Economics of Beef Production With and Without Implants

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ABSTRACT

This paper applies fall 1996 prices and cattle market conditions to implant responses to provide an economic value to various implant regimes. Suckling calf implants under current economic conditions return cattlemen about $10 for each $1.00 invested in the implant. Typically, stocker cattle with one implant return about $12 to 13 above the cost of the implant. Implanting feedlot steers once returns from $21 to $43 above the cost of the implant. Reimplanting steers increased the return above a single implant by $4 to $20. Implanting heifers once increased return from $17 to $22; reimplanting increasing return to as much as $40 above non-implanted animals. The increase in carcass weight associated with implants typically adds an additional $4.20 to the value of each animal due to a cost for slaughter and fabrication. Implants reduce beef's production cost by approximately 7 percent. If this amount of cost competitiveness were lost, beef's share of the meat market would fall from its current 31.9 percent to 29.8 percent. This would result in annual loss of roughly $1.4 billion in retail sales of beef. This reduction in sales would reduce the number of beef cows needed by about 1.2 million.

INTRODUCTION

Implants have been used in beef cattle production since the 1960's. Implants have the potential for increasing the market weight of steers 154 by pounds. (NRC 1996) This large increase has a sizable effect on both production economics on the total supply of beef. The first part of this paper will address the effect of implants on production economics. The second part will examine the effect of implants on the supply of beef, its market share and profitability of beef production.

PART 1

The effects of implants on the cost of beef production in the United States.

Implants improve both the rate and efficiency of gain in beef cattle. The value of any implant program is dependent on cattle performance, cattle prices, feed prices, overhead prices, and the cost of capital. Implants also affect carcass traits other than carcass weights. These changes can alter the value of the end product. Computer models such as the Oklahoma State University feedlot calculator and the pasture calculator are capable of making cost comparisons under a given set of cost conditions.

For suckling calves the value of implants can be determined by multiplying the added gain by the value of gain minus the cost of the implant. For this paper the value of gain for calves and stocker cattle was assumed to be $55 per hundred pounds. This value has remained constant for a number of years and was determined by comparing how much more the market is willing to pay for a 500 pound steer compared to a 400 pound steer of the same quality description. For suckling calves receiving a single implant, gain is increased by 18.6 pounds (steer & heifer average). While one would assume that these calves may have eaten slightly more feed, none of the research has reported an amount. Most cattlemen thus assume that the suckling calf implant has a gross value of (18.6 * $0.55 = $10.23). Most cattlemen implant at a normal working time for the calves and consider that the only added cost is the cost of the implant, about one dollar. Thus, return is about $10 for each $1 invested in implants. Because response to calfhood implants varies with rate of gain faster gaining calves probably produce a larger dollar return than slower gaining calves. Reimplanting suckling calves increased gains about 5 pounds over a single implant. Using the same value of gain, the value of reimplanting is (5 lbs @ $.55 = $2.75) less the cost of the implant.

The value of implants in stocker cattle can be accurately evaluated using the Oklahoma State University Stocker Planner 1996 as shown in Figure 1. As in all cattle budgets, the value of an implant depends on many factors. In preparing these budgets we assumed that the value of the added live weight gain again is worth $55 per hundred. The OSU Stocker Planner (NEWPAST) CR-3026 can pinpoint the value of an implant for steers on the wheat pasture (Figure 1.) All calculations of this program are based on the assumption that an implanted steer will gain 12 percent faster than one that is not implanted. The implant value can be determined by subtracting the

Figure. 1

OKLAHOMA STATE UNIVERSITY STOCKER PLANNER (PASTURE COST GAIN OR WT. BASIS)

*** PRESS ALT D TO ENTER DATE ***		Starting date		11/23/96	
Cattle cost per cwt	$65.00	Pasture pricing options			1
purchase weight (lbs)	500	Cost per pound of gain = 1			
cattle cost per head ($)	$325.00	Cost in $ per cwt grazed per month=2			
Days pastured	100	COSTS ON A TOTAL OR DAILY BASIS			
	*********		TOTAL	DAILY	
Equity in dollars per head	$0.00				
Cattle interest rate (%)	11.00		$9.93	$0.10	
Pasture cost option:	$3.60		$60.00	$0.60	
Medical costs ($) per head	$7.00		$7.00	$0.07	
Death loss rate (%)	2.00		$6.64	$0.07	
Pickup and equipment ($) / head	$0.00		$0.00	$0.00	
Management fee ($ per head)	$0.00		$0.00	$0.00	
Labor cost ($) per day	$0.05		$5.00	$0.05	
Beef check off ($)	$1.00		$1.00	$0.01	
Options / hedge costs ($/head)	$0.00		$0.00	$0.00	
Marketing costs ($ per head)	$0.00		$0.00	$0.00	
Freight ($) per head	$0.00		$0.00	$0.00	
Feed costs ($ per head)	$6.00		$6.00	$0.06	
opperating capital interest (%)	11.00		$1.31	$0.01	
Dollars invested / head at end	$421.88	TOTAL $	$96.88	$0.97	

Performance options for		SELLING DATE-->>	03/03/97	Control	Implanted
items with (*)		PROJECTED DAILY GAIN --->>>		2.00	2.24
0=NO; 1=YES;		TOTAL GAIN POUNDS		200.0	224.0
Implant cost ($)	$0.92	SELLING WEIGHT		700.0	724.0
Implant present *	**1**	SELLING PRICE $ PER CWT		$65.71	$65.42
Days fed	0	COST OF GAIN $ / CWT		$48.44	$43.67
Pounds fed per day	0.00	FEED ONLY COST OF GAIN		$33.00	$29.46
Feed cost per ton	$0.00	BREAKEVEN SELLING PRICE		$60.27	$58.40
Protein supplement *	0	**PROFIT PER HEAD**		**$38.12**	**$50.80**
Ionophore *	0	TOTAL PROFIT		38.12	50.80

