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The Value of Third-Party Certification of Preconditioning Claims at Iowa Feeder Cattle Auctions

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After controlling a variety of feeder cattle characteristics and market and sale conditions in Iowa feeder auctions, the price premiums for preconditioning claims (vaccinations and minimum 30 days of weaning) with and without third-party certification (TPC) are estimated as \$6.12/cwt and \$3.35/cwt, respectively. These premiums differ statistically ($p < 0.0001$), and their difference exceeds the average participation cost of TPC (\$1/cwt). This indicates that TPC is valued in the market to credibly signal preconditioning investment under asymmetric information.

Key Words: asymmetric information, feeder cattle auctions, quality, signalling, third-party certification

JEL Classifications: Q11, Q12, Q13, C23

The U.S. beef industry is striving to meet consumer demands for consistent, high-quality products in both domestic and foreign markets amid intense competition from other animal protein sources and health concerns such as bovine spongiform encephalopathy (BSE) and foot-and-mouth disease. The recent proliferation of beef alliances, value-added programs, beef brands, and quality and process assurance programs reflects these efforts. There is, therefore, considerable interest in the preconditioning investment in feeder calves at the farm of origin, which generally refers to vaccinations and minimum 30-day weaning, along with other good management practices such as dehorning, castration, etc. The purpose of preconditioning is to boost the immunization system of cattle in feedlots. This makes the cattle less susceptible to disease, which in turn decreases treatment costs and mortality rates and increases feedlot efficiency and prospects for achieving a higher quality grade.

It has been reported that preconditioning efforts create value for the entire chain (Busby et al.; Dhuyvetter, Bryant, and Blasi; Lalman and Smith; Nyamusika et al.). The preconditioning concept and practices are not new (i.e., the Iowa Green Tag Preconditioning Program has been around for nearly 40 years), but producers' adoption rates for these programs continue as an ongoing discussion in the literature. Hartwig and Vermeer report that the Iowa Green Tag Preconditioning Program has grown in size and reputation over time;

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Table 1. Part I. Data Summary for Categorical Variables[a]

Variable	Frequency[b]	Percentage
Heifer	8,612	45.2
Steer	9,845	51.7
Bull	589	3.1
Black	9,348	49.1
Black–mixed	3,436	18.0
Black–other	392	2.1
Nonblack	5,870	30.8
Horns	470	2.5
No horns	18,576	97.5
Fleshy	908	4.8
Not fleshy	18,138	95.2
Sick and dirty	14	0.1
Sick and clean	293	1.5
Healthy but dirty	595	3.1
Healthy and clean	18,144	95.3
Monthly time dummy for October	1,045	5.5
Monthly time dummy for November	3,388	17.8
Monthly time dummy for December	3,507	18.4
Monthly time dummy for January	7,499	39.4
Monthly time dummy for February	3,607	18.9
Certified vaccinated and weaned at least 30 days	7,046	37.0
Uncertified vaccinated and weaned at least 30 days	3,269	17.2
Vaccinated and weaned other (no date or <30 days)	2,079	10.9
Vaccinated but not weaned	4,134	21.7
Weaned but not vaccinated	843	4.4
Not vaccinated and not weaned	1,675	8.8

[a] Number of observations: 19,046 feeder calf lots.
[b] Number of lots.

close to 400,000 head of cattle (nearly half of the Iowa calf crop) was preconditioned in 2002. Whereas other studies (Dhuyvetter, Bryant, and Blasi; Lalman and Smith) report a slow industry-wide adoption of preconditioning programs because of often contradictory research, variation in management practices and production environment, and controversy over economic incentives. Nevertheless, there is general agreement that the recent trends in the beef industry show the potential of increased interest in preconditioning practices.

The value of preconditioning programs relative to price premiums has been reported (Avent, Ward, and Lalman; Corah et al.; Dhuyvetter, Bryant, and Blasi; King and Seeger; Ward and Lalman). However, none of these studies has focused explicitly on whether third-party certification of preconditioning adds greater value than seller preconditioning or vice versa. The objective of this paper is to fill this gap by investigating the following questions: 1) Is the higher cost of third-party certification of preconditioning offset with a sufficiently higher premium? 2) Does the market make a distinction between the value of uncertified preconditioning and partial preconditioning claims?

On the basis of data that include 19,046 feeder calf lots sold in various sale barns in Iowa from October 2005 to February 2006, it was determined that 37% of feeder calf lots had preconditioning claims with third-party certification (TPC), whereas more than 54% of feeder calf lots had preconditioning claims that were either uncertified or incomplete in the dataset (see Table 1, Part I). Assuming these uncertified or incomplete claims are true, they imply a cost incurred by producers; however, some value can be left on the table because of information asymmetry between seller and buyer.

