



Agricultural Issues Center
University of California

February 18, 2005

Costs and Benefits of Marketing Differentiated Beef through Process Verification Systems

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www.aic.ucdavis.edu

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This research was reported on in a special symposium entitled "Process Verification: What Does it Mean for Your Operation?" held at the National Cattlemen's Beef Association in Phoenix, Arizona on January 27, 2004. This research and symposium were funded by the Agricultural Marketing Resource Center. This research brief is based on Beth Vaaler's M.S. thesis research.

Executive Summary

The objective of this report is to analyze the costs of developing and implementing a process verified program using the generic manual developed by the Agricultural Marketing Resource Center. Costs decreased as the number of animals are marketed through this producer alliance. The larger producers in this alliance had costs of \$0.66 per animal. Age, Days fed grain, the USDA Choice Boxed Beef price, gender, breed, USDA grade, and seasonality variables were significant. Process Verification of an animal resulted in a significant discount. This raises a question about what this binary variable is capturing in the model. It seems that Process Verification may be capturing a time trend instead of the characteristics of the animal. Animals that have Process Verified characteristics may already be identified in the model through age, gender, and breed. Therefore, the Process Verified variable may be capturing a time trend between 2002 and 2003. A longer time series is needed to further analyze this relationship.

Costs and Benefits of Marketing Differentiated Beef through Process Verification Systems

Increasingly, food quality as related to traceability is becoming more important. To address this need in the meat industry, the United States Department of Agriculture has developed a standard certification program called QSVP. The purpose of the USDA Quality System Verification Program (QSVP) is to provide an USDA endorsed version of ISO 9000, a quality standards program that is globally utilized in a variety of industries. The QSVP system currently subscribes to a list of 20 requirements. Each of these requirements must be addressed in a participant authored manual. The requirements manual details the production system for that particular group of producers and verifies the production claims through the use of the 20 USDA requirements’.

Production requirements vary among groups that apply to be process verified. These requirements are self-imposed and are deemed the ‘things that the group is process verified for.’ Requirements can be as rigorous or as simple as a group desires. For instance, certain groups require nothing more than verification that an animal is of a particular breed and origin. Regardless of the requirements however, each group must address the 20 requirements in the QSVP system to verify that their requirements are fulfilled.

Once the group has written a manual that addresses these 20 points, they can submit it to the USDA and apply for an audit. Auditors review the manual and visit the production sites specified in the manual. Auditors ask various questions related to the production practices documented in the manual and make sure that each participant can present the appropriate paper trail specified in the manual. Upon completion of an audit, there are generally some items that need attention and, once addressed, groups can reapply for certification. Only a handful of groups have been certified as USDA Process Verified nationwide.

The 'generic' manual, developed by Kansas State Research and Extension through the Agricultural Marketing Resource Center, was based off work done with a natural beef alliance that is undergoing process verification. By working closely with this alliance, Kansas State was able to participate first hand in the steps needed to achieve process verification including the writing of a process verification manual. This generic manual was developed with the intention that other groups would be able to learn from the knowledge received while working to achieve process verification. Funding for this project was provided by Agricultural Marketing Resource Center.

The objective of this report is to analyze the costs of developing and implementing a process verified program using the generic manual developed by the Agricultural Marketing Resource Center. This report includes sections corresponding to costs of involvement in the program based upon extensive producer interviews and an analysis of the value-based marketing program under which the animals were sold. The generic manual and other materials developed can be found at http://www.agmanager.info/agribus/process_verify/default.asp

Cost Issues Associated with Process Verification

There are various costs related to the specific USDA Process Verified natural beef program. In a 2003 analysis of producer maintenance costs, costs directly related to Process Verification were available from a survey of the members in this producer alliance. The survey was conducted by Sanden (2003) at Kansas State University. Transaction cost data were collected from producers participating in a natural beef marketing alliance in Kansas. The data were formatted and collected using a survey similar to Hobbs (1997). Forty producer members of the alliance were interviewed by Sanden to determine the cost per head associated with Process

Verification on the producer's farm or ranch. The cost per head was calculated by combining the number of hours spent by the producer on animal verification, training and creation of a farm plan.

