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Marginal Value of Quality Attributes for Natural and Organic Beef

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ABSTRACT

The objective of this research is to determine the marginal value of attributes to consumers with respect to natural beef or beef produced with organic grains. A hedonic model is used to value attributes of 11 different primal cuts. Results suggest that producers under this particular natural/implant-free marketing alliance should market high-yielding animals rather than high-quality grading animals. Consumers of this beef value taste, as measured by dry aging, and leanness, as measured by USDA Select grade. The economic magnitudes of the variables under a producer's control were small relative to those that could be controlled by a processor.

Key Words: *beef, small farms, hedonic.*

Consumers are increasingly demanding food products possessing specific attributes related to production and/or processing (Barkema; Streeter, Sonka, and Hudson). One popular food product is organically or naturally produced beef. Producers have responded to the increasing demand for natural beef products by attempting to meet the demand through organized alliances. Givry found more than 30 producer-owned cooperatives or private firms marketing organic or natural beef in the United States in 1998.[1] Many beef producers are considering making investments in organic or natural beef production systems and marketing cooperatives to provide beef products to consumers.[2] The USDA Small Farm Commission Report indicated that market research is a critical need for producers in these types of systems. Because producers of organic or natural beef market animals that may possess any combination of multiple attributes (e.g., organically grown, produced on small farms, no

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[1] The terms *natural* and *organic* are often confusing to consumers and producers. *Natural* is defined by the U.S. Department of Agriculture as "a product containing no artificial ingredient or added color and is only minimally processed (a process that does not fundamentally alter the raw product) may be labeled natural. The label must explain the use of the term natural (such as no added colorings or artificial ingredients or minimally processed)." *Organic* is in the process of being defined by USDA but is being labeled as "certified organic by (the name of the certifying agency)." The U.S. Department of Agriculture did not allow beef to be labeled as organic until February 1999. However, beef could be labeled as natural.

[2] It should be noted that Greene found that the number of beef cows which were considered 'organic' actually declined from 6796 in 1992 to 4429 in 1997. However, this could be because meat could not be labeled as organic. Thus producers did not receive any economic incentives for organic certification. While it is likely that the total number of cattle under organic certification systems increased, producers did not attempt to certify them.

synthetic growth promotants, etc.) using contracts (e.g., Laura's Lean Beef, Coleman, etc.) or through cooperatives (e.g., Tall Grass Prairie, All Natural Beef, etc.), it is important that they have information on which attributes are most valued by consumers.

Some attributes (such as breed, marbling, etc.) may be attainable through production practices such as genetic selection, becoming certified organic, or feeding grain or grass in the finishing ration. Other attributes valued by consumers might include tenderness or pasteurization labeling, which are at least influenced through processing practices such as dry aging or irradiation, respectively. The value of the attribute has implications for a producer's decision to invest in a cooperative. This could help avoid potential moral hazard problems that arise in an agency theory framework whereby a firm contracts with a producer for beef with certain attributes using some premium over a commodity price but the producer does not know which attributes are most highly valued. Consequently, producers may make investments in production assets or systems that may not be needed.

Natural or organic beef and conventionally produced beef are examples of product differentiation. The product (e.g., beef) is the same across production systems but its price may differ because producers use different production methods and consumer demand varies by production practice. The variety of attributes (e.g., conventional, natural, organic, etc.) for beef products is characteristic of differentiation. The value of these attributes can be estimated by using hedonic price functions. The objective of this research is to determine the marginal value of attributes to consumers with respect to natural beef or beef produced with organic grains and sold by small producers in a chain of Midwestern supermarkets.

Background Information

Demand for beef has declined markedly since the late 1970s (Purcell). Lusk *et al.*, in reviewing literature on factors contributing to the decline in beef demand, noted that changes in relative prices, consumer health concerns, food safety concerns, product convenience and offering, product quality and consistency, changing demographics, and evolving consumer preferences are significant factors explaining this decline. Schroeder, Marsh, and Mintert found that many of these factors adversely affected beef demand especially vis-a-vis competing meats. However, many of these factors cannot be changed solely by producers, processors, or retailers (Smith *et al.*). Integrated or tightly coordinated beef production and processing systems are able to respond to economic incentives for various product quality attributes more readily than the traditional cash market system (Schroeder *et al.*).