Expected value of gain ($ / cwt.) $55.00 TOTAL COST FOR-->> 1 HEAD

Price structure at sale weight

WEIGHT	$ PER CWT	CASH NEEDED
400	$73.75	FIGURED ON
450	$71.67	EXPECTED=0
500	$70.00	OPTION =1
550	$68.64	
600	$67.50	0 <SELECT
650	$66.54	
700	$65.71	
750	$65.00	< Expected sales
800	$64.38	price adjusted for
850	$63.82	basis.
900	$63.33	
950	$62.89	
1000	$62.50	

TOTAL CATTLE COST	325.00
TOTAL CATTLE INTEREST	9.93
GAIN COST (PASTURE ONLY)	60.00
MEDICAL COST	7.00
DEATH LOSS COST	6.64
PICKUP & EQUIPMENT	0.00
LABOR COST	5.00
MANAGEMENT FEE	0.00
BEEF CHECK OFF	1.00
OPTIONS /HEDGE COST	0.00
MARKETING COSTS	0.00
FREIGHT	0.00
FEED & MINERAL & IMPLANTS	6.00
OPERATING CAPITAL INTEREST	1.31
TOTAL MONEY NEEDED	421.88

NOTE PASTURE PRICING OPTIONS: PERFORMANCE OPTIONS INCLUDE THE FOLLOWING INCREASES: IMPLANT 12%, IONOPHORE .2 LB GAIN, PROTEIN .31, FEED .09 LB.
DEVELOPED BY DONALD GILL OKLAHOMA STATE UNIVERSITY 1996.

expected profit per head for control from that of implanted steers. This was $12.68 ($50.80-38.12=$12.68). The implant advantage was apparent even though the implanted cattle were assumed to sell for less per hundred weight because of their greater weight. Pricing assumptions for the winter of 1996 are apparent in the budget

The value of implants for feedlot cattle sold live is computed in Figure 2 using the OSU Program to Estimate Feedlot Cost of Gain (FLCALC Revision 2) CR-304. An abbreviated form of this program was used to calculate profitability of different implant programs under the cost structure in place in November 1996. Table 1 shows the feedlot cost structure. We assumed that corn was delivered to the feedlot for a price of $2.90 per bushel. Feed markup, typical of commercial practice, generated a gross return markup between feed and yardage of about 25 to 35 cents per day depending on feed intake. The cattle performance response used was that presented by Duckett and Owens in a separate paper in this publication. Only selected cost comparisons were made based on comparisons with the most data and interest. The value of the implant is depends on the value of gain and the input costs assigned to cattle feeding. The values generated in this paper are valid only at the price structure specified.

The cost of each implant for calculation purposes is shown in Table 2. No charge was made for the cost of extra labor involved for implanting or reimplanting; the $6.00 medical cost to cover cattle handling was assigned to all cattle in these comparisons. The cost of multiple implants by some programs becomes substantial.

Table 1. Feedlot Cost Structure (steers and heifers).

Cattle cost $ per cwt.	$66.00
Purchase weight	713
Days on feed	140
Sale price $ per cwt.	$67.00
Cattle interest rate (%)	11.00
Death loss (%)	0.75
Medical cost / head $	$6.00
Beef checkoff $ / head	$1.00
Yardage cost per day	$.05
Operating capital interest (%)	11.00

Table 2. Implant Cost

Implant	Cost
Revalor S	$3.35
Revalor H	$3.95
Finaplex H	$3.20
Finaplex S	$2.75
Synovex Plus	$3.65
Synovex H	$.92
Synovex S	$.92
Ralgro	$1.00
Ralgro Magnum	$1.60

The complete feeding budget for control cattle is shown in Figure 2 . Similar budgets were calculated for each comparison. Implant value in each case was calculated as the difference between total profit between control and implanted cattle. This ignores any difference in carcass quality.

Figure 2. Control cattle for the mild estrogen comparison.

OSU FEEDLOT PERFORMANCE PROGRAM.		DATE PLACED ON FEED		11/23/96
MEDIUM-FRAME STEER CALVES.	(INPUTS)			
Cattle cost $ per /cwt.	$66.00	***Optional inputs***		
Purchase weight lbs.	**713**	Ration NEm		96.00
Days fed	**140**	Ration NEg	*	62.00
Sex and body type (1-8)	6	(Average energy for feed period)		
Feed cost per ton 'as is'	$121.56	**		
Ration dry matter (%).	81.00	Feed cost per /ton DM.		$150.07
Selling price $ per cwt.	$67.00	Mean feeding weight.		904.80

	(INPUTS)	Total cost($)	Cost per day($)
Equity in ($) per head.	$0.00		
Cattle interest rate (%)	11.00	$20.13	$0.14
Freight to feedlot $/head.	$0.00	$0.00	$0.00
Death loss %	0.75	$3.57	$0.03
Medical cost / head ($).	$6.00	$6.00	$0.04
Beef check off ($) head.	$1.00	$1.00	0.01
Implant costs ($) head.	**$0.00**	$0.00	$0.00
Yardage cost ($) per day.	$0.05	$7.00	$0.05
Daily feed dry matter (#)	**19.14**		
Estimated daily gain (#).	**2.74**		
Operating interest (%).	11.00	$4.60	$0.03
	Non-feed total $	$42.30	$0.30
	Feed cost / head $	$201.07	$1.44
	Total cost $	$243.37	$1.74

EXPECTED SALE DATE----->>>>	04/12/97	Calculated Values
Daily gain lbs.		**2.74**
Feed DM per pound of gain.		**6.99**
Cost of gain feedlot basis $.		55.81
Cost of gain total $		63.44
Expected sale weight lbs.		1096.60
Total dollars returned.		734.72
Total less original cattle cost.		264.14
Break-even selling price.		65.11
Profit or loss per head ($).		**20.77**
Break-even purchase price ($)/CWT.		68.91

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Tables 3 through 14 show specific comparisons for steers sold live.