The cost per head was estimated by Sanden (2003) on an hourly basis. This hourly basis is converted to a dollar value. According to Fogleman et al. (2002), an average hourly compensation rate of \$9.65 was seen on Kansas farms (p.6). This compensation rate was taken from a sample of full-time, part-time and seasonal workers. The hourly cost per head is multiplied by \$9.65 per hour to establish cost on a dollar per head basis. Producer cost of Process Verification are converted from a per head value to a per 100 pounds of hot weight (e.g., carcass weight) value by dividing the cost per head by the average hot weight of 691.39 pounds and multiplying by 100. The calculation is provided below.

$$\begin{aligned} \text{Average Cost (dollars/100 pounds of hot weight)} &= \\ \{[\text{Average Cost (hours/head)} * \$9.65/\text{hour}] / 691.39 \text{ pounds}\} * 100 \end{aligned}$$

Table 1 summarizes the statistics associated with Process Verification at the producer level. The minimum average cost per 100 pounds of hot weight is \$0.10, while the maximum average cost is \$6.80. The producer with a cost of \$6.80 per 100 pounds of hot weight marketed two animals to the alliance over the study period. The average cost is \$1.48 per 100 pounds of hot weight.

The average producer has been in the cattle business for 35.83 years. The education of producers is defined by a discrete variable. Education is equal to one if the producer had a high school diploma, two if the producer has some college credits, three if the producer has a college degree and four if the producer has completed some graduate courses. The average amount of time that producers spend on Process Verification training is 3.30 hours. On the average,

producers develop a farm plan for Process Verification in 11.27 hours. The average time that producers spend completing a passport for animal verification is 0.30 hours/head. The average number of animals marketed as Process Verified is approximately 33 head. The maximum number marketed by any single producer is 188 head. The minimum number of animals marketed is two head.

The estimation of average cost represented in Figure 1 is indicative of traditional cost curves found in production agriculture. The cost curve provides an estimate of cost per 100 pounds of hot weight relative to farm size. As the number of animals marketed increases, average cost decreases. This relationship is consistent with increasing returns to size. Cost efficiency of marketing under the Process Verified system increases as the number of animals marketed through the system increases.

The cost of Process Verification is more accurately expressed per 100 pounds of hot weight as opposed to defining cost at a flat yearly rate. A per 100 pounds of hot weight analysis provides information on the relationship between cost and the number of animals that a producer markets as Process Verified. The economic efficiency of the Process Verification program is increased when more animals are enrolled in the program on an individual operation. This can be attributed to more productive utilization of training and planning. In this case, productive utilization refers to applying the skills and knowledge acquired to more animals.

Table 1 Summary Statistics for Process Verification (sample size = 40 producers)

Variable	Average	Std. Dev.	Min	Max
Total Cost (hours)	14.87	3.55	9.13	26.75
Average Cost (hours/head)	1.28	1.12	0.08	5.88
Average Cost (dollars/head)	10.24	9.00	0.66	47.00
Average Cost (\$/100 pounds of hot weight)	1.48	1.30	0.10	6.80
Experience ^a (years)	35.83	8.38	12.00	47.00
Education ^b	1.56	0.78	1.00	3.00
Training ^c (hours)	3.30	0.64	2.00	5.00
Farm Plan ^d (hours)	11.27	3.51	6.00	24.00
Animal Verification ^e (hours/head)	0.30	0.15	0.13	0.50
Sold Process Verified (head)	32.54	44.57	2.00	188.00
Total Animals Sold (head)	34.80	48.86	6.00	228.00

^aExperience is the number of years that a producer has raised cattle.

^bEducation is a discrete variable for a producer's level of education:

1 = high school diploma, 2 = some college, 3 = college degree and 4 = some graduate courses.

^cTraining is the hours that a producer spent in Process Verification training sessions.

^dFarm Plan is the hours that a producer spent developing a Process Verified farm plan.

^eAnimal Verification is the hours that a producer spent completing an animal's passport.