Producers

Beef producers are able to make improvements in genetics through selecting for traits such as improved feed conversion to reduce per-unit production costs or enhanced marbling to increase per-unit marketing revenues. Similarly, a producer may decide not to use cost-reducing technologies such as synthetic growth promotants or subtherapeutic antibiotics if sufficient economic incentives exist to produce natural beef products.

Sartwelle identified three categories of marketing alliances that were used by producers to increase revenue per animal: breed association-sponsored, commercial, and natural/implant-free. Depending upon the program, alliances typically seek high quality grade targets with acceptable muscling *or* acceptable quality grades with high-yielding carcasses within these three categories. One breed association-sponsored program, Certified Angus Beef™, seeks high-yielding carcasses and has doubled in size since 1995 to almost 500 million pounds annually. A brand for one commercial alliance, Maverick Ranches Beef Prime Beef, seeks high quality grade targets (USDA Prime).

The choice of farming system is another factor producers may use to enhance revenues. Economies of size and scope exist among various enterprises (e.g., cow-calf production, feedlot) and a producer may choose a production system that utilizes more labor than cap-

ital (e.g., cow-calf to finishing). Organic beef production is primarily done through cow-calf to finishing systems rather than cow-calf and feedlot systems. However, it is unclear whether consumers will provide large enough economic incentives to offset potential higher production and processing costs associated with tightly controlled organic beef systems. Organic certification vis-a-vis natural beef labeling may or may not be a valuable attribute to consumers.

The choice of feed ingredients is another controllable factor. Grain has long been known to increase marbling in beef relative to grass-fed beef. Although marbling level is reflected in USDA quality grade, perceptions of other beef quality attributes associated with grain-fed beef may make it have greater value to consumers.

Processors

Many factors affecting beef demand are related to product quality. In particular, lack of tenderness is a commonly cited quality concern of processors and retailers (Smith *et al.*). Many studies have found that tenderness is the most important attribute of beef palatability (Dikeman; Huffman *et al.*). Tenderness is a function of several things including genetics, length of time cattle are fed, processing, aging, and product cooking and preparation (Miller *et al.*). Beef processors have numerous techniques they can use to influence beef product tenderness including aging and various methods of mechanical tenderizing.

Wet-aged or vacuum-packaged beef has been the industry standard since development of commercial vacuum-packaging technology in the late 1960s. This has decreased processing costs as a result of lower inventory costs. Dry-aging is more costly relative to other conventional processing methods, but aging tenderizes beef naturally (Huffman *et al.*). However, additional time required in refrigerated coolers and estimated shrink loss of at least 10 percent significantly increases the cost of producing dry-aged beef.

Unnevehr and Bard determined that the more external fat and seam fat beef table cuts had, the lower the consumer demand for those cuts. They also found that higher levels of marbling were preferred for loin steaks but discounted in chuck roasts. The current USDA quality grading system uses intramuscular fat or marbling as a primary measure of quality. However, this is poorly correlated with tenderness (Wheeler, Cundiff, and Koch). Consequently, tenderness or similar attributes have not been a component of most beef value-based marketing programs. However, several existing technologies have potential for measuring and/or changing tenderness and could be used in a value-based marketing program (Miller *et al.*, Shackelford, Wheeler, and Koohmaraie).

Schroeder, Marsh, and Mintert found that a large increase in the number of beef recalls results in a significant decline in beef demand. Although it is difficult to obtain quantitative evidence on consumer attitudes towards food safety concerns, traceability or identity-preservation has clearly become a more important attribute in recent years. Labeling beef that has been produced under such systems may help alleviate consumer concerns over safety and therefore have increased value to consumers.

Conceptual Model

Ladd and Martin used consumer demand theory to develop a similar theory for processor demand using profit maximization rather than utility maximization. In the Ladd and Martin framework, inputs are used to produce a product using some production process. They developed the familiar hedonic price model where prices of a good are a function of the attributes the good possesses as seen in equation (1):

$$(1) \qquad P_y = \sum_{i=1}^{m} B_i Q_{iy}.$$

In (1), B_i is the marginal implicit value of attribute i and Q_{iy} is quantity of the ith attribute in each unit of input x used to produce y. For beef, (1) states that the observed price of beef (P_y) is equal to the summed product of the value of marginal product of attribute i (i =

color, tenderness, etc., . . . , m) used to produce y and the marginal yield of attribute i used to produce y from input x. It is commonly assumed that each additional unit of input x contributes the same amount of the ith attribute to produce y (ex., each unit of corn makes an equal contribution to the marbling attribute in beef) and that the marginal implicit price for each i attribute is constant for each unit of x (e.g., the price of marbling is the same for all units of grain fed).

