausage and fresh pork products are not perfect substitutes for bacon. Thus consumers will consume more sausage and other pork products only at lower prices.
8. Pure competition exists at the farm level.

Theoretical Considerations

The price of live hogs is determined by supply and demand. Prior to the banning of nitrites, assume the market is in equilibrium at a price of $40/cwt. and a production level of Q (Figure 1B). Each firm is earning a normal profit at the point where the marginal cost (MC) and average cost (AC) curves intersect the average revenue (AR) and marginal revenue (MR) curves (Figure 1A).

4/ George, P.S., et. al., "Consumer Demand for Food Commodities in the United States With Projections for 1980," Giannini Foundation Monogram 26, pp. 46-51.

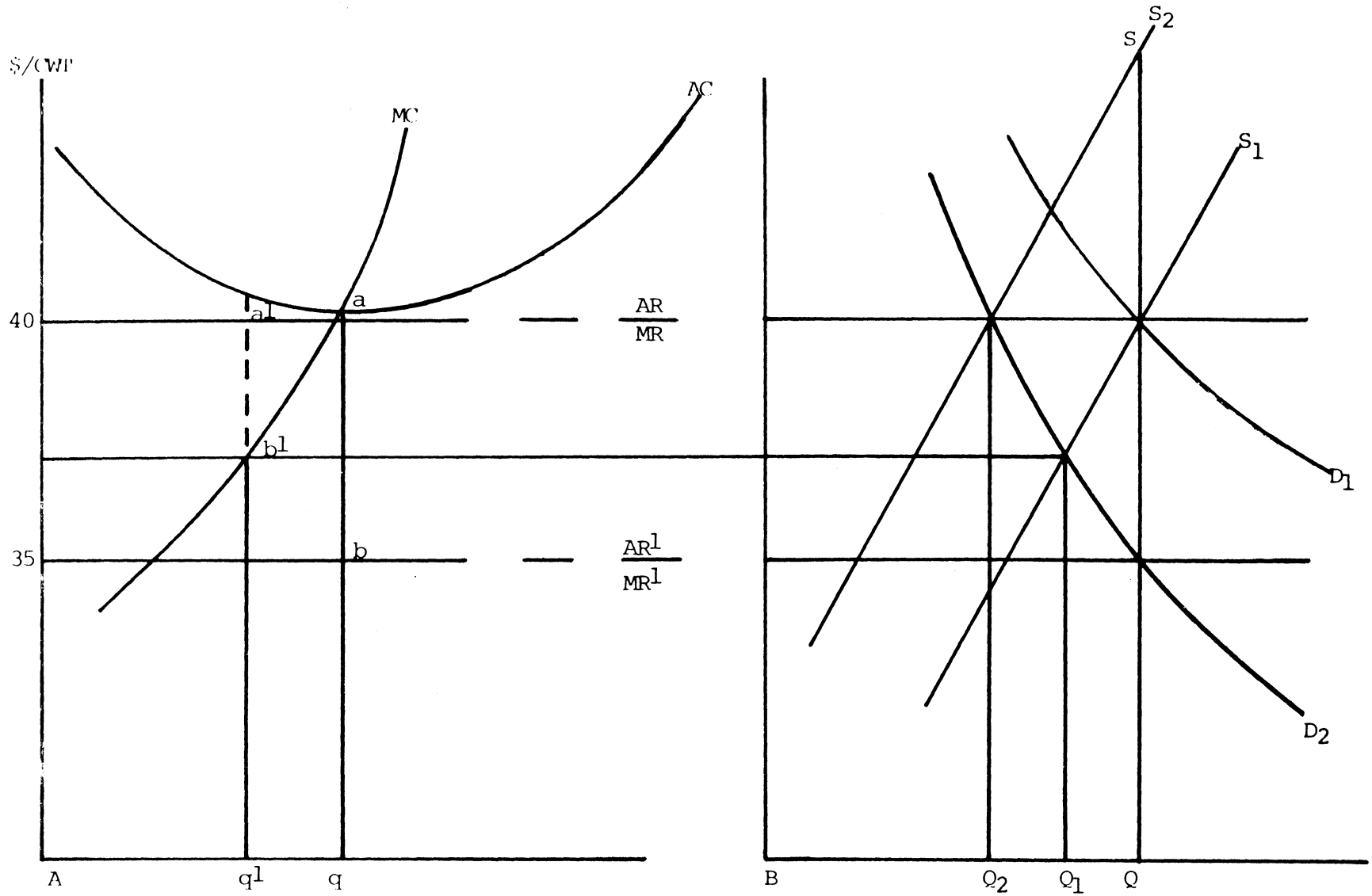

FIGURE 1. Equilibrium in Hog Market and at Firm After Nitrites are Banned From Bacon Process: Short and Long Term With Constant Costs

Markets and Short Run Effects

In the market period, the supply curve is perfectly inelastic and is represented as QS in Figure 1B. When the nitrite ban is instituted, the supply of trimmings increase and the price of pork bellies decrease. As a result the derived demand curve shifts from D_1 to D_2 (Figure 1B). A new market equilibrium would be established where D_2 intersects the supply curve QS. The market would establish a lower price, $35/cwt., and quantity Q would be traded in the market. Each firm would produce quantity q and would sustain a loss a-b (Figure 1A) or $5/cwt.