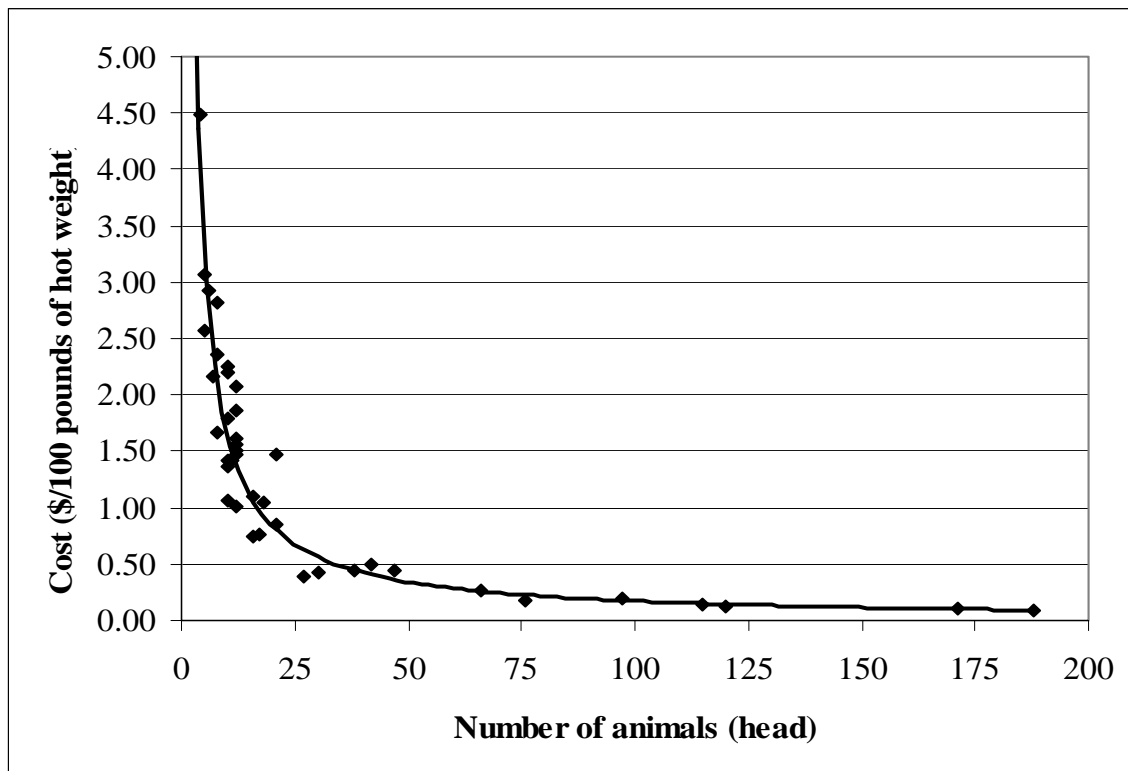


Figure 1 Average Cost per 100 pounds of Hot Carcass Weight (\$) for Process Verified Producers

Revenue Issues Associated with Process Verification

The producer value-based marketing program for this alliance was analyzed to discern whether there were any possible economic incentives for marketing process verified animals. This data set is very unique. The observations are not recorded at regular intervals over the study period, so the data set is not a pure time series. The data consist of both cross sectional and time series components. To better summarize the data, a descriptive statistical analysis is included.

Table 2 lists descriptive statistics of the data including the averages, standard deviations, minimums and maximums. This data corresponds to the producers whose cost data was discussed in the previous section. The upper half of Table 2 discusses the continuous variables. The average premium for animals sold during 2002 and 2003 to the alliance is \$0.17 per pound. Premiums are received for 1,709 animals and discounts are received for 93 animals marketed. The range of discounts and premiums is a negative \$0.72 to \$0.60 per pound of hot weight. Of the 1,833 animals with complete information, 31 of these animals receive the base price of \$1.10 per pound of hot weight, which means neither a premium or discount is received. After adding premiums to and subtracting discounts from the base price the average price received was \$1.27 per pound of hot weight. The average age of an animal marketed to the alliance was 659.55 days or approximately 22 months. Animals were finished on grain for an average of 133.51 days. The USDA Choice Light Boxed Beef price was at an average of \$1.27 per pound from 2002 through 2003. The average hot weight for an animal marketed was 691.39 pounds.