Ladd and Martin's model of processor demand describes the value of inputs that are observable and composed of attributes that are unobservable. That information is important to processors. However, using that information in a value-based marketing program may be difficult. For example, Sartwelle noted that value-based marketing programs for cattle are based on total carcass revenue which is adjusted for various quality targets. This can be seen as a modification of (1) allow for multiple outputs of

$$(2) \qquad \sum_{y=1}^{n} P_y Q_y = \sum_{i=1}^{m} \alpha_i Q_{ix}$$

where $\alpha_i (\alpha_i \neq B_i)$ is the marginal implicit value of attribute i, P_y is the price of output y and Q_y is the quantity of output y (y = rib eye, brisket, etc., . . ., n). For beef, (2) states that the summed revenue of output is equal to the summed product of the marginal product of each attribute. Thus the goal of a beef processor seeking to form an alliance with producers to meet consumer demand for various quality attributes is to devise a value-based marketing program that uses the information on the value of unobservable attributes obtained in (1) and convey that information to producers via (2) using economic incentives.

In order to accomplish this, a processor may contract various x inputs that contain i attributes with producers or provide quality targets similar to those noted by Sartwelle. In either case it is important for a processor to devise a value-based marketing program that best provides economic incentives to producers to use inputs that enable it to meet consumer demand for various attributes.

Data

Data for natural and organic beef sales on 630 beef cattle marketed from May 1996 to December 1999 were obtained from a collaborating producer-owned cooperative. The first three months of data (55 carcasses) were not used because of wide variability in live weight as the program was getting started. Another 97 carcasses had incomplete information. Thus data on 478 carcasses are used in this analysis. The production system used by these producers are typical of small farms as defined by Gebremedhin and Christy and USDA's Small Farms Commission in that they likely have less than $40,000 a year in sales and have an integrated livestock and cropping system that is highly dependent upon their own and family labor. The majority of producers have little or no post-secondary education and market under 25 head of cattle per year.

The beef was sold through a value-based marketing program based upon weight of the primal cuts. The retailer pays producers wholesale prices for each cut based on a negotiated rate for that week. A net carcass price per pound based on the weighted average of the primal cut weights and prices is also reported to producers. Slaughter and processing are contracted on a per-head basis by the marketing cooperative. Producers receive no credit for byproducts, but these are used by the processor. The contract processing fee is reduced by the value of byproducts, hide, bones, and similar inedibles.

Producers are required to complete information on each animal marketed through the cooperative as part of their identity-preserved system. Producer variables include *Age* which is the life of the animal measured in months, *Live Weight* (measured in pounds), *Days Fed Grain* which is the number of days that the animal was fed a finishing ration to help promote marbling, *Feed Type* or principal type of feed in the finishing ration (corn, barley or milo, hay or pasture grasses), *Breed Type* (measured as Angus crosses or European

breed crosses), *Gender* (steer or heifer), *Lot Number,* and *Eartag Number.*[3]

The majority of animals that were sold initially on this program were solely grass-fed because the retailer indicated a preference for a very lean product. However, the retail supermarket soon asked the producers to increase the amount of marbling in the primal cuts because the beef was too lean. Thus *Feed Type* was measured to provide information to the retailer regarding tradeoffs between leanness (grass-fed) and marbling (corn-fed). *Days Fed Grain* was used to provide information to both producers and the retailer on leanness and marbling. If animals are grain-fed for long periods, they may develop excessive marbling for consumers desiring lean beef. On the other hand, a finishing ration that is fed for too short a period likely will not provide sufficient marbling desired by consumers. Thus a quadratic relationship between price and *Days Fed Grain* is expected. The weight, as measured by *Carcass Weight,* also is used as a measure to ensure that animals have desired muscling.