Whereas auctions are very efficient at bringing buyers and sellers together for price discovery and transferring large volumes of cattle from ranchers to feeders (possibly backgrounders and stockers in between), it is often a challenge to signal the value of cattle at auction. Objective means of measuring quality exist, but they are difficult to employ at auctions, where transactions are done quickly and involve a large volume of animals. Feedlots typically hire order buyers who are experienced in visually assessing cattle, but this has limitations. It is particularly difficult to discern unobservable traits related to past management (such as vaccinations, treatment, nutrition history, weaning status, etc.), and incentives exist for sellers to overstate the condition of their animals or to fail to disclose unfavorable information.

The reputations of sellers are of less concern in a feeder auction environment, where the majority of producers sell a small number of cattle once or twice a year (Chymis et al.; Nyamusika et al.). Moreover, reselling on the basis of speculative motives is not uncommon—buyers and sellers are not negotiating one-to-one as they do in a contract environment; therefore, buyers can be uncertain regarding the previously cited unobservable traits of the cattle. Unless sellers can verify the quality of their cattle in that regard, pricing will be based on the average quality of these attributes in the market, which might not be enough to fully capture investments undertaken by sellers in improving the health or quality of their cattle.

Alternatively, sellers can make their claims more credible via TPC programs such as state-sanctioned Iowa Green, Gold Tag Preconditioning Programs, or private company programs such as Merial Surehealth. These programs have strict prespecified health protocols covering health procedures followed, and a veterinarian signs off the certificates once all the requirements of these programs are met.[1, 2]

Although TPC programs have the potential to mitigate the asymmetric information problem, there are potential complications as well. For these programs to be successful, buyers must trust the integrity of programs and procedures. Nevertheless, different states have multiple protocols and procedures that are not equally monitored and controlled. Feedlots routinely revaccinate the cattle they receive, in part because of a lack of trust in vaccination claims and commingling of cattle with multiple protocols from various regions (Chymis et al.). Furthermore, the flexibilities within TPC programs can create confusion among market participants. For example, in the Iowa Green Tag Preconditioning Program, calves can carry green tags if they satisfy all the requirements except the weaning requirement (minimum 30 days), but they are not considered to be preconditioned and are not provided with the preconditioning certificate (Hartwig and Vermeer). Yet, passing this information and the certificates along at the time of sale requires communication and effort among buyers, sellers, and auction barn operators. Finally, cattle certified by a third

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[1] In the Iowa Green Tag Program, calves must be vaccinated (for IBR, BVD, BRSV, PI-3, 7-way Clostridia, and *Haemophilus somnus*), treated for internal and external parasites, castrated, and dehorned, if necessary. They can be further vaccinated for Mannheima (formerly Pasteurella) and other diseases, implanted with growth promotant, or both, but these are optional. All vaccinations and health procedures must be done by a veterinarian. For gold tag level, calves must be revaccinated 2 weeks or later after the first round of vaccinations. Once these are done, green or gold tags are placed in the upper part of the left ear of the calf by the veterinarian. Calves can be sold as green or gold tagged but they are not considered as preconditioned yet, and they are not supposed to be represented as such. To obtain a preconditioning certificate, calves must be weaned at least 30 or 45 days for green and gold tag programs, respectively. In the certificate, additional information on weaning ration, breed type, source (home raised or not), etc. can be provided, but this is optional. More information about the preconditioning program can be found at the website http://www.iowavma.org.

[2] The details of the Merial Surehealth certified calf preconditioning program can be found at the website http://surehealth.us.merial.com/.

party should be offered at sufficient volume in sales to be of some value to buyers.

The information asymmetry between buyers and sellers at feeder cattle auctions is recognized in the literature (Allen; Chymis et al.; Hueth and Lawrence; Nyamusika et al.). Nyamusika et al. report an insufficient number of vaccinations because of the asymmetric information problem in the market and show that vaccinations against bovine respiratory disease complex generate a $40/head return at the herd level (considered as the closed system of cow/calf producers and feedlots). Chymis et al. analyze the welfare loss effects of the problem of asymmetric information in cattle auctions by focusing on the "revaccination issue," and they suggest the need for more research, particularly empirical research, to quantify this problem. Chymis et al. and Nyamusika et al. also argue that a sufficiently low-cost TPC could improve the efficiency of the system by partially separating high- and low-quality cattle.

Data Sources

The main data for this analysis were collected by four recorders from 105 sales that took place in nine sale barns located in southern and western Iowa. The recorders (trained field specialists) were hired by the Iowa Beef Center at Iowa State University and worked with U.S. Department of Agriculture market reporters who were present in the sales. The sales, which took place between October 20, 2005, and February 24, 2006, included 20 preconditioned and five featured sales; the rest were "special" or regular sales. The preconditioned sales were restricted to cattle weaned and vaccinated according to a certain protocol (e.g., all green tag preconditioned calves, or all according to Merial Surehealth protocol). The featured sales were advertised as "featuring 'all-vaccinated' calves," meaning that most of the animals were vaccinated, although both certified and uncertified protocols might have been followed. Finally, sales advertised as "special" were, in fact, regular feeder cattle sales that featured cattle of various weaning and vaccination status. The main dataset included detailed items relevant to price formation. In addition, daily live cattle futures prices were obtained from the Livestock Marketing Information Center database. Daily corn prices were obtained from the Iowa State University Extension database.