Table 3. Control vs. Mild Estrogen

	Control	Mild Estrogen
Average daily gain	2.74	2.98
Feed / gain	6.99	6.66
Feedlot cost / gain	$55.81	$53.10
Total cost / gain	$63.44	$60.41
Sale weight	1096	1130
Break-even price	$65.11	$63.94
Profit / head	$20.77	$34.64
Implant advantage		**$13.87**

Table 4. Control vs Strong Estrogen

	Control	Strong Estrogen
Average daily gain	2.68	3.09
Feed / gain	7.66	6.90
Feedlot cost / gain	$60.95	$54.75
Total cost / gain	$68.84	$61.86
Sale weight	1088	1145.60
Break-even price	$66.98	$64.44
Profit / head	$0.23	$29.37
Implant advantage		**$29.14**

Table 5. Control vs Androgen + Estrogen

	Control	And + Est
Average daily gain	3.11	3.77
Feed / gain	6.39	5.65
Feedlot cost / gain	$50.95	$44.86
Total cost / gain	$57.72	$51.15
Sale weight	1148	1240
Break-even price	$62.86	$59.68
Profit / head	$47.53	$90.78
Implant advantage		**$43.25**

Table 6. Control vs Androgen

	Control	Androgen
Average daily gain	2.51	2.92
Feed / gain	7.36	6.50
Feedlot cost / gain	$58.95	$51.98
Total cost / gain	$67.24	$59.83
Sale weight	1064	1122
Break-even price	$66.41	$63.75
Profit / head	$6.28	$36.45
Implant advantage		**$30.17**

Table 7. Strong Estrogen vs Androgen + Estrogen

	Strong Estrogen	And + Est
Average daily gain	3.32	3.50
Feed / gain	6.07	5.87
Feedlot cost / gain	$48.32	$46.67
Total cost / gain	$54.87	$53.41
Sale weight	1178	1203
Break-even price	$61.61	$60.87
Profit / head	$63.50	$73.72
Implant advantage		**$10.22**

Table 8. Mild Estrogen vs Strong Estrogen

	Mild Estrogen	Strong Estrogen
Average daily gain	3.08	3.13
Feed / gain	6.53	6.38
Feedlot cost / gain	$52.91	$50.82
Total cost / gain	$59.09	$57.76
Sale weight	1144	1151
Break-even price	$63.40	$62.86
Profit / head	$41.23	$47.61
Implant advantage		**$6.38**

Table 9. Mild Estrogen vs Mild Estrogen Reimplant

	Mild estrogen	Mild Est Reimplant
Average daily gain	2.84	3.04
Feed / gain	7.11	6.61
Feedlot cost / gain	56.59	52.64
Total cost / gain	$64.27	$60.06
Sale weight	1111	1139
Break-even price	$65.38	$63.78
Profit / head	$17.97	$36.67
Implant advantage		**$18.70**

Table 10. Strong Estrogen vs. Strong Estrogen Reimplant

	Strong	Strong Est Reimplant
Average daily gain	3.02	3.07
Feed / gain	7.25	7.13
Feedlot cost / gain	$57.49	$56.55
Total cost / gain	$64.79	$63.95
Sale weight	1136	1143
Break-even price	$65.55	$65.23
Profit / head	$16.48	$20.23
Implant advantage		**$3.75**

Table 11. Androgen + Estrogen vs Androgen + Estrogen Reimplant

	Androgen + Estrogen	Reimplant And + Est
Average daily gain	3.66	3.89
Feed / gain	5.83	5.56
Feedlot cost / gain	$46.31	$44.09
Total cost / gain	$52.79	$50.83
Sale weight	1225	1258
Break-even price	$60.48	$59.43
Profit / head	$79.93	$95.18
Implant advantage		**$15.25**

Heifer comparisons: The same cattle and feed price assumptions are made for heifers as was used for the steers.

Table 12. Heifer Control vs Androgen + Estrogen

	Control	Androgen + Estrogen
Average daily gain	2.74	3.05
Feed / gain	6.83	6.38
Feedlot cost / gain	$54.66	$50.92
Total cost / gain	$61.98	$58.49
Sale weight	1064	1107
Break-even price	$64.55	$63.10
Profit / head	$26.04	$43.14
Implant advantage		**$17.10**

Table 13. Heifer Control vs Synovex-H + TBA

	Control	Synovex H + TBA
Average daily gain	3.34	3.67
Feed / gain	5.78	5.35
Feedlot cost / gain	$46.16	$42.71
Total cost / gain	$52.20	$49.19
Sale weight	1147	1193
Break-even price	$60.34	$58.76
Profit / head	$75.99	$98.32
Implant advantage		**$22.33**

Table 14. Heifer control vs Synovex H + TBA with same Reimplant

	Control	Syn + TBA Reimplant
Average daily gain	2.97	3.46
Feed / gain	6.57	5.67
Feedlot cost / gain	$52.39	$45.23
Total cost / gain	$59.20	$52.11
Sale weight	1096	1164
Break-even price	$63.42	$60.22
Profit / head	$39.24	$78.94
Implant advantage		**$39.70**

Table 15. Adjustment for reduced Choice percentage for Androgen & Estrogen implants.