The cooperative contracts slaughter, processing, and dry aging of beef with several local processing plants. The processor variables include *Organic Label* if the animal was produced under a certified organic system; *USDA Grade* measured as Prime, Choice, or Select; and *Number of Days Aged* which represents how long each primal cut is aged (measured as number of days from slaughter until placed in the retail supermarket counter). Other variables collected but not used in this analysis include weight (in pounds) of the primal cuts (Shoulder Clod, Top Butt, Tenderloin, Flank Steak, Inside Round, Gooseneck, Knuckle, Brisket, Strip, Mock Tender, and Rib Eye), weight of the trimmings and ground beef, liver, tail, and other byproducts.

Thus in this analysis 10 variables in i (i = *Days Fed Grain, Days Fed Grain*^{2}, *Breed, Age, Feed Type, Carcass Weight, USDA Grade, Number of Days Aged, Gender* and *Organic Label*) are used to explain the price of 11 inputs (x = Rib Eye, Brisket, Mock Tender, Tenderloin, Strip, Top Butt, Inside Round, Gooseneck, Knuckle, Shoulder Clod, and Flank Steak). These 11 inputs (plus byproducts) determine Y which is the quantity of wholesale beef produced from each carcass.

Another variable, *Choice Price*$_x$, was added to i to account for changes in aggregate beef price over time. This variable is the Choice U.S. Department of Agriculture price for each respective beef subprimal for the week the producer sold the animal. In addition, the U.S. Department of Agriculture Choice Wholesale boxed beef cutout carcass equivalent price was collected and used in analyzing the prices received by producers for entire carcasses.

Summary statistics of the i variables and live weight are reported in Table 1. In Table 2 the wholesale price per pound paid to producers for each primal cut (e.g., P_x) and the USDA prices are reported. A producer's total carcass revenue was calculated by multiplying the wholesale prices in Table 2 by their respective weight as measured in pounds. Each of the wholesale prices paid to producers in Table 2 was regressed on the i variables in Table 1 (excluding live weight) and the USDA prices for each animal using ordinary least squares to determine the marginal implicit value of each i (equation 1). The same process was used to regress carcass revenue on the i variables and a USDA choice boxed beef price (equation 2).

Equation (1) was estimated for each of the x equations using seemingly unrelated regressions and equation (2) was estimated using ordinary least squares. Because of the number of potentially correlated variables used in the regression models, collinearity diagnostics were calculated.

Results

Results are discussed separately for information available to a processor in equation (1) and information available to a producer in equation (2). Multicollinearity was not an issue in any of the models (except for the expected collinearity between *Days Fed Grain*

[3] USDA regulations require products that have been certified organic to be labeled as such. Natural labeling has no such certification program and does not require such labeling.

Table 1. Summary Statistics for NonPrice-Independent Variables Used to Explain Beef Primal Cut Prices

Variable	Average	Std. Dev.	Min	Max
Live Weight (100 pounds)	11.80	0.97	9.20	18.00
Carcass Weight (100 pounds)	7.32	0.89	.52	1.03
Age (months)	21.21	3.21	15	30
Corn[a]	0.78	0.41	0	1
Milo[a]	0.10	0.30	0	1
Hay[a]	0.12	0.32	0	1
Prime[b]	0.01	0.12	0	1
Choice[b]	0.47	0.50	0	1
Select[b]	0.51	0.51	0	1
Breed[c]	0.21	0.41	0	1
Days Fed Grain (100 days)	1.93	0.40	1.05	3.00
Days Aged—steaks[d]	15.56	1.32	14	19
Days Aged—roast[e]	6.20	1.12	5	9
Organic Label[f]	0.12	0.32	0	1
Gender[g]	0.56	0.50	0	1

[a] Corn, Milo, and Hay are binary variables equal to 1 if that was the predominant finishing ration and 0 otherwise.
[b] Prime, Choice, and Select are binary variables equal to 1 if the carcass was that quality grade and equal to 0 otherwise.
[c] Breed is a binary variable where 0 is an Angus cross and 1 is other European crosses.
[d] Steaks are flank, brisket, mock tender, tenderloin, rib eye, and strip.
[e] Roast includes shoulder clod, inside round, top butt, knuckle, and gooseneck.
[f] Organic labeling is a binary variable where 0 = non-organic labeled and 1 = organic labeled.
[g] Gender is a binary variable where 0 = heifer and 1 = steer.

and Days Fed Grain^2).[4] Table 3 presents parameter estimates, (β_i), and standard errors for the 11 different equations from equation (1). The system weighted R^2 was 0.64.