The unit of observation for analysis is a lot. The final dataset included 19,046 feeder calf lots sold after the following adjustments:[3] 1) observations with missing price or feeder cattle characteristics are deleted; 2) yearlings are excluded because the focus of this study is the value of preconditioning effort on feeder calves, and possible preconditioning efforts on yearlings is no longer relevant in that they are mature enough to prove their health (the results of this paper remained robust to the exclusion of yearlings); and 3) the weight range for feeder calves is restricted to have a maximum of 900 lb, consistent with Dhuyvetter and Schroeder. This weight range adjustment resulted in dropping less than 0.7% of the dataset. The results are robust to the alternative weight ranges including the original weight range (1,250 lb maximum) and restricting the weight range further down to the maximum of 750 lb as in Avent, Ward, and Lalman, but the latter would require leaving out a significant portion (nearly 9%) of the dataset.

Modeling

The price received for a lot of feeder cattle is modeled as a linear function of a set of explanatory variables or characteristics. This type of modeling, known as the hedonic pricing model, is commonly used in the literature to study the valuation of feeder cattle. A similar specification to those in Avent, Ward, and Lalman and Dhuyvetter, Bryant, and Blasi is adopted.

The hedonic pricing equation can be generically written as

$$(1) \quad P = \beta_0 + \sum_{i=1}^{K} \beta_i X_i + \sum_{i=1}^{L} \theta_i Z_i + \varepsilon,$$

[3] The adjustments made in the dataset because of the age and weight of feeder calves are in line with the comments from three anonymous referees.

Table 1. Part II. Data Summary for Continuous Variables[a]

Variables	Mean	SD	Minimum	Maximum
Price ($/cwt)	121.1	14.4	90	186
Weight (lb)	577.8	121.4	305	900
Lot size (head)	8.2	11.6	1	229
Sale size (thousand head)	1.636	0.802	0.303	4.136
Live cattle futures ($/cwt)	86.5	2.2	82.4	96.2
Corn cash price (¢/bushel)	166.6	14.4	142.5	186.5

[a] Number of observations: 19,046 feeder calf lots.

where P is the average lot price per hundredweight (cwt); β_0 is the intercept parameter; X_i ($i = 1, \ldots, K$) are explanatory variables (characteristics) relevant to the price formation; β_i ($i = 1, \ldots, K$) are the corresponding parameters; Z_i ($i = 1, \ldots, L$) are preconditioning categories, θ_i ($i = 1, \ldots, L$) are the corresponding coefficients, and ε is the disturbance term to the equation. Because the primary focus of this study is on preconditioning categories, they are distinguished in notation from other explanatory variables. Other than the intercept term, 22 explanatory variables (i.e., $K = 22$) and five preconditioning categories (i.e., $L = 5$) are considered. These variables are discussed next, and the summary statistics are presented in Table 1, Part I and II.

P (price). This dependent variable denotes the lot price; that is, the average price that a given lot receives. It has a mean value of nearly $121/cwt and ranges from a minimum of $90/cwt to a maximum of $186/cwt in the dataset.

The first group of explanatory variables is lot specific.

X_1 and X_2 (weight and weight squared, respectively). These variables denote the lot weight and lot weight squared, respectively, and are continuous. The lot weight is the average weight of a given lot. The previously cited literature consistently confirmed a negative relationship between price and weight. The lower the initial weight, the more weight the animal can gain for the buyer. The squared term is added to capture the curvature of this relationship. A convex relationship is expected between price and weight; that is, as weight increases, price should decrease at a decreasing rate. This is because the growth potential of cattle is most rapidly used up at lower weights than heavier weights. The convex relationship implies a positively signed coefficient for the squared weight term. The weight variable has a mean value of nearly 578 lb and ranges from a minimum of 305 lb to a maximum of 900 lb in the dataset.

X_3 and X_4 (steer and bull, respectively). These are dummy variables that take the value 1 if a lot consists of the corresponding sex category and 0 otherwise. Lots of heifers are the base for the sex variable. Steers and bulls are expected to have premium over heifers because of their higher gaining potential, and this premium is expected to be relatively higher for steers because of the value of castration in the market. No mixed-sex lots are in the final data set.

X_5, X_6, and X_7 (black, black–mixed, and black–other, respectively. These are dummy variables that take the value of 1, depending on the frequency of black cattle in a lot, and 0 otherwise. A lot is called black if it consists of all black cattle (such lots are 49.1% of all lots in the dataset), black–mixed if at least 50% of the lot consists of black cattle (such lots are 18% of all lots in the dataset), black–other if less than 50% of the lot consists of black cattle (such lots are 2.1% of all lots in the dataset). Base is nonblack lots (the remaining 30.8% of lots in the dataset). Black hair coat typically signals Angus breed genetics. Whether black cattle bring in significant price premiums over nonblack cattle is investigated here.

X_8 (horns). This is a dummy variable that takes the value 1 if there are cattle with horns

in a lot and 0 otherwise. Base is cattle lots without horns.