There were 2,094 animals supplied to the alliance in 2002 and 2003. Figure 2 represents the average price received by each producer marketing to the alliance in 2002 and 2003. This average price is sorted and plotted by the number of animals marketed by the producer over the

Table 2 Summary Statistics for Animals Marketed in 2002 and 2003

Variable	Average	Std. Dev.	Minimum	Maximum
Carcass Price (\$/pound)	1.27	0.14	0.38	1.70
Carcass Premium (Discount) (\$/pound), CARPD	0.17	0.14	(0.72)	0.60
Age (days), AGE	659.55	120.88	354.00	1,026.00
Days Fed Grain (days), DFG	133.51	34.85	65.00	270.00
USDA Choice Boxed Beef Price (\$/pound), BBP	1.27	0.15	1.08	1.70
Carcass Hot Weight (pounds), HWT	691.39	80.06	440.00	1,072.00
Gender ^a , GEN	0.58	0.49	0.00	1.00
Breed ^b , BRD	0.30	0.46	0.00	1.00
Corn ^c , FD1	0.86	0.46	0.00	1.00
Milo or Barley ^d , FD2	0.11	0.46	0.00	1.00
Prime ^e , GRD1	0.05	0.59	0.00	1.00
Choice ^f , GRD2	0.45	0.59	0.00	1.00
Process Verified ^g , PV	0.54	0.50	0.00	1.00
April through June ^h , SEA1	0.27	1.09	0.00	1.00
July through September ⁱ , SEA2	0.26	1.09	0.00	1.00
October through December ^j , SEA3	0.21	1.09	0.00	1.00
Producer ^k , PR	87.29 ^l	90.36 ^m	2.00 ⁿ	330.00 ^o

^aGender is a binary variable where 0 = heifer and 1 = steer.

^bBreed is a binary variable where 0 = at least 50% Black Angus and 1 = less than 50% Black Angus.

^cCorn is a binary variable representing feed type used in the finishing ration where 1 = corn and 0 = otherwise.

^dMilo or barley is a binary variable representing feed type used in the finishing ration where 1 = milo or barley and 0 = otherwise.

^ePrime is a binary variable representing the USDA Quality Grade where 1 = Prime and 0 = otherwise.

^fChoice is a binary variable representing the USDA Quality Grade where 1 = Choice and 0 = otherwise.

^gProcess Verified is a binary variable where 0 = Not Process Verified and 1 = Process Verified.

^hApril through June is a binary seasonal marketing variable where 1 = April through June and 0 = otherwise.

ⁱJuly through September is a binary seasonal marketing variable where 1 = July through September and 0 = otherwise.

^jOctober through December is a binary seasonal marketing variable where 1 = October through December and 0 = otherwise.

^kProducer is a binary variable where each producer was assigned a number 1 to 20 and compared to the base producer supplying the most animals to the alliance over the study period.

^lDenotes the average number of animals supplied to the alliance.

^mDenotes the standard deviation of animals supplied to the alliance.

ⁿDenotes the minimum number of animals supplied to the alliance.

^oDenotes the maximum number of animals supplied to the alliance.

sample period. If two producers marketed the same number of animals over the study period, the average price received by each producer is averaged to create one average price for the given number of animals marketed. As the number of animals that an individual producer marketed increases, the average price per pound of hot weight that the producer received decreases. However, this result may be misleading due to the small number of animals marketed by some producers.

It is important to understand that the producers do not sell to the alliance at regular intervals. This results in data collection at irregular intervals. Animals are brought to the alliance and slaughtered in response to demand at the retail level. This creates irregular lot sizes and delivery intervals. Therefore, the average price that a producer receives can be heavily influenced by the number of animals marketed and the time period in which cattle are marketed to the alliance. Producers that market more animals to the alliance receive more consistent average prices. Producers that market fewer animals to the alliance see more variability in the average price received.

Trends in the producer price received at the alliance and the USDA Boxed Beef price also prove interesting (Figure 3). Over the two-year period, the alliance price trend is slightly positive. However, compared to the positive trend in the USDA Boxed Beef price, the alliance's positive price trend is minimal. A distinctly positive price effect took place in the USDA Boxed Beef market between 2002 and 2003 as boxed beef prices increased in 2003. The alliance trend does not suggest that proportionally higher premiums were paid for animals marketed under Process Verification in 2003 when comparing alliance prices to USDA Boxed Beef prices over the study period.