	Control	And + Est
Average daily gain	3.11	3.77
Feed / gain	6.39	5.65
Feedlot cost of gain	$50.95	$44.86
Total Cost of Gain	$57.72	$51.15
Sale Weight	1148	1240
Break-even price	$62.86	$59.68
Profit sold live	$47.53	$90.78
Live Implant advantage		$43.25
Discount for 14.6% less choice		**-$7.91**
Net Effect		**35.34**

Profit comparisons in these tables all assumed that the selling price for control and implanted cattle was the same. Other factors altered value of the carcass. In most packing plants the costs associated with slaughter and fabrication of the carcass are calculated per animal. If these costs are $100 per head, then the heavier animal has more value. Using the OSU boxbeef calculator (NEWCUTII), a live steer producing a 800 pound carcass is worth $0.76 more per cwt live than one yielding a 700 pound carcass, all else being the same. If an implant increases carcass weight by 50 pounds, the decrease in kill-fab costs is worth about $4.20 per head ($0.38 x 1100 lb).

Changes in carcass traits caused by implants can alter carcass grade and value. Grade breakdown of test cattle makes it possible to adjust the sale prices for implants. However, Choice to Select spread in price is not constant. For 1995, Dolezal (1996) reported that the average discount from Choice to Select was $7.10 per cwt carcass. Owens and Duckett (1997) reported, that 67.3% receiving a single Androgen + Estrogen implant, had a choice grade compared to 81.9 percent for controls. The economic consequence of this 14.6 percent drop in percentage of Choice cattle with the 1995 average spread of $7.10 is illustrated in Table 15.

The economic advantage was decreased by $7.91 a head. Had the $22 spread was in effect on the day of this conference been considered, the loss in value would have been tripled. Most of the reported implant data does not contain sufficient detail on carcass data to make economic comparisons. The only precise way to calculate the value of cattle on a carcass basis use each individual carcass weight, its measured yield grade and its quality grade. In addition, weight discounts, discounts for Standard grade cattle and a schedule for carcass defects must be used. In many pens of cattle from mixed background, the lightest carcasses often draw a grade premium while the heavy cattle are often discounted for grade.

Implants also may effect the yield grade of cattle. From the OSU Boxbeef Cutout Calculator a 0.1 unit change in yield grade 750 pound carcass affects final cutout value by $3.75 per cwt carcass.

Limited data are available on the effects of implants on boxed beef yields. In a study at Oklahoma State, Al-Maamari et al (1995) reported no difference in box beef yields between non-implanted (CON), and steers implanted with either 28 mg estradiol benzoate and 200 mg trenbolone acetate on day 0 (ET), ET on day 0 plus reimplants on day 61 (ETET), and 20 mg estradiol benzoate and 200 mg progesterone on day 0 and a reimplant of ET on day 61 (SET). These treatments achieved quite high levels of both estradiol and trenbolone acetate in some treatments. However, other than an increased yields of lean box, yield grades were not different from the control. In this serial slaughter study, implanting did not appear to alter composition of gain (tissue percentage basis) in time constant comparisons; however, implants increased weight of sellable lean without increasing trimmable fat.

Implants have both positive and negative effects on carcass value. The two items most important economically are the cost efficiencies associated with increased carcass weight and the negative from a reduced percentages of high grading cattle. Caution should be taken when assigning value to increased carcass weight. Many cattle, because of genetics or management, are already too large in the eyes of consumers; making cattle larger has a very negative effect. Research to reduce the depressions in quality grade and in tenderness associated with implants should have a high priority.

Implants can reduce production cost in the calf, stocker and feeder phases of beef production. Estimates of cost savings vary with the type(s) of implants used and other assumptions made. Tables 16 and 17 summarize the typical production cost savings attributable to using implants for steers and for heifers.

Table 16. Cost Advantages of Using Implants With Steers

	Minimum	Maximum
Suckling Calves	$9.23	$10.98
Stockers	9.10	9.10
Feeders	21.49	58.50
Total	39.82	58.50
Animal Value	$752.00	$831.00
Percent Cost Reduction	4.8%	10.4%

Expected Percentage Cost Reduction 7.5%

These costs can be expressed as a percentage of total production cost by placing a value on the animals produced assuming that total production cost equals the value of the animal, i.e., that production is occurring at break-even cost.

Table 17. Cost Advantages of Using Implants With Heifers

	Minimum	Maximum
Suckling Calves	$9.23	$10.98
Stockers	9.10	9.10
Feeders	17.10	30.70
Total	35.43	58.78
Animal Value	$742.00	$799.00
Percent Cost Reduction	4.4%	6.8%

Expected Percentage Cost Reduction 5.6%

This should be a fairly accurate assumption in the long-term. For this study the typical sales price for both steers heifers was assumed to be $67/cwt. Slaughter/sales weight varied with the implant system used; hence, a maximum and minimum animal value was calculated depending upon sales weight. Dividing the minimum cost by the maximum value and the maximum cost by the minimum value (e.g. in the case of steers $39.82/$831 and $78.58/$752) gives the widest feasible range of percentage reductions in cost of production attributable to implant use. The midpoint of this range likely represents typical cost savings in the industry from implant use.