X_9 *(fleshy)*. This is a dummy variable that takes the value 1 for fleshy cattle lots and 0 otherwise. Lots without fleshy cattle are the base. This information is based on the recorders' (trained professionals in cattle) written comments of "fleshy" concerning a given lot. The sign of the coefficient of this variable can go either way. A fleshy look can be a sign of health, but it also can decrease the potential gain for the buyer.

X_{10}, X_{11}, *and* X_{12} *(sick and dirty, sick and clean, and healthy but dirty, respectively)*. These are dummy variables for health and appearance that take the value 1 if a lot consists of cattle with the corresponding condition and 0 otherwise. Lots of healthy and clean (not dirty) cattle are the base. The sick category applies to cattle that are sick, nonconformant (e.g., rat-tail, lame, bad foot, bad eye, etc.), or both. Dirty and muddy cattle may be discounted because their appearance could signal poor previous management practices and accommodations. The order of discount from highest to lowest with respect to the base is expected to be for sick and dirty, sick and clean, and healthy but dirty cattle. Preconditioned cattle are conditioned to have stronger immune systems and are more likely to be healthy, thus avoiding these discounts.

Marketing-related explanatory variables also are included.

X_{13} *and* X_{14} *(lot size and lot size squared, respectively)*. These are continuous variables that account for the effect of total head number in a given lot on the price that the lot receives. Buyers might find efficiency gains in larger lot sizes in filling a truckload and shipping. Previous literature reported diminishing returns to larger lot sizes. The squared term is added to capture this relationship.

X_{15} *and* X_{16} *(sale size and sale size squared, respectively)*. These variables account for the effect of the total number of head in a given sale on the lot prices and are continuous. The larger sales can be considered to be more aggressively advertised by sale barns through placement of ads in various media channels well ahead of sale time, as well as the content of claims and the actual size of these ads in cattle magazines.[4] At the same sale size, heavier advertisement might attract more buyers, which in turn would increase the intensity of competition among buyers, thus positively affecting the feeder price. However, because the supply of cattle is larger at the same time, which of these effects dominates is not known *a priori*.[5] A squared term is added to determine whether the returns (if any) to the size of sale level off or even decline after some point.

Dhuyvetter and Schroeder found that live cattle futures and corn futures (expected output price and input costs to cattle feeding, respectively) are important factors in the price–weight relationship (price slides). The following explanatory variables for market conditions are included.

X_{17} *(live cattle futures)*. This variable denotes the live cattle future price of the month that cattle are expected to be marketed. The same rule in Dhuyvetter and Schroeder is adopted here to determine the expected marketing month for cattle of different weights. The fifth, fourth, third, and second distant contracts were used, respectively, for the following weight ranges: 300–499, 500–699, and 700–900 lb.

X_{18} *(corn prices)*. In Iowa, the main input of cattle feeding is corn, and the local cash prices (taken as Iowa average) should be more relevant to farmers' feeding decisions than corn futures used in Dhuyvetter and Schroeder. In particular, during the time of this study, corn basis (cash price minus future price) varied widely.

X_{19}, X_{20}, X_{21}, *and* X_{22} *(monthly time dummy variables for November, December, January, and February, respectively)*. These variables take a value of 1 for the corresponding month and 0 otherwise. Base is October. The variables primarily capture the seasonality of feeder cattle prices, but they could also

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[4] A sample of sale ads can be found at the website http://www.iowafarmertoday.com/classifieds/?loc=datead&main=Advertisers&sub=Livestock+Sales.

[5] The authors are grateful to an anonymous referee for pointing this out.

reflect opportunity costs of labor, weather, stress, and other nonprice variables. There opportunity might be present for marketing cattle in an upward trending market because of seasonal price trends, which is in line with preconditioning. It is known that the largest supply of nonweaned calves are brought to the market from October to November, which leads to lower prices compared with other months *ceteris paribus*. For example, between 1991 and 2000 in Colorado, prices for 400–500-lb steers compared with the yearly average were 3.7% and 5.9% higher in January and February, respectively, whereas they were 4.9%, 3%, and 2.4% lower in October, November, and December, respectively (Peel and Meyer).

Finally, the following preconditioning vaccination and weaning categories are considered. These are dummy variables that take a value of 1 if a lot belongs to the corresponding vaccinations and weaning category and 0 otherwise. The base is unvaccinated and nonweaned calf lots. In constructing these categories, the weaning requirement (at least 30 days) is considered to be the primary component of preconditioning, which is the main requisite to obtain an Iowa Green Tag Preconditioning Certificate (see footnote 1) and is also emphasized elsewhere (Chymis et al.; Hartwig and Vermeer; Lalman and Smith).