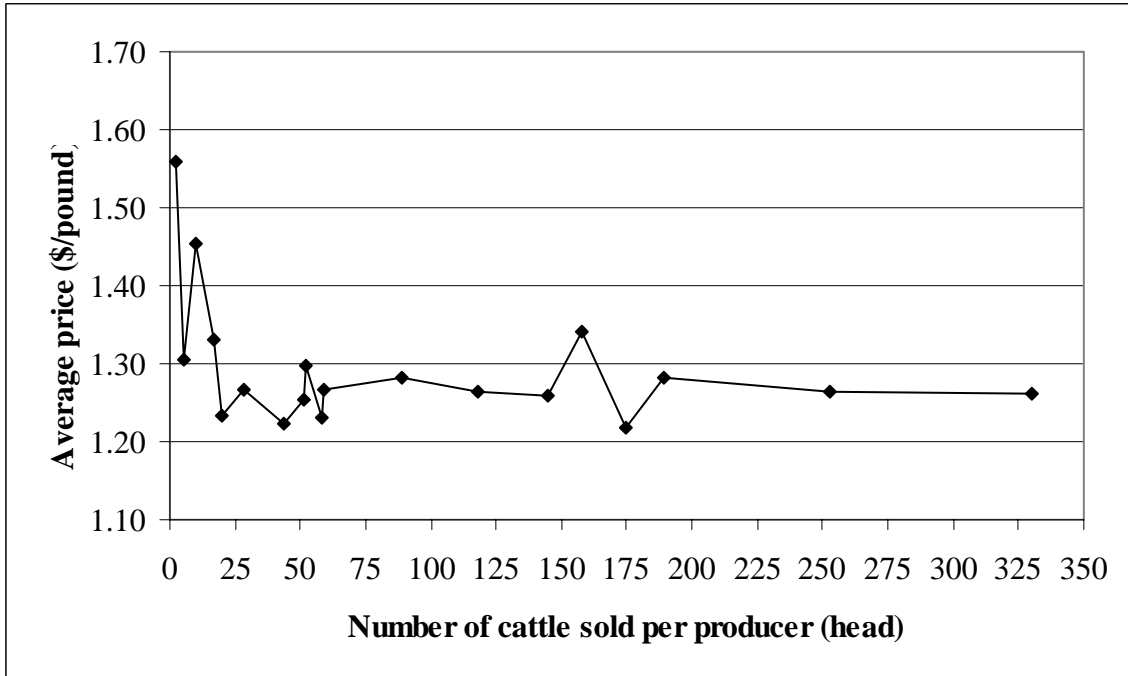


Figure 2 Average Price (dollars/pound hot carcass weight) of Cattle Sold

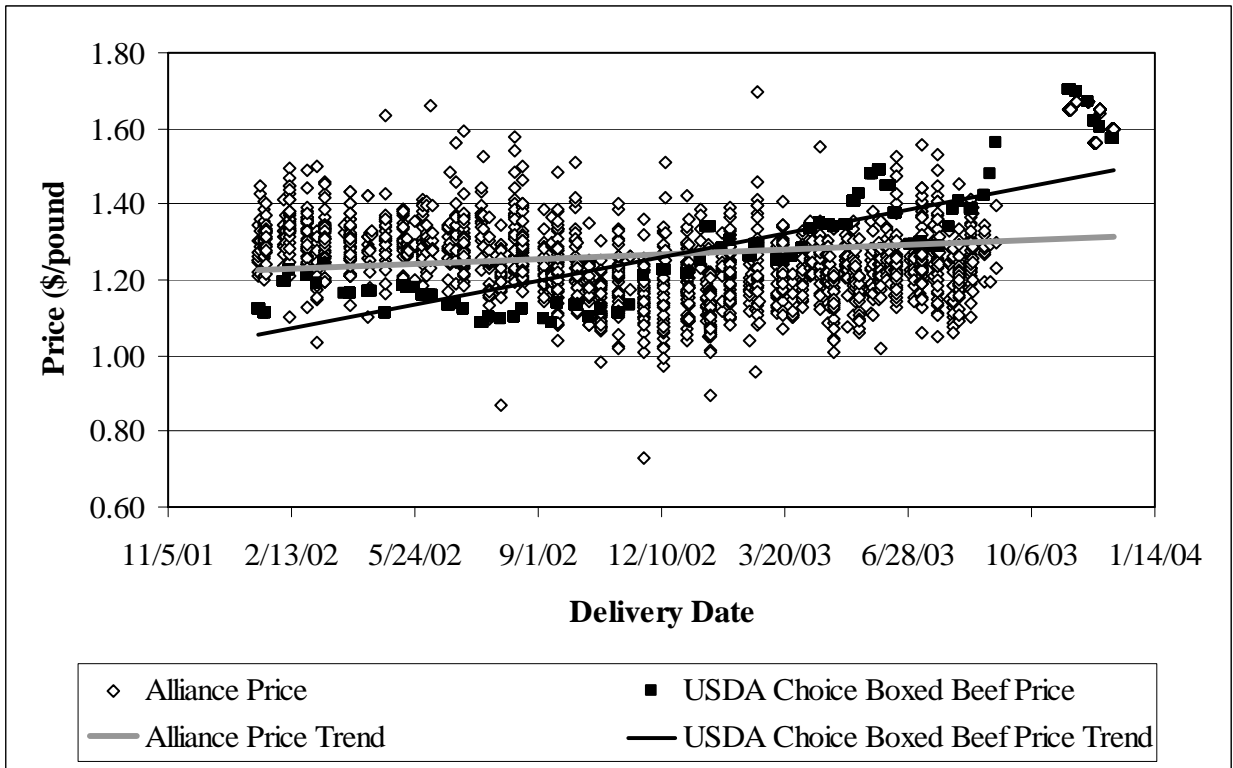


Figure 3 USDA Boxed Beef Price and Alliance Price Trends

A regression model was used to determine the relationship between any possible economic incentives for marketing animals labeled under the alliance's process verification program and various variables corresponding to the producer's operation. Independent input variables include information pertaining to the specific characteristics of each animal delivered to the alliance for slaughter. These characteristics include age, days fed grain, USDA Boxed Beef price for Choice Light (600 to 700 pounds) animals, carcass hot weight, gender, breed, feed, grade, USDA Process Verification, marketing season and producer. The dependent variable used is the premium or discount received for the carcass at slaughter. A hedonic model similar to Boland and Schroeder's (2002) is used to estimate determinants of carcass premium or discount for the animals marketed to this alliance before achieving Process Verification and after Process Verification.

The regression model is used to empirically estimate the average total premium or discount received by producers for a carcass with the base characteristics in a natural beef marketing program. Premium and discounts are calculated per pound of hot weight by differencing the price per pound of hot weight by the base of \$1.10 for each observation. By differencing the base price from the actual price, the dependent variable becomes the premium or discount received for the animal at slaughter. The calculation can be represented by the following equation:

$$\text{Premium or discount} = \text{actual price} - \text{base price}.$$

The model attempts to explain the premium or discount received per pound of hot carcass weight by including the age of the animal, the number of days the animal was fed grain in the finishing ration, the animal's carcass hot weight, gender, breed, the feed type used in the finishing ration, the quality grade of the animal and the USDA Boxed Beef price. The USDA

Boxed Beef price is incorporated into the model because of the way that the alliance determines the price paid to producers. The base price of \$1.10 per pound of hot weight is adjusted for premiums and discounts through a proportion. This proportion divides the weight of the individual cut from the producer's animal by the USDA average weight of the corresponding cut.

The proportions for individual cuts are summed to determine the composite proportion for the animal. This composite is added to the base price. The USDA Boxed Beef price provides a proxy for the USDA average cuts. The remaining variables represent the characteristics of the producer cuts. With the exception of the USDA Boxed Beef price, the remaining variables characterize the animal. The price an animal receives at slaughter in this alliance is perceived to be dependent on production, conformation and quality variables. Process Verification and the season in which the animal is marketed are also included as independent variables. The Process Verification variable represents a management decision to participate in the alliance's marketing program. The season that the animal is marketed in is thought to affect price because the number of animals available for slaughter. Reproductive schedules and growth rates influence when an animal will reach market age.