As noted from Tables 16 and 17. the cost advantage for steers is about 2 percentage points greater than for heifers. Since about 20 percent of all heifers produced typically are held as replacements, the slaughter mix typically is about two-thirds steers and one-third heifers. Thus, for the average animal slaughtered, the cost savings from using implants is closer to the 7.5 percent for steers than the 5.6 percent for heifers. With this in mind, we assumed that the average cost advantage to producing beef with implants averages about 7 percent.

Several points should be noted with regard to this 7 percent advantage. This analysis ignores any reduction in the quality of the beef produced and that reduces the value of the animal. Likewise, feed costs were based on $2.90/bushel corn, this yields a costs of gain of about $.50/pound. Obviously, the cost advantages of using implants rises as the cost of feed rises. A complete sensitivity test of the impact of high feed cost (such as those seen recently) was not done here. Rather typical feed costs were used to reflect the long term impact of implant use upon the cattle industry. However one rough rule-of-thumb is that for each 10% increase in feed costs, the cost value of using implants will rise by 0.5%. Thus, a 30 to 40 percent increase in feed cost caused the advantage to using implants to be 8 to 9 percent versus the typical advantage of 7 percent assumed here.

INDUSTRY WIDE IMPACT OF IMPLANT USE VERSUS NON-USE

Thus far this analysis has estimated the cost advantage to using implants for individual animal. If implants were to be "banned" from use, and the industry lost the cost competitiveness attributable to implant use, how would that impact sales and income? A "market share" analysis helps to answer that question. Before presenting that analysis it is necessary to examine some historical relationships between beef's market share and its price competitiveness.

A Brief History of the Beef Market

Figure 3 shows the per capita pounds of retail weight meat disappearance in the in the United States from 1930 to 1995. Following the depression and drought years in the early 30's, and excluding several years in the mid 40's during World War II, per capita meat consumption grew steadily until about 1970. At that time meat consumption per capita stabilized. Some would argue that the industry "matured" at that point and that further growth through increased consumption per capita had ended. The 10 pound per capita increase in meat consumption from 1990 to 1995 raises some question about this mature industry hypothesis.

What has been beef's share of the growing meat market depicted in Figure 3? Figure 4 shows the meat market shares of beef, pork and chicken from 1970-1996. In 1975-76, beef's market share was close to 50 percent of the market. However, since that time beef's market share has eroded steadily while the market share of chicken has grown steadily. Pork's market share has remained reasonably constant at around 25 percent of the market. Why did beef lose market share from 1975 to 1996? What impact would eliminating the use of implants have upon beef's market share in the future?

Beef's loss of market share from 1975 to 1996 can be attributed to two factors, 1) changes in consumer preferences and 2) changes in the price competitiveness of beef versus other meats. More specifically "variations" in beef's market share can be attributed to beef's fluctuating price competitiveness, while the prolonged drop in beef's market share since 1975/76 is more attributable to a general decline in consumer's preference for beef relative to other meats over the period from 1979 to 1986.

Figure 5 shows the responsiveness of beef's market share to its price competitiveness. Beef's price competitiveness is measured by the ratio of beef price to the weighted average of chicken and pork price (referred to hereafter as B/CP). The weighted average price of chicken and pork is calculated as the total expenditures on chicken and pork divided by the total pounds of chicken and pork consumed. As can be seen in Figure 5, when beef had nearly 50 percent of the market in 1975-76, the B/CP ratio was about 1.5, or stated alternatively, beef price was only about 50 percent higher than the weighted average chicken and pork price. Beef's price competitiveness declined rapidly from 1976 to 1979. During this same period beef's market share fell from 48 percent to about 40 percent. Likewise looking at the time period from 1986 to 1993, beef's price competitiveness weakened and it lost market share. In the last two years, 1994 and 1995, beef has regained some price competitiveness and has stabilized its market share at about 32 percent of the market. However, what is disturbing is that today's B/CP ratio of 1.7 results in a market share of only 32 percent; 20 years ago during the period from 1970 to 1975, a similar B/PC ratio would have resulted in a market share of about 45 percent. This decline in beef's ability to maintain market share, despite maintaining price competitiveness, indicates a decline in consumer preference for beef -- consumers will no longer buy as much beef as they used to, even given the same relative price relationship between beef and competing meats.

Figure 6 presents an alternative view of the relationship between beef's market share and its price competitiveness as measured by the B/CP price ratio. It shows much more clearly when beef lost market share due to a change in consumer preferences versus due to price competitiveness. From 1970 to about 1980, beef's market share fluctuated between 40 to 48 percent in response to changes in the B/CP ratio between 1.5 and 2.0. The upper right line (demand curve) shows that beef lost (gained) about one percent of the market for every .06 points of increase (decrease) the B/PC ratio. However, from 1979 to 1986, the B/CP ratio fell from 2.1 to 1.5 with virtually no change in beef's market share. Starting in 1986, and continuing through 1995, a new, lower, and flatter demand curve for beef has been formed. On this curve, beef loses (gains) about 1 percent of the total meat market for each .03 units of change in the B/CP ratio.

This lower, and flatter demand curve for beef from 1986 to 1995 has two implications. First, beef has suffered a loss amounting to about 8 percent or the total meat market between 1979 to 1986 for some reason other than price competitiveness, i.e., because of adverse changes in consumer preferences for beef. Secondly, beef's market share is now twice as sensitive to beef's price competitiveness as it was during the 1970 to 1980 period, i.e. a .1 unit change in the B/CP ratio will now cause beef's share of the market to change by 3.3 percent versus only 1.6 percent during the period 1970 to 1980.