In general, statistical significance was noted in five or more of the models (except *Breed*) for variables that producers have some control over such as *Days Fed Grain, Gender, Age,* and type of feed (*Corn, Hay* or *Pasture Grasses, Milo* or *Barley*). However, the economic significance was small relative to variables that a processor had some control over such as *Number of Days Aged* and *Choice Price.*

For example, *Days Fed Grain* was statistically significant (linear, quadratic, or both terms) for six of the 11 cuts. All roast type cuts (except Shoulder Clod and Gooseneck) had significant *Days Fed Grain* parameter estimates. The most notable price impact was for the strip where optimal number of days on feed (i.e., the point where the highest premium was paid) increased at a decreasing rate with a maximum premium relative to zero days fed of approximately $1.03 per pound at about 180 days on feed. The Top Butt and Inside Round had similar patterns to the Strip but with smaller premiums at the optimal number of days. The Rib Eye, Knuckle, and Flank Steak had declining prices the longer the animal was on feed (for at least up to 200 days on feed). Largest discounts were realized at about 260 days on feed with discounts as large as $1.09 per pound for Rib Eye and small discounts for the other cuts.

Allowing animals to become more mature (*Age*) results in small price increases for Rib Eye, Mock Tender, Top Butt, and Shoulder Clod but decreases price for Tenderloin. As an animal gets heavier, muscling increases at a faster rate than live weight. Thus older animals tend to have more muscling which is a desirable trait because many consumers value boneless cuts for convenience in cooking. It is more cost efficient to remove the bone from larger primal cuts of meat.

[4] Multicollinearity was judged to be potentially degrading if the condition index was greater than 30 and the variance decomposition proportions among two or more estimated parameter estimates were greater than 0.50 (Belsley, Kuh, and Welsch).

Table 2. Summary Statistics of Actual Wholesale Prices Paid to Producers in Cooperative and USDA Wholesale *Choice Price*, P_x ($ per pound)[a]

Variable	Mean	Standard Deviation	Minimum	Maximum
Prices paid to producers				
Rib Eye	4.04	0.62	3.08	5.38
Shoulder Clod	0.98	0.09	0.83	1.25
Brisket	0.90	0.13	0.72	1.23
Mock Tender	1.48	0.13	1.23	1.98
Tenderloin	7.41	0.94	6.24	10.12
Strip	3.31	0.41	2.52	4.22
Top Butt	1.26	0.15	1.05	1.88
Inside Round	1.07	0.11	0.83	1.35
Gooseneck	1.09	0.04	0.86	1.16
Knuckle	1.33	0.08	1.15	1.53
Flank Steak	2.53	0.22	2.22	3.20
USDA Prices				
Rib Eye	4.01	0.51	3.27	5.20
Shoulder Clod	0.94	0.06	0.83	1.09
Brisket	0.89	0.12	0.73	1.24
Mock Tender	1.25	0.11	1.02	1.50
Tenderloin	7.10	1.02	5.14	10.33
Strip	3.03	0.39	2.47	3.98
Top Butt	1.73	0.21	1.43	2.21
Inside Round	1.15	0.05	1.04	1.27
Gooseneck	1.07	0.04	0.81	1.11
Knuckle	1.21	0.06	1.05	1.37
Flank Steak	2.40	0.22	2.12	2.97
Boxed Beef	1.05	0.07	0.94	1.20

[a] We acknowledge Rob Murphy, Sparks Inc., for providing USDA Wholesale prices.

Corn and Hay were used as dummy variables in measuring *Feed Type*. Using mostly corn in the finishing ration increases price (relative to using milo) of Rib Eye, Top Butt, Shoulder Clod, and Flank Steak but decreases Tenderloin and Gooseneck prices. Conversely, using mostly hay in the finishing ration increases price (relative to using milo) of Brisket, Top Butt, and Inside Round and decreases Strip, Gooseneck, and Knuckle prices.

Choice Price was significant in all 11 models. An increase in the USDA Choice price for each primal cut, *ceteris paribus*, is associated with an increase in price of each cut. The greatest change was for the *Choice Price* of Tenderloin where a $1 increase in the USDA Choice price resulted in a $0.96 increase in Tenderloin price. Gooseneck had the lowest increase in price ($0.21) for a $1 increase in *Choice Price*.