In all the models, CARPD is the premium or discount (measured as dollars per pound of hot weight) paid for the animals at slaughter. AGE is the number of months the animal has lived (months), DFG is the number of days that the animal was fed grain (days) and DFG2 is the number of days the animal is fed grain squared (days). Age is expected to have a positive influence on price received. The number of days that the animal is fed grain is squared to demonstrate the quadratic relationship between days fed grain and carcass price. This relationship exists because there is a tradeoff between marbling and leanness (Boland and Schroeder). BBP is the USDA Boxed Beef carcass equivalent price for Choice Light weight

animals (dollars per pound) and HWT is the carcass hot weight (pounds). The USDA Boxed Beef price is expected to have a positive sign. As the conventional market price increases, the price paid by the alliance will increase to provide producers with an incentive to sell to the alliance. The hot weight of the carcass is expected to have a positive effect on price also. The coefficients for DFG, DFG2, HWT, and BBP are scaled to one hundred units by dividing by 100. These variables are scaled to simplify the interpretation of the coefficient estimates.

GEN is a binary variable for gender. Steers are expected to receive a premium over heifers. BRD is the binary variable for breed. Animals that are at least 50% Black Angus are expected to command a premium over animals that are less than 50% Black Angus. FD1 and FD2 are binary variables for the feed used in the finishing ration. Hay is the base feed in the finishing ration, which means that both corn and milo/barley are compared to hay. The sign on corn is expected to be positive. Corn is a higher energy feed when compared to hay. Therefore, cattle gain weight more efficiently. Milo or barley is expected to yield a premium over hay as well.

GRD1 and GRD2 are binary variables for USDA quality grades. Select carcasses are considered the base. Prime and Choice quality grades can be interpreted relative to the Select base. Both Prime and Choice quality grades are both expected to receive a premium over Select quality grades. PV is a binary variable that indicates whether or not the animal is Process Verified. The Process Verified variable is expected to be positive. Process Verification is thought to add value in marketing the animal because more information is made available from producer to consumer. The seasonal binary variables are defined as SEA1, SEA2, and SEA3. The base is January through March. Each of the three seasons is compared independently to the base of January through March. A carcass with the base characteristics is defined as a 50% Black Angus

heifer that is fed hay and quality graded Select, is not Process Verified and is marketed from January through March.

Results

The model, which was estimated using ordinary least squares, explained 42.35% of the variability in carcass premium or discount by the independent variables as seen in Table 3. Age was highly significant, with a one month increase in the age of the animal resulting in a \$0.0026 increase in carcass price per pound. Days fed grain and days fed grain squared are also highly significant. The optimal number of days to keep an animal on feed as a finishing ration is 136 days. A \$1 per pound increase in the price of USDA Choice Boxed Beef price results in a \$0.8905 per pound increase in the carcass price. A steer carcass receives a discount of \$0.0086 per pound. This result is significant at the 0.10 level. The carcass of an animal less than 50% Black Angus is discounted by \$0.0296 per pound. The estimates for predominant feed type in the finishing ration are not significant. A carcass graded Prime receives a premium of \$0.1196 per pound relative to a carcass graded Select and the estimate is highly significant. If the carcass graded Choice, carcass price increases by \$0.0060 per pound relative to a Select carcass. This estimate is not statistically significant.

Variables for the season that the animal is marketed in have contrasting effects. A discount of \$0.0314 per pound results when animals are marketed from April through June compared to marketing from January through March. Cattle that are marketed from October through December are also discounted by \$0.0107 per pound compared to those marketed from January through March. A premium of \$0.0187 per pound is received when animals are marketed from July through September compared to marketing from January through March.