Exactly what caused the loss in preference for beef between 1979 and 1986 cannot be quantified: there is no way to measure what is in the minds of consumers. The decline, however, is generally attributed to two factors. The first is a concern over the health effects of having to much beef in one's diet. Concern over the amount of cholesterol in beef and its relationship to heart conditions were widely publicized and discussed during this period. Likewise, some contend that the high price of beef in 1979 and 1980 broke many consumers of their beef consuming habits and forced them to turn to alternative forms of meat. After learning to eat these meats as a major part of their diet (which was a new first time experience for some consumers) they never returned to the same level of beef consumption even after beef prices fell back into a normal relationship with chicken and pork.

LINKING PRODUCTION COST CHANGES TO IMPACTS UPON MARKET SHARE

Two relationships must be established to link a production cost change to its impact upon beef's price competitiveness and hence its market share. The first of these is to establish the fact that beef cattle production is a very competitive industry and changes in cost of production are soon matched by changes in cattle prices such that profits remain very near break-even. The second relationship to be established is that a 1 percent change in the cost of beef production does not translate into a 1 percent change in retail beef prices.

Cost Equals Revenue. In the beef industry "we eat what we produce and we produce what is profitable." Beef is not a very storable commodity. Once an animal is born it will go to market within a fairly predictable time period (i.e., plus or minus a few months). Thus when an over-supply of animals is produced, they must be sold one way or the other. The general consequence of over supplying beef is that the price must be cut to sell the available supply. The packing industry has long stated this situation as "sell it or smell it". Price cutting inevitably leads to losses and losses inevitably lead to cut-backs in production. These cut-backs remove beef from the market and eventually alleviate the "sell it or smell it" situation and allow prices to rise, thus restoring a measure of profitability to the industry. But just as losses lead to cut-backs, profits, in a competitive industry, lead to expansion in response to high prices, good profits and shortages in the market. Eventually profits are removed through expanded production and falling prices and the cycle of expansion and contraction begins to repeat itself. In the cow/calf business, this well known cycle is about 10 years long. In the stocker and feedlot business it is shorter, i.e., about one to two years in length.

Figure 7 shows the recent ups and downs in feedlot profits. Profits and losses have ranged from a +$100/hd. to a -$100/hd. over the period from late 1992 to late 1996, but have averaged $5.61/hd. This average profit occurred over a time when slaughter cattle prices ranged from a high of about $80/cwt. to a low of less than $60/cwt., thus causing animal values to fluctuate by about $250/hd. The point here is that despite tremendous volatility in prices and cost of production, in the long-term (over this four period) production cost and revenue averaged out to be nearly the same such that only $5.61/hd of profit occurred. This relationship will be found for any phase of the beef industry considered (cow/calf, stocker, feedlot) for any extended period of time considered. This is because the beef industry is competitive. It adjusts to any change in cost of production or price of its product by expanding to take advantage of profits (and in so doing eliminating them) and contracting to avoid losses (and in so doing alleviating losses). Thus, over extended periods of time, the average price of beef is always very near its cost of production. Thus the bottom-line in this analysis is the inference that <u>if banning the use of implants causes a 7 percent increase in beef's production cost, eventually a 7 percent increase in the live animal price for beef will occur.</u> This increase in beef price, assuming the consumer's preference for beef does not change, must come from a cut-back in beef production. More specifically, in today's meat market it must come from moving to the left up the lower, and flatter demand curve in Figure 6, i.e. by losing market share through a loss of price competitiveness.

The Live to Retail Beef Price Relationship. Before we can use Figure 6 to determine what a 7 percent increase in the cost of live beef production, and hence in the price of live cattle, means in terms of market share and the total value of beef sales, a link must be made between live cattle prices and retail prices. The 7 percent increase in production cost estimated here from not using implants was calculated on a live animal basis. The market share analysis in Figure 6 is done in terms of retail price, the price level at which beef establishes its competitiveness to other meats.

Figure 8 plots the percentage changes in retail versus live cattle prices from 1970-1996. The percentage change in retail price from one year to the next is plotted on the vertical axis while the percentage change in live cattle prices during the same year is plotted on the horizontal axis. Hence the dot for 1973 (which appears by itself near the upper right hand corner of the graph) indicates that in 1973 retail beef prices rose by 20 percent while live cattle prices rose by about 22 percent. One of the first things to note from this graph is that live cattle prices have been more volatile than retail beef prices, i.e. retail price changes have ranged from a -5 percent to a plus 25 percent while live cattle price changes have ranged from a -12 percent to a plus 30 percent.

Two trend lines and one reference point line (Ref. Line) have been drawn through the data plotted in Figure 8. The steepest line is a Ref. Line. It is drawn at a 45 degree angle, i.e., it connects points showing equal percentage changes in retail and live cattle prices. Notice that to the right of the vertical line through a 0 percent change in live cattle prices, most of the points fall below this reference .line. This implies that in most cases when live cattle prices rise, retail prices do not rise by as much in percentage terms. Likewise to the left of the vertical line through a 0 percent change in live cattle prices, most of the dots fall above the reference line, meaning that when live cattle prices fall, retail prices do not fall as much in percentage terms. This reference line, and the relationship of the points plotted to it, reiterate the point made above; retail prices do not change as much as live cattle prices. In the twenty six years of data plotted here, only three clear exceptions to this rule exist, i.e. 1982, 1989 and 1993. In those years, retail prices rose slightly more than live prices in percentage terms. The graph also shows that in five out of twenty-six cases retail prices rose when live cattle prices fell. Those years were 1974, 1980, 1981, 1991 and 1995.