Z_1 *(calves certified vaccinated and weaned at least 30 days)*. The majority of cattle in this category are vaccinated according to the protocols of the Iowa Green Tag Program (tags are displayed). The category also includes cattle vaccinated under the Iowa Gold Tag program (nearly 10%) and similar private company programs (nearly 5%) such as Merial Surehealth. The minimum weaning requirement to obtain a preconditioning certificate from the Iowa Green Tag Program is 30 days; the minimum weaning requirement in the Iowa Gold Tag Program and Merial Surehealth is 45 days. These programs are combined together under the common denominator of TPC and at the minimum requirements of preconditioning. The objective of this study is not to compare the values of alternative TPC programs.

Z_2 *(calves uncertified vaccinated and weaned at least 30 days)*. In this category, sellers made claims of vaccinations and at least 30 days weaning, which are considered here as competing claims to TPC programs. Vaccination claims can include such comments as "green tag–like" (including those similar to the Iowa Green Tag Program, and green tag claims without tags displayed), a specific set of vaccinations, individual shots such as 4-way or 7-way, vaccination claims without specifics, etc. The common denominator for these claims is that they are made by an auctioneer on behalf of sellers and they are not certified by a third-party agent.

Z_3 *(other calves vaccinated and weaned)*. In terms of weaning, preconditioning requirements are not met because the producer either indicated a weaning period of less than 30 days or made a weaning claim without specific weaning date or length of time. The overwhelming majority of weaning claims are in the latter category. Vaccination claims can include certified or uncertified claims. This category is considered as partial preconditioning with some claims in both vaccination and weaning components.

Z_4 *(calves vaccinated but not weaned)*. In terms of weaning, preconditioning requirements are not met because either there were no weaning claims or sellers provided information that calves were not weaned before the sale date. Nevertheless, vaccination claims (certified or uncertified) were made.

Z_5 *(calves weaned but not vaccinated)*. For these calf lots, a weaning claim was made but either was without a vaccination claim or the sellers explicitly provided information that calves were not vaccinated.

Recall that θ_i is the corresponding coefficient for the preconditioning category Z_i ($i = 1, 2, \ldots, 5$) in Equation (1) (i.e., the premium for the corresponding preconditioning category over the base category, nonvaccinated and nonweaned). Then, the following hypotheses regarding the premiums of preconditioning categories are considered.

Hypothesis 1. H_0: $\theta_1 = \theta_2$ *versus* H_1: $\theta_1 > \theta_2$. This hypothesis compares the premiums for third-party–certified preconditioning with self-claimed preconditioning. The alternative hypothesis is one-sided because the TPC is expected to bring in a higher premium than the self-claimed one. If the null hypothesis is rejected in favor of the alternative, then the next question is whether the difference in premiums outweighs the participation cost; that is, denoting the participation cost with $c^P > 0$, the question is $\theta_1 = \theta_2 + c^P$ versus $\theta_1 > \theta_2 + c^P$. If it is the latter, then the producer can be relatively worse off by incurring the same cost of the preconditioning program, less the participation cost, and self-claiming. An example will be worked out in the Application section.

Hypothesis 2. H_0: $\theta_2 = \theta_3$ *versus* H_1: $\theta_2 \neq \theta_3$. The uncertified full preconditioning claim is tested against the partial preconditioning claim with claims in both vaccination and weaning components. This determines whether full preconditioning claim premiums differ from partial preconditioning claim premiums whenever not certified by a third party, other things being equal. The alternative hypothesis is taken as two-sided because the partial preconditioning claim could include cattle that have certified vaccinations (such as green tag) but have failed to fulfill weaning requirements of preconditioning.

Hypothesis 3. H_0: $\theta_2 = \theta_4$ *versus* H_1: $\theta_2 \neq \theta_4$. This is to further compare self-claimed full preconditioning with partial preconditioning without weaning. The effect of failing in the weaning requirement of preconditioning is expected to be more pronounced here than in *Hypothesis 2*. Therefore, the self-claimed full preconditioning might be found to be statistically different from partial preconditioning here, if not in *Hypothesis 2*. The alternative hypothesis is again two-sided because the partial preconditioning claim totally fails in the weaning component and yet could include calves with certified vaccinations (e.g., green tag calves without weaning).

Hypothesis 4. H_0: $\theta_3 = \theta_4$ *versus* H_1: $\theta_3 > \theta_4$. Here, two categories of partial preconditioning claims differing in the weaning component are compared. The one with some weaning is expected to bring a higher premium than the one without weaning. Therefore, the alternative hypothesis is one-sided.

Hypothesis 5. H_0: $\theta_4 = \theta_5$ *versus* H_1: $\theta_4 \neq \theta_5$. This hypothesis compares the value of claims in which either component of preconditioning is missing. Because there is no *a priori* expectation on which component of preconditioning buyers value more, the alternative hypothesis is two-sided.

Estimations and Results

The model described in the previous section is estimated on the basis of the 19,046 observed lots by the ordinary least squares (OLS) estimation procedure under standard Gauss–Markov assumptions. In addition, given the size of the random sample, the OLS procedure is expected to yield unbiased estimators (Wooldridge). The PROC REG procedure in SAS software (SAS Institute) is used.