Number of Days Aged was statistically significant in nine of the models. An increase in *Number of Days Aged, ceteris paribus*, yielded an increase in the price of Top Butt and Inside Round. The largest increase was Top Butt where a one-day increase in number of days aged resulted in a $0.031 per pound increase in price. Prices of Rib Eye, Mock Tender, Tenderloin, Gooseneck, Knuckle, Shoulder Clod, and Flank Steak decrease when *Number of Days Aged* increase. These primal cuts are primarily roast type products where tenderness is of less value relative to higher valued steak cuts such as Rib Eye and Strip. This result also could reflect that as inventory of these cuts increases, price may adjust downward as new

Table 3. Parameter Estimates, Standard Errors, and Regression Statistics for Nine Variables Explaining Wholesale Primal Cut Prices (n = 478), β_i[a]

Variable[a]	Rib Eye	Brisket	Mock Tender	Tender-loin	Strip	Top Butt	Inside Round	Gooseneck	Knuckle	Shoulder Clod	Flank Steak
Intercept	1.159	.182	.994	.94	.919	.255	−.161	.939	.377	.761	1.831
	(.574)	(.096)	(.093)	(.606)	(.406)	(.136)	(.124)	(.041)	(.089)	(.094)	(.222)
Days Fed Grain	−.809*	.045	.052	.128	1.13*	.422*	.232*	−.042	−.35*	−.09	−.662*
	(.436)	(.068)	(.066)	(.429)	(.324)	(.115)	(.086)	(.031)	(.072)	(.076)	(.172)
Days Fed Grain^2	.15	−.019	−.016	−.066	−.311*	−.124*	−.058*	.009	.096*	.004	.159*
	(.116)	(.018)	(.017)	(.114)	(.086)	(.031)	(.023)	(.008)	(.019)	(.02)	(.046)
Gender	−.028	−.022*	.009	.126*	.143*	−.001	−.005	.005	−.006	−.017*	−.037*
	(.045)	(.007)	(.007)	(.044)	(.034)	(.011)	(.009)	(.003)	(.008)	(.007)	(.018)
Breed	−.011	.005	.001	−.038	.049	−.017	.003	.01*	−.01	.014	−.009
	(.053)	(.008)	(.008)	(.052)	(.04)	(.014)	(.011)	(.004)	(.009)	(.009)	(.021)
Age	.02*	.002	.003*	−.02*	.01	.009*	.001	.001	−.002	.004*	.003
	(.009)	(.001)	(.001)	(.009)	(.006)	(.002)	(.002)	(.001)	(.001)	(.002)	(.003)
Corn	.216*	.01	−.006	−.294*	−.035	.056*	−.014	−.014*	−.019	.037*	.114*
	(.077)	(.012)	(.011)	(.075)	(.057)	(.02)	(.015)	(.006)	(.013)	(.013)	(.03)
Hay	.077	.044*	−.012	−.111	−.2*	.064*	.05*	−.014*	−.067*	.02	.18
	(.101)	(.016)	(.015)	(.099)	(.076)	(.027)	(.020)	(.007)	(.017)	(.018)	(.04)
Carcass Weight	.076*	.003	−.006*	.002	−.03	−.011	−.019*	.002	.015*	−.002	−.015*
	(.026)	(.004)	(.004)	(.025)	(.019)	(.007)	(.005)	(.002)	(.004)	(.005)	(.01)
Choice Price	.759*	.747*	.505*	.96*	.286*	.222*	.876*	.208*	.928*	.28*	.528*
	(.029)	(.027)	(.022)	(.019)	(.023)	(.017)	(.061)	(.017)	(.026)	(.039)	(.029)
Organic Label	.17*	−.009	−.003	.034	−.056	−.041*	−.035*	.012*	.03*	.008	−.011
	(.066)	(.01)	(.01)	(.064)	(.049)	(.017)	(.013)	(.005)	(.01)	(.012)	(.026)
Prime	−.077	−.005	.025	−.213	.074	.083*	.01	−.023*	−.024	−.039	−.062
	(.178)	(.027)	(.027)	(.172)	(.132)	(.047)	(.035)	(.013)	(.029)	(.031)	(.07)
Choice	−.076*	−.011	−.005	−.067*	.035	−.007	−.016*	.003	−.008	−.003	−.004
	(.043)	(.007)	(.006)	(.042)	(.032)	(.011)	(.009)	(.003)	(.007)	(.008)	(.017)
Number of Days Aged	−.028*	−.001	−.021*	−.029*	.001	.031*	.028*	−.011*	−.015*	−.005*	−.014*
	(.014)	(.003)	(.003)	(.016)	(.009)	(.005)	(.004)	(.002)	(.003)	(.003)	(.007)

[a] * Denotes that the variable is significant at the .10 level. Standard errors are in parentheses.

inventories arrive. Steak primal cuts are aged about ten days longer than roast type products (Table 1).