The two trend lines plotted in Figure 8 depict the average relationship/ratio of percent changes in live cattle and retail price changes over the entire period considered (1970 to 1996) and over the last twelve year (1985 to 1986). The trend line over the last twelve years is flatter than that for the entire period. This indicates that retail prices have become less responsive to changes in live cattle prices over time. This is consistent with the fact that the "farmer's share" of the retail price of meat has declined over the period 1970 to 1996 from about 65 percent, to an little less than 50 percent. This implies that the raw commodity, i.e., live beef, makes up only about 50 percent of the total price of meat at the retail counter. The other 50 percent consist of value-added processing, shipping, packaging, storage, labor, etc. Thus what the two trend lines in Figure 8 display is the fact that as the farmer's share (live cattle value portion of the retail product) has declined over time, retail prices have become less sensitive to changes in live cattle prices. The bottom line in this analysis is that according to the 1985-96 trend line, a 7 percent increase in live cattle prices will translate into about a 4 percent increase in retail level beef prices

Expected Adjustments to a 7 Percent Increase in Beef Production Cost. Following the logic presented in the preceding section, Table 19 calculates and summarizes the impact of a 7 percent increase in beef production cost; this is assumed to be the impact of removal of implant use.

Figure 9 depicts and summarizes what is reported in line 4 of Table 19. It shows graphically that a 4.15% increase in retail beef prices (and thus a 4.15% increase in the B/CP ratio) causes a 2.12% decline in beef market share. Viewing this change graphically helps put in perspective the impact of a 7 percent rise in beef production cost relative to other changes in market share and price competitiveness that have occurred recently.

INDUSTRY WIDE IMPLICATIONS OF NOT USING IMPLANTS

A perspective upon the industry wide implications of a 7 percent increase in beef production cost due to discontinuing the use of implants can be gained by making a few additional calculations from the results presented in Table 19. Table 20 presents these calculations.

The 2.12 percent loss in market share calculated in Table 19, as shown in Table 20, translates into a 4.48 lb. per capita drop in beef consumption, this is equates to a 6.65 percent decline. This per capita drop in beef consumption, when multiplied by the current U.S. population of 263.2 million, implies a decline in retail weight sales of 1.18 billion pounds. The revenue reduction due to this sales decline will not be as severe in percentage terms as the quantity of sales decline because prices do rise with reduced sales (e.g., enough to cover the increased production cost). Thus beef expenditures per capita are calculated to drop $5.29 per capita, or 2.76 percent. This translates into a loss of $1.39 billion of retail beef sales. The 1995 "farmer's share" of the retail value of beef was 49 percent, which implies that $0.58 billion of live cattle sales would be lost.

Table 19. Expected Industry Level Adjustments to a 7 Percent Increase in Beef Production Cost.

1) Percent Change in Live Cattle Production Cost 7%
2) Implied Retail Price Change = (1.36 + .398x7) 4.15%
3) 1995 B/CP Price Ratio and Beef Market Share

$$\text{Price ratio} = \frac{\text{Avg. Retail Beef Price}}{\text{Weight Avg. Retail Chick and Pork Price}} = \frac{\$2.84}{\$1.67} = 1.70$$

$$\text{Market Share} = \frac{\text{Lbs. of Beef Per Capita}}{\text{Weighted Avg. Retail Chicken and Pork Price}} = \frac{67.4}{211.2} = 31.9\%$$

4) New B/CP Price Ratio and Beef Market Share
   a) New Retail Beef Price = \$2.84 x 1.0415 = \$2.96

$$\text{Price Ratio} = \frac{\text{Avg. Retail Beef Price}}{\text{Weight Avg. Retail Chicken and Pork Price}} = \frac{\$2.96}{\$1.67} = 1.77$$

   b) New Market Share = (.879 - .3285 x 1.77) 29.79%

One last way to look at the implications of a 7 percent increase in beef production cost due to not continuing to use implants is in terms of numbers of animals that would remain in the national beef breeding herd. Table 21 presents these calculations.

Meat production per cow would drop without the use of implants. The budgeting figures presented previously in this paper suggest that slaughter weights would decline by about 4 percent; thus, beef production per cow also would drop by about 4 percent. Retail weight beef production per cow per year was 397.4 lbs. in 1995.

Table 20. Implications of 7 Percent Increase in the Cost of Beef Production

Consumption Changes	
Current Per Capita Beef Consumption is	67.40 lbs.
Per Capita Beef Consumption Becomes	62.92 lbs.
Change in Per Capita Beef Consumption	-4.48 lbs.
Change in Per Capita Beef Consumption	- 6.65%
Current Population (millions)	263.2
Total Retail Weight Change of	-1.18 Billion lbs.
Industry Revenue Changes	
Beef Sales Per Capita	
Currently 67.40 lbs. @ \$2.84/lb.	\$191.42/person
Becomes 62.92 lbs. @ \$2.96/lb.	\$186.13/person
Change in Beef Expenditures Per Capita	\$-5.29/person
Change in Beef Expenditures Per Capita	- 2.76%
Total Change in Retail Beef Expenditures	\$-1.39 Billion
Net Change in Farm Level Value	-\$0.58 Billion
(Assuming a Farmer's Share of 49%)	

Table 21. Implied Changes in the National Cow Herd Size as a Result of Not Continuing to Use Implants.

1995 Retail Weight Beef Production Per Cow ....397.4 lbs.

Estimated Retail Weight of Beef Production per Cow Without the Use of Implants.................... 381.5 lbs.