Table 2 presents the estimation results, in which the coefficients of dummy variables represent price premiums/discounts (\$/cwt) relative to the base, defined as dehorned, nonblack, not fleshy, healthy and clean, heifer feeder calves, marketed in October, and without vaccination and weaning claims. Moreover, the coefficients of continuous variables represent the resulting change in price (\$/cwt) due to a unit change in the corresponding explanatory variable.

The fit measure of adjusted R^2 ($\bar{R}^2$) equals 0.70, which is close to the value reported in Avent, Ward, and Lalman. The explanatory variables considered here explain 70% of the variation in price. White and Breusch–Pagan tests strongly rejected the null hypothesis of homoscedasticity ($p < 0.0001$), which points out that OLS estimates might not be efficient. The same problem is reported in Avent, Ward, and Lalman. On the basis of an inspection of residuals and fitted values, this problem is traced to some low-weight cattle that are predicted as being higher in value than their actual price. In cattle, low weight can be an indicator of potential to gain, but it also can be a signal of previous health problems.

In terms of inference, the problem has almost no bearing because heteroscedasticity robust standard errors and usual standard errors are very close. The inference and tests

Table 2. Estimated Premiums and Discounts at Iowa Feeder Cattle Auctions for Specific Cattle and Market Attributes, 2005–2006

Dependent Variable: P (lot price, per cwt)
Number of Observations: N = 19,046 lots, $\bar{R}^2$ = 0.70

Explanatory Variable[a]		Estimate ($)[b]	t-Statistic[c]
	Intercept	122.83	26.6
X_1	Weight	−0.15	31.32
X_2	Weight squared	0.000046	11.6
X_3	Steer	8.92	73.67
X_4	Bull	2.7	6.25
X_5	Black	3.34	24.34
X_6	Black–mixed	2.54	15.27
X_7	Black–other	1.71	5.1
X_8	Horns	−1.92	5.29
X_9	Fleshy	−2.37	8.78
X_{10}	Sick and dirty	−13.58	4.26
X_{11}	Sick and not dirty	−9.62	13.4
X_{12}	Healthy but dirty	−1.29	4.16
X_{13}	Lot size	0.33	17.5
X_{14}	Lot size squared	−0.0022	7.02
X_{15}	Sale size (1,000 head)	2.6	9.07
X_{16}	Sale size (1,000 head) squared	−0.29	4.28
X_{17}	Live cattle futures	0.7	18.57
X_{18}	Corn price (¢)	−0.05	3.38
X_{19}	Monthly time dummy for November	1.74	5.58
X_{20}	Monthly time dummy for December	0.94	2.54
X_{21}	Monthly time dummy for January	3.87	7
X_{22}	Monthly time dummy for February	7.17	10.4
Z_1	Certified vaccinated and weaned at least 30 days	6.12	22.51
Z_2	Uncertified vaccinated and weaned at least 30 days	3.35	11.92
Z_3	Vaccinated and weaned other (no date or $<$30 days)	3.12	10.29
Z_4	Vaccinated but not weaned	2.41	9.11
Z_5	Weaned but not vaccinated	1.66	4.14

[a] Bases: Calves, heifer, nonblack, no horns, not fleshy, healthy and clean, monthly time dummy for October, not vaccinated, and not weaned.
[b] All variables, except monthly time dummy for December, have $p < 0.0001$; therefore, they are statistically significant at the 1% level of significance. Monthly time dummy for December has a $p = 0.011$; therefore, it is statistically significant at the 5% level of significance. p-Values are based on t-statistics with the use of heteroscedasticity robust standard errors.
[c] Absolute values.

are based on the robust standard errors per se, which are obtained by the ACOV option under the PROC REG procedure of SAS. All reported p-values in the text are based on t-statistics with the use of heteroscedasticity robust standard errors.

All variables, except the monthly time dummy for December, have $p < 0.0001$ and therefore are statistically significant at the 1% level of significance. The monthly time dummy for December has $p = 0.011$ and therefore is statistically significant at the conventional 5% level of significance. Finally, even though some of the variables such as weight, fleshy, sex, and color are correlated, given the significance level of estimated parameters in the model, multicollinearity is not a concern for the results.

The parameter estimates for lot-specific variables are consistent with previous estimates in the literature. Price and weight have a negative, convex relationship; that is, as weight increases, price decreases, but at a decreasing rate. For example, the price slide for weights of 500 to 700 lb at 50-lb increments is calculated as −\$5.29, −\$5.05, −\$4.82, and −\$4.59, respectively (see the Application section for similar calculations).

For color effect, the market places a greater value on black, black–mixed, and black–other cattle lots with premiums of \$3.34, \$2.54, and \$1.71, respectively, over nonblack calf lots. The premium for black cattle increases with their frequency in a lot. A comparable study regarding the premiums for breed effects recorded breed data over a 5-year period (2001–2005) on 14,382 lots in the Superior Livestock Auction (Corah et al.). The authors found that the premium of \$4.42 for black and black white-faced lots over Brahman influence cattle. In our study, the premium appears to be lower, but this is because our base choice is nonblack, which could include British crosses and British–Continental crosses and which also had premiums of \$2.90 and \$2.93, respectively, over Brahman influence cattle noted in Corah et al.