During the short run, firms will minimize costs by decreasing production. In this example, the firm will reduce production from q to q_1 (Figure 1A), resulting in a smaller supply of hogs in the market Q_1 (Figure 1B). This in turn results in a price between $40 and $35/cwt. Losses to each firm are reduced and now equal a^1-b^1.

The Long Term Constant Cost Effect

Because economic losses exist, a^1-b^1, firms will exit from the industry. This causes the supply curve to shift from S_1 to S_2 (Figure 1B). The long term adjustments continue until the firms are earning normal profits. Production decreases to Q_2, price increases to $40/cwt., each firm produces quantity q, total revenue earned from the hog industry declines, the number of hog firms decreases, demand for grain and other feed inputs declines.

The Long Term Changing Cost Effect

At the time firms exit from the industry, costs could begin to decrease, reflecting the decrease in the demand for feed grains and ingredients. In this case, the average cost (AC) and marginal cost (MC) curves would shift downward and to the right (Figure 2A). If the curves shifted to AC_2 and MC_2, a new equilibrium is established in the market. Farmers produce quantity q

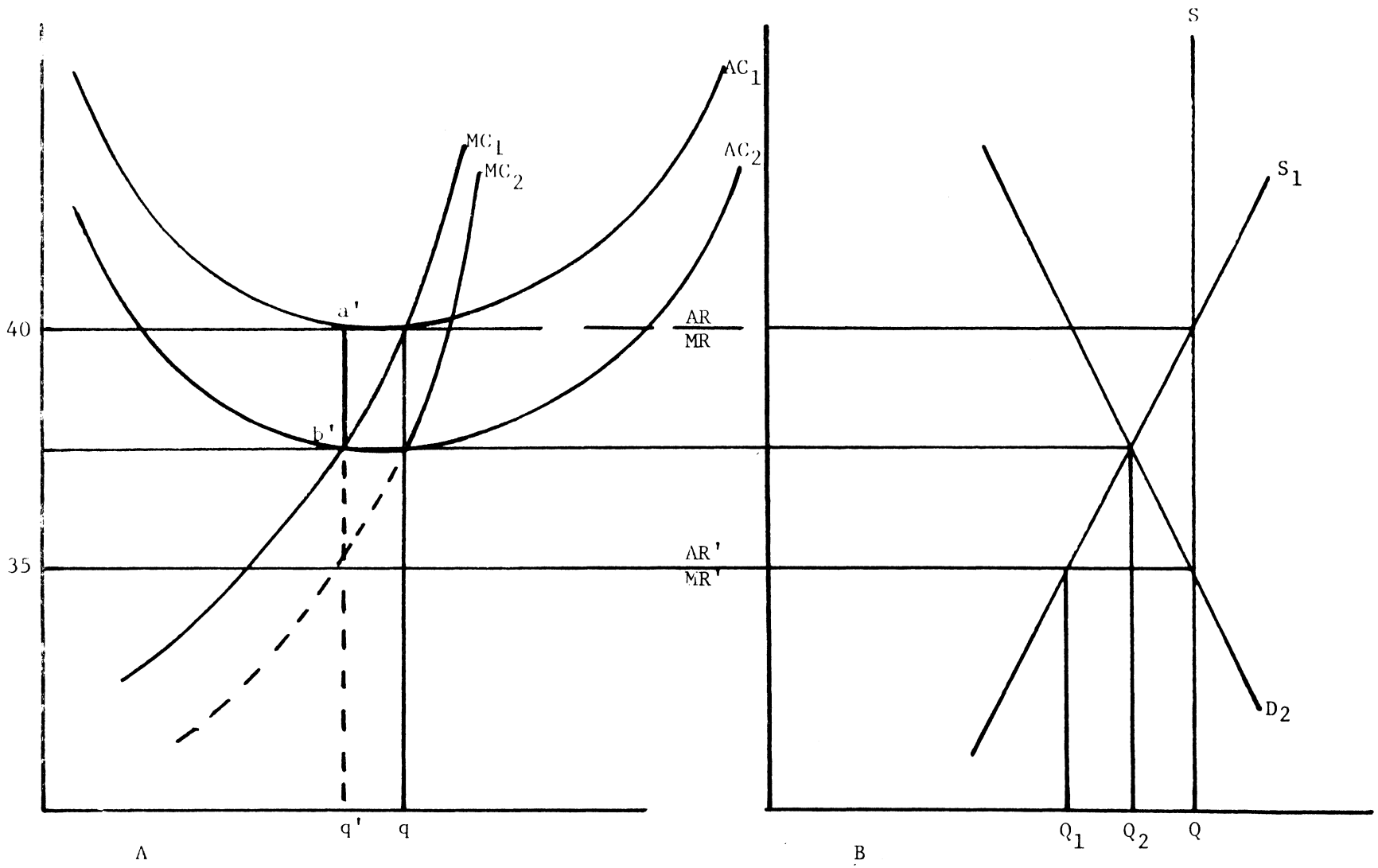

FIGURE 2. Equilibrium in hog market and at firm after nitrites are banned from bacon process: Short and long term with changing costs.

(Figure 2A) at a price between $35 and $50/cwt. Quantity Q_2 would be traded in the market (Figure 2B). Each firm would earn a normal profit. Costs, prices, number of hog firms, total supply of pork, and total revenues decrease. Demand for grain and other feed inputs decreases.

Empirical Results

Prior to the ban 1978, hog producers in the U.S. and in Ohio produced 19.5 billion and 950 million live-weight pounds of pork, respectively (Table 1).[5/] In the U.S., 4.8 billion pounds of sausage and 1.4 billion pounds of bacon are manufactured. Ohio farmers contribute 220 million pounds of sausage and 65 million pounds of bacon to the U.S. totals. Prices paid to farmers are expected to range between $38 and $42 for the year [1,4,5]. Based on this price, total revenues in the United States would equal $7.8 billion. In Ohio, total revenues would equal $380 million.

Effect of Ban in Market and Short Run Periods