	Lbs. of Retail Wt. Beef (billions)	Retail Wt. Production Per Cow	Number of Cows (millions)
1995	17.74	397.4	44.64
Without Implants	16.56	381.4	43.41
Change	-1.18 (-6.6%)	16.0 (-4.0%)	-1.23 (-2.7%)

If this figure dropped by 4 percent it would become 381.5 pounds per cow. In 1995 the U.S. beef industry produced 17.64 billion lbs. of retail weight beef from 44.64 million head of cows, i.e. 397.4 lbs. per cow. The estimates made here indicate that after retail and farm level prices rise to cover a 7 percent increase in beef production cost, only 16.56 billion lbs. of beef would be sold. If productivity per cow dropped by 4 percent to only 381.4 lbs. of retail beef per cow, it would take 43.41 million cows to produce the beef consumers would continue to demand. Thus cow numbers would not drop by as much in percentage terms as retail sales of meat. However the decline in cow numbers would still be sizable at 2.7 percent, a number roughly equal to half the cows currently in Oklahoma (e.g., in 1995 Oklahoma was reported to have 2.1 million head of cows).

SUMMARY

A beef industry without implants would be a less competitive with other industries producing meat. The use of implants is estimated to reduce live beef cattle production costs by 7 percent. If this cost competitiveness were lost due to an inability to continue to use implants, beef's share of the meat market would fall from its current 31.9 percent to 29.8 percent, a little over 2 percentage points. This would result in a loss of roughly $1.4 billion in retail sales of beef. This reduction in sales would reduce the need for beef cows about 1.2 million. Thus the U.S. beef cow inventory could be expected to shrink within a few years by 1.2 million head, a number equal to half the cows currently in Oklahoma.

LITERATURE CITED

Al-Maamari, M.T., et al., 1995. Effects of combination anabolic implants on boxed beef yields of serially slaughtered steers. Okla. Agr. Exp. Sta. Res. Rep. P-943:26.

NRC. 1996. Nutrient Requirements of Beef Cattle. National Academy Press. Washington. D.C.

Dolezal, H.G., 1996. "Grid Pricing - The Known and the Unknown" *Texas Cattle Feeders Association Report*. Sept. 12, 1996: 7-15.

QUESTIONS & ANSWERS

Question: How does the price of competing products alter the price of beef? Is there a 1:1 ratio?

Trapp: It doesn't matter whether price or cost of production changes; the impact is the same. If in composite, pork and chicken drop their price by 7% relative to the beef, this has the same impact as beef losing 7% in price.

Question: Is the ratio of the live animal to retail meat the same for beef, pork, and chicken?

Trapp: No. The ratio of live to meat price for beef and pork around 40%. In pork that makes a big difference. In chicken, I don't know the percentage. This depending on extent of processing and the efficiency of both production and processing. USDA recently mentioned pork as around 40% and beef near 49%. Over time, this ratio has decreased because efficiency of live animal production has increased more rapidly than efficiency of processing. So the live animal share has dropped from 50 or 55 down to 49 over the last 20 years.

Question: How would a grain price of $200 per ton alter your conclusions?

Trapp: One can calculate the percentage increase in cost of production and the fraction of total cost that is feed cost and work that into the equations. If grain cost increases by 40% and feed is one-third of total production cost, then total production cost is increased by 10 to 15%. However, pork and poultry eat grain, too, so their costs are rising also. Which does an increase in grain price hurt the worst - beef, pork or chicken? Chicken is much more efficient at using grain than beef, but beef has the flexibility to substitute forage for grain. So it is a wash after you pencil through it. Increases in grain prices cause similar increases in production cost for all species. Overall, as cost production goes up, retail prices are going rise, but it will take time for that to happen.

Question: How does grain price alter the value of implants?

Gill: The economic impact of implants are larger with higher priced corn. Had I use $5 corn in my examples, the savings from implants would have been larger.

Trapp: We did not use today's grain prices in these calculations because they would be misleading when grain prices drop. The impact of removing implants is quit sensitive to the cost of gain in beef. Implants are specific to beef and do not affect production cost of pork or chicken. Grain prices affect all markets to the same degree.

Question: Beef production per cow has been listed several times. What is this and why is it increasing?

Trapp: Production per cow includes two things - cows and meat from all slaughtered animals. Both beef and dairy cows are included in the formula. Productivity has been increasing not only because the beef industry itself is doing better, but because we have fewer and fewer dairy cows. Dairy cows are not good beef producers. If you decrease the proportion of the population that is dairy cows, meat production per cow will increase. Some of that spillage may explain these increases. (WHAT ABOUT WHETHER THE COW HERD IS EXPANDING OR CONTRACTING?)

Question: If we need to examine carcass information more closely to evaluate implants, what can Oklahoma State do to gather more information and put it on the internet for everybody to fit to their own conditions?

Gill: It would be relatively easy for us to put our own data on the Animal Science home page we haven't done any of that yet. We have completed two serial slaughter studies from which we have made the carcass data available. To me those are two studies are under-utilized. For example, a given pen of feed cattle fewer or more days. Total price will change each day with the market. But the relative value of feeding cattle for fewer or more days doesn't change that much. Other universities should do the same thing. We don't have carcass data from these studies on the internet yet, but we can stick it on the Animal Science home page.

Question: Someone needs to take the initiative to gather the complete implant data base provide it for users in some usable format.

Morgan: This is something that the National Beef Cattle Association tried to do with their beef carcass collection program. However, the data fed back to producers was not user friendly. The association is rethinking how it could be made more user friendly. The Ranch-to-Rail program provides feedout and carcass data, also. These are little drops in the bucket toward accumulating more carcass data. I agree that more carcass information of this type is needed.