Lots including cattle with horns are discounted by \$1.92, indicating the market value placed on dehorning. Fleshy cattle are discounted in the market by \$2.37, which might go against preconditioned cattle if they appear too fleshy. For health-related variables, the market discounts lots that include sick and dirty, sick and clean, and healthy but dirty cattle by \$13.58, \$9.62, and \$1.29, respectively, compared with healthy and clean cattle. Because preconditioned cattle have better health care and are subject to better management practices, they are more likely to avoid these discounts.

The lot size variables are economically and statistically significant. The price premium increases at a decreasing rate, reaching a maximum at 77 head and then declines eventually for higher lot sizes. One can verify from the estimated regression equation in Table 2 that, other things being equal, the lots with 5, 10, 20, 40, 60, 70, and 77 head bring in \$1.28, \$2.78, \$5.46, \$9.52, \$11.85, \$12.45, and \$12.46 relative premiums, respectively, over single lots. Higher premiums are found here than in Avent, Ward, and Lalman, yet the results are qualitatively consistent.

The sale size variables are also economically and statistically significant. The price premium increases with the size of the sale, *ceteris paribus*, at a decreasing rate. The estimated coefficients suggest that, other things being equal, instead of selling at small sale, such as 500 head, sellers can obtain an additional \$1.08, \$2.81, \$3.96, and \$4.52 by selling in sales with 1,000, 2,000, 3,000, and 4,000 head, respectively. The premium for sale size reaches its maximum at 4,500 head and then declines slightly.

As in Dhuyvetter and Schroeder, live cattle futures and corn prices are statistically significant variables in determining feeder cattle price, although the economic effects are somewhat lower here. A \$1 increase in live cattle futures increases the price for cattle by \$0.70/cwt. Also, a 10¢ increase in corn price per bushel decreases the price of cattle by \$0.5/cwt. Results for monthly time dummies show that there is a significant premium for marketing calves in November, January, and February compared with October. As mentioned, the December coefficient is positive and significant at the 5% level of significance, but it does represent a lower premium compared with November, which could be due to rather adverse weather-related conditions (very cold weather and heavy snowfall followed by mild weather) in December in Iowa in 2005. The premium for December would be expected to fall between the November and January values on the basis of a typical seasonal pattern.

All parameter estimates for vaccinations and weaning categories are individually and therefore jointly significant ($p < 0.0001$). The implication here is that the vaccinations and weaning status categories are statistically important determinants of price. The estimated premiums along with the corresponding tests of the hypotheses from the Modeling section are discussed next. The test results are presented in Table 3.

Calves without vaccination and weaning claims are the base; calves with certified vaccination and at least 30 days weaning claims have a premium of \$6.12, whereas calves with uncertified vaccinations and at least 30 days

Table 3. Tests on the Coefficients of Preconditioning Claims

Hypothesis			t-Statistics[a]	Decision on Null Hypothesis (H_0)
1	H_0: $\theta_1 = \theta_2$ H_1: $\theta_1 > \theta_2$	Certified vaccinated and weaned at least 30 days vs. uncertified vaccinated and weaned at least 30 days	16.76 (<0.0001)	Reject at the 1% level of significance
2	H_0: $\theta_2 = \theta_3$ H_1: $\theta_2 \neq \theta_3$	Uncertified vaccinated and weaned at least 30 days vs. vaccinated and weaned other (no date or <30 days)	1.06 (0.29)	Do not reject at the 10% level of significance
3	H_0: $\theta_2 = \theta_4$ H_1: $\theta_2 \neq \theta_4$	Uncertified vaccinated and weaned at least 30 days vs. vaccinated but not weaned	4.89 (<0.0001)	Reject at the 1% level of significance
4	H_0: $\theta_3 = \theta_4$ H_1: $\theta_3 > \theta_4$	Vaccinated and weaned other (no date or <30 days), vs. vaccinated but not weaned	3.14 (0.0008)	Reject at the 1% level of significance
5	H_0: $\theta_4 = \theta_5$ H_1: $\theta_4 \neq \theta_5$	Vaccinated but not weaned vs. weaned but not vaccinated	2.09 (0.0364)	Reject at the 5% level of significance

[a] t-Statistics are based on heteroscedasticity robust standard errors; p-values are in parentheses.

weaning claims bring in \$3.35. The null hypothesis of the equality of the coefficients of both categories in *Hypothesis 1* is rejected with $p < 0.0001$. Therefore, the relative premium between the two categories—\$2.77—is statistically significant. If calves were brought to market without a minimum 30-day weaning claim (i.e., either no weaning date was mentioned or the date mentioned was <30 days) and vaccination claims were made, they earn an average premium of \$3.12 compared with the base. In fact, this premium is not statistically different from the premium for uncertified vaccinations and at least 30 days weaning in *Hypothesis 2* ($p = 0.29$); buyers offer a pooling price for these two categories. This confirms the hypothesis that whenever not certified by a third party, a full preconditioning claim loses some credibility and is discounted in value toward the partial preconditioning claims in the market. Nevertheless, in *Hypothesis 3*, uncertified full preconditioning claims are still distinguished in the market with respect to a partial preconditioning claim without a weaning claim at all ($p < 0.0001$).