Table 3 Parameter Estimates and Standard Errors for the Model

Variable	Parameter Estimate
Intercept	-0.9980 ** (0.0551)
Age (months), AGE	0.0026 ** (0.0007)
Days fed grain (100 days), DFG	0.1625 ** (0.0410)
Days fed grain squared (100 days), DFG2	-0.0596 ** (0.0143)
USDA Choice Boxed Beef price (\$/pound), BBP	0.8905 ** (0.0277)
Hot weight (100 pounds), HWT	-0.0028 (0.0033)
Gender (steer), GEN	-0.0086 * (0.0051)
Breed (less than 50% Black Angus), BRD	-0.0296 ** (0.0054)
Corn, FD1	0.0100 (0.0135)
Milo/barley, FD2	-0.0177 (0.0152)
Prime, GRD1	0.1196 ** (0.0109)
Choice, GRD2	0.0060 (0.0050)
Process Verification, PV	-0.1814 ** (0.0080)
April through June, SEA1	-0.0314 ** (0.0070)
July through September, SEA2	0.0187 ** (0.0071)
October through December, SEA3	-0.0107 (0.0076)
Adjusted R ²	0.4235

Standard errors are in parentheses.

**Denotes significance at the 0.01 level.

*Denotes significance at the 0.10 level.

Process Verification of an animal resulted in a discount of \$0.1814 per pound to carcass price. This estimate is statistically significant and unexpected. The magnitude of the estimate is relatively large. This raises a question about what this binary variable is capturing in the model. This is perplexing because Process Verification is expected to add value to the animal by providing the consumer with more information. It seems that Process Verification may be capturing a time trend instead of the characteristics of the animal. Animals that have Process Verified characteristics may already be identified in the model through age, gender, and breed. The negative sign of Process Verified may also be explained by the market environment in 2002 and 2003. In 2003, USDA Boxed Beef prices increased to record levels. Therefore, the Process Verified variable may be capturing a time trend between 2002 and 2003. A longer time series is needed to further analyze this relationship.

Limitations of the Research

There are certain limitations to the research. The limitations mainly pertain to the data that were available to conduct the study. These limitations are preventing the possibility of increasing the explanatory power of the models. Three major limitations are discussed: the length of the study period, the absence of yield grade information and the inclusion of only one alliance.

The first limitation is the length of the study. The time period of the study may be too short. Data are only available for one year of Process Verification. To complicate this limitation, 2003 was an uncharacteristic year in the conventional market. USDA Boxed Beef prices were at record highs. The negative impact of Process Verification is likely a result of a short study period during an uncharacteristic year.

The second limitation is the absence of yield grade information. Yield grades are frequently used in determining carcass prices. In addition to the absence of yield grades, there are also no data available on marbling scores or dressing percentages. This provides part of the explanation for the inability of the independent variables to more accurately predict price.

The third limitation is that the data are alliance specific. More could be gained by studying Process Verification throughout the beef industry. Consideration could be given to different geographical regions incorporating a larger share of the market. This would allow for comparisons between groups of producers.

Future Research

Research related to producer alliances and USDA Process Verification may hold much promise in the future. The directions of this research should consider long term effects, cost and benefit analyses and more descriptive data collection. This research would provide a measure for the viability of producer certification programs.

There may be considerable value in studying the long term effects of Process Verification. This would require a significantly larger data set. Data prior to the adoption of Process Verification and after the adoption of Process Verification would be needed. A very discriminatory system of identifying animals that comply with the program's standards should be developed. If Process Verification is to be defined as a binary variable, estimates should be adjusted for yearly effects. This could be accomplished through studying the market over a number of years.

More research on the costs and benefits of programs such as Process Verification is warranted. This research could be used to determine the profitability of implementing the

program. Research regarding what type of producer would benefit the most from the program would also be beneficial. This could be in relation to the producer's age, operation size or expertise.

Collecting data that is multifaceted and complete is essential to studying producer programs that focus on providing the consumer with additional information, such as Process Verification. Collection of data from all levels of the supply chain would be beneficial. This would allow study of the program and market response at the producer, processor and consumer levels.

This was a relatively carefully planned study. The main lesson for producers involved in an alliance that is contemplating process verification is that there are no immediate economic incentives. The main issue for this alliance is creating competitive advantage for the animals marketed by these producers. Creation of a national animal identification program should make these producers more competitive relative to other producers or producer alliances that are not process verified.

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