Since farrow to finish is approximately six months, producers cannot change production during the first half of the year (market period). It is assumed that the short run constitutes an additional six months. In the second year of the ban, firms are permitted to exit from the industry, the long run.

During the market period, the supply of trimmings once used for bacon are diverted into sausage representing a 24 percent increase (Table 1). Assuming a demand elasticity of -.75[6/], the price of trimmings decline from $0.49/lb. [5] to $0.16. Because pork bellies represent 15% of the carcass weight, price paid to farmers decreases to $35/cwt. in the market period.

5/ Economic data derived from Livestock and Meat Statistics, Agricultural Statistics 1977 and Hadley [1,4,5]. Technical meat processing data from on going research, Dr. Bobby Van Stavern, Department of Animal Science, Ohio State University.

6/ The -.413 elasticity as estimated by George and King indicates a lower price for trimmings.

TABLE 1. Estimated Farm Value of Pork Production in United States and in Ohio 1978 (Base Estimates)

	U.S.[1]	Ohio
Pounds of Pork (live wt-mil. pounds)[1]	19500	950
Sausage (mil. pounds)	4850[3]	220[4]
Bacon (mil. pounds)	1370[3]	65[4]
Farm Value		
Dollars/cwt[2]	38-42	38-42
Mil. dollars (based on $40/cwt)	7800	380

[1] 1976 Data as reprinted in Livestock and Meat Statistics, Statistical Bulletin No. 522, USDA, June 1977, times an expected 12 percent increase (Hadley, Herbert, Economic Information for the Service Enterprise, Department of Agricultural Economics, Ohio State University, ESO 478, March 1978.

[2] Hadley, Herbert, Economic Information for the Service Enterprise, Department of Agricultural Economics, Ohio State University, ESO 478, March 1978.

[3] "Does not represent total production as a product may be inspected more than once," Agricultural Statistics 1977, USDA, 1977.

[4] Estimated based on national average times pounds of pork product in Ohio.

In the short run, there is a decrease in the quantity of hogs supplied, pork production decreases to 1.85 billion pounds in the U.S. and to 903 million in Ohio, a five percent decrease in supply of pork (Table 2). Based on a supply elasticity of .4, farm prices equalize at $37/cwt. Swine producers in the U.S. generate $6.7 billion of total revenue, a decrease of 14.5%. In Ohio, farmers generate $325 million of total revenue.