Under this particular value-based marketing program, prices are lower (relative to USDA Select) for Rib Eye, Tenderloin, and Inside Round if the animal graded USDA Choice relative to Select. Prices also are lower (relative to USDA Select) if the animal graded USDA Prime for Gooseneck and higher (relative to USDA Select) for Top Butt. Discounts for higher levels of marbling reflect this particular program where leanness is preferred and certainly are not reflective of national wholesale beef markets. Prices of Rib Eye, Gooseneck, and Knuckle increase when produced (and labeled) under organic production (*Organic Label*) but Top Butt and Inside Round decrease in price.

Table 4 presents the parameter estimates (α_i), standard errors (in parentheses), and coefficient of determination (R^2) for equation (3) where the entire carcass price received by the producer is analyzed.[5] The relative ability of the variables to explain variability in total carcass revenue was 0.83. *Days Fed Grain, Gender, Carcass Weight,* and *USDA Boxed Beef Price* had significant parameter estimates. The optimal number of days to feed cattle in terms of highest price per pound was 221 days. Of course, this needs to be considered jointly with discounts for increased carcass weights and marginal costs of adding weight. A $1-per-pound increase in the *USDA Boxed Beef Price* increased total carcass revenue $41.90. Carcass revenue increased for heavier carcasses and steers had a higher value relative to heifers. Clearly, a processor could develop a value-based marketing program using carcass weight, boxed beef price, and an animal's gender to further provide economic incentives to producers.

Table 4. Parameter Estimates, Standard Errors, and Regression Statistics for Eight Variables Explaining Carcass Revenue, α_i, (n = 478)[a]

Variable	Parameter Estimate
Intercept	−16.746
	(30.761)
Days Fed Grain	−24.133*
	(15.449)
Days Fed Grain^2	5.454
	(6.77)
Gender	3.015*
	(1.679)
Breed	2.265
	(3.138)
Age	.234
	(.52)
Corn	2.047
	(4.525)
Hay	−1.128
	(5.594)
Carcass Weight	1.735*
	(.508)
Boxed Beef Price	4.19*
	(.19)
Organic Label	1.148
	(3.845)
Prime	−1.451
	(10.442)
Choice	1.155
	(2.547)
Regression F[b]	191.55
R^2	.832

[a] * Denotes that the variable is significant at the .10 level. Standard errors are in parentheses.
[b] All the Regression F statistics are significant at .001.

Implications

Results suggest that producers under this particular natural/implant-free marketing alliance should market high yielding animals rather than high quality grade animals. Consumers of this beef value tenderness, as measured by dry aging, and leanness, as measured by USDA Select grade. From the processor's perspective, these two variables contributed the most after the USDA Choice price. The economic magnitudes of variables under a producer's control were small relative to those that could

[5] *Number of Days Aged* was not included as an explanatory variable because aging occurred after deadline for pricing the animal to the producer. Under the 1920 Consent Decree, processors are required to make payment to a producer within 24 hours.

be controlled by a processor. This suggests that a processor desiring natural beef might seek to coordinate production (e.g., contracts or integration) with producers. Carcass weight, gender, and less marbling would be a significant part of a value-based marketing program between this processor and these producers. Producers would need to invest in the processor in order to share in any positive returns from dry aging of beef.

These results are specific to this particular alliance and are not generalizeable to all producers or all alliances. However, this demonstrates clearly that some consumers value beef attributes that differ from aggregate market signals. Prime and Choice wholesale beef are always at premiums in the market relative to Select. However, consumers patronizing this particular alliance apparently value leanness over marbling and prefer to rely on aging to improve tenderness. Whether the producer is certified organic is not important to these consumers. Other consumer groups likely value different attributes in different ways from those in this study. This suggests that when beef producers target specific consumer segments, they need to know the particular consumers' preferences and realize they may differ from aggregate market signals.

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