Effect of Ban in Long Run Constant Cost

Assuming the $35-$37/cwt. price creates a $35 cwt. loss for each hog producers, firms exit from the industry. To reestablish a $40/cwt. average marketing price, the demand elasticity of -.75 causes production to decline by ten percent to 17.6 billion pounds in the U.S. (Table 3). Ohio farmers produce 855 million pounds of pork. This indicates that as many as ten percent of the swine firms could exit from the industry. Because of the decrease in supply, swine producers in the U.S. forego $780 million in total revenue annually. In Ohio, total revenue decreases by $38 million annually, an annual ten percent decrease.

Conclusions and Implications

The benefits and costs associated with the nitrite policy ban are summarized in Table 4.

A nitrite ban without an alternative substitute or process creates many disequilibriums within the meat and livestock industries. The price of meat trimmings and prices paid to farmers vary. The supply of pork and total farm revenues from the swine enterprise decline. The analysis implies a decrease in demand for feed grains and other feed ingredients. Thus other enterprises within the farm sectors will be affected. The analysis also implies an adjustment in production and employment in the meat processing industry. Because bacon disappears from the grocery shelf, consumers lose some freedom of choice.

TABLE 2. Estimated Changes in Farm Value of Pork Production Assuming Nitrites are not Used to Process Bacon, United States and Ohio Market Period

	UNITED STATES			OHIO		
		Absolute Change From 1978 Base Year[1]	Percentage Change From 1978 Base Year[1]		Absolute Change From 1978 Base Year[1]	Percentage Change From 1978 Base Year[1]
Pounds of Pork						
Live weight (mil. of pounds)[2]	18525	975	-5	903	47	-5
Sausage (million of pounds)[3]	6022	+1172	+24	275	+55	+25
Bacon (million of pounds)[3]	0	-1370	-100	0	-65	-100
Farm Value						
Dollars/cwt.[4]	$35-37	-3 to 5	-7.5 to 12.5	35-37	-3 to 5	-7.5 to 12.5
Millions of dollars	6669	-1131	-14.5	325	-55	-14.5

[1]The absolute and percentage changes demand by taking difference from the estimates Table 1.

[2]1976 data as reported in Livestock and Meat Statistics, Statistical Bulletin No. 522, USDA, June 1977, times an expected 12 percent increase (Herbert Hadley, Economic Information For the Swine Enterprise, Department of Agricultural Economics, Ohio State University, ESO 478, March 1978).

[3]It is assumed that the all belly is processed into sausage products. With a conversion of .9.

[4]It was assumed that the elasticity of demand is -.75, Brandow, G. E., Interrelations Among Demands for Farm Products and Implementation for Control of Market Supply, The Pennsylvania State University, Bulletin 380, August 1961. It was assumed that each hog dressed at 26 pounds of belly, study completed by Dr. Bobby VanStavern, Department of Animal Science, Ohio State University, 1978, 10-12 pound bellies used for bacon roll for 63.4¢/lb. and 50% lean for sausage roll for 49¢/lb.

TABLE 3. Estimated Changes in Farm Value of Pork Production Assuming Nitrates are Not Used to Process Bacon and Farmers React to Price Change, United States and Ohio Long Term

	UNITED STATES			OHIO		
		Absolute[1] Change From	Percentage[1] Change		Absolute[1] Change	Percentage[1] Change
Pounds of Pork						
Live weight (mil. of pounds)[2]	17550	1950	10	855	95	10
Sausage (mil. pounds)	5475	+625	+12	250	+30	+13
Bacon (mil. pounds)	0	-1370	-100	0	-65	-100
Farm Value						
Dollars/cwt	40	0	0	40	0	0
Millions of dollars	7020	780	-10	342	-38	-10

[1]The absolute and percentage changes derived by taking difference from the estimates Table 1.

[2]Assuming a supply elasticity of .4 and a demand elasticity of .75, supply could decrease by 10 percent to reestablish an equality price of $40.00. If demand elasticity was less than .75, then supply would decrease even more.

TABLE 4. Summary of the Costs and Benefits from the Elimination of Nitrites in the Bacon Manufacturing Process

Costs	Benefits
1. Less total revenue from swine farms	1. Possible reduction in the risk of cancer
2. Possible depressed grain prices	2. Possible reduction in other diet-related diseases
3. Less choice for consumers at the meat counter	3. Possibly more grain to be processed into human foods
4. Loss of export markets for pork	4. Possible increases in grain exports
5. Possibly less employment in meat packing, distribution and retailing businesses	

Because the benefits of improved human health are invaluable and unmeasurable, society will continue to press for improved diets. Meat scientists and chemists must develop improved techniques for measuring the causal relationships between diet and human diseases. Since a nitrite ban is a possibility, and market disequilibrium will result, meat scientists should improve the accuracy of the nitrite measuring devices. In addition, alternative substitutes for nitrites should be developed as rapidly as possible.

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