Consistent with these findings, the partial preconditioning claim with some weaning is valued more ($p < 0.001$) in the market than the partial preconditioning claim without a weaning claim at all in *Hypothesis 4*. Moreover, the premium for calves with vaccinations but no weaning (\$2.41) is statistically different from the premium (\$1.66) for calves with weaning claims but no vaccinations at the 5% significance level ($p = 0.0364$) in *Hypothesis 5*. Finally, having a claim in either component—vaccinations or weaning—brings in statistically higher premiums compared with no claims at all.

The foregoing shows how a variety of vaccination and weaning claims are valued in the market with respect to preconditioning. Finally, the answer for the question of whether the found relative premium of nearly \$2.77 between preconditioning with and without TPC (from testing *Hypothesis 1*) covers the cost difference—the participation cost—is confirmative. Some estimates in the literature on the participation cost for an average producer are as follows. Avent, Ward, and Lalman report \$5/head for the additional marketing costs for ear tags, commissions, etc.; Dhuyvetter, Bryant, and Blasi place these costs at \$3/head in the baseline and \$5/head in the high-cost scenario. For a 500-lb calf, this means \$1/cwt at maximum, nearly one third of the found relative premium.

Application

The primary purpose of this section is to demonstrate a use of the estimated Equation (1) for a typical postweaning scenario. Consider a livestock producer's postweaning decision to sell calves at weaning without preconditioning (base category) versus fully preconditioning them and selling later. The full preconditioning option can be certified through a third party ($Z_1 = 1$ and $Z_i = 0$ for $i = 2, 3, 4, 5$) at an additional cost (participation cost) or can be done and claimed by the producer ($Z_2 = 1$ and $Z_i = 0$ for $i = 1, 3, 4, 5$). The specific values of the explanatory variables for these options are introduced below. Note that the superscript 0 is used to refer to the explanatory variables under the default option of selling at weaning without preconditioning—(X_i^0 for $i = 1, 2, \ldots, 22$)—whereas the superscript 1 is used to refer to those under the preconditioning option—(X_i^1 for $i = 1, 2, \ldots, 22$). Between the selling at weaning versus preconditioning options, the explanatory variables, weight and weight squared, corn price, and the monthly time dummy variables will differ. Across the preconditioning options (with and without TPC), the explanatory variables remain the same.

The feeder calves in question can be sold at weaning without preconditioning on November 1, 2005, with a pay weight (net of shrinkage) of 500 lb. Therefore, $X_1^0 = 500$ and $X_2^0 = 500^2$. Alternatively, the producer could precondition the calves for 45 days and sell them on December 15, 2005, with vaccinations and weaning. Assume that the preconditioning option targets a pay weight gain of 100 lb in a 45-day period (2.22 average daily gain). The necessary diet to achieve this gain is obtained from Iowa State University Extension and provided for the feed cost calculations below. Note that preconditioned calves can typically shrink less, but this factor is ignored here. Therefore, $X_1^1 = 600$ and $X_2^1 = 600^2$.

Assume further that the calves are steers ($X_3^0 = X_3^1 = 1$ and $X_4^0 = X_4^1 = 0$), black, ($X_5^0 = X_5^1 = 1$ and $X_i^0 = X_i^1 = 0$ for $i = 6, 7$), dehorned ($X_8^0 = X_8^1 = 0$), not fleshy in appearance ($X_9^0 = X_9^1 = 0$), healthy and clean ($X_i^0 = X_i^1 = 0$ for $i = 10, 11, 12$), in a lot size of 10 ($X_{13}^0 = X_{13}^1 = 10$ and $X_{14}^0 = X_{14}^1 = 10^2$), and sold in a sale with 2,000 head ($X_{15}^0 = X_{15}^1 = 2$ and $X_{16}^0 = X_{16}^1 = 2^2$) under both options. Note that the assumption that cattle will not appear fleshy can be justified because average fleshy cattle lots weigh 649.4 lb, whereas average nonfleshy cattle lots weigh 566.2 lb and the fleshy cattle lots comprise only 4.1% of all lots in December in the dataset.

The December 15 quote for June live cattle futures and corn prices is unknown on November 1. The latest available live cattle futures price for June (fourth distant contract) was \$85.65 on November 1. Assume that the producer will take the live cattle futures price on November 1, 2006, as the expected live cattle future price 45 days later; that is, $X_{17}^0 = X_{17}^1 = \$85.65$/cwt. On the other hand, the corn price 45 days later (X_{18}^1) will be equal to the current day's cash corn price plus 45 days' interest rate expense (r) and storage cost (s). The latest available corn price was 143¢ per bushel on November 1. On the basis of a 7% annual interest rate, the interest expense can be calculated as $r = (0.07/365) \times 45 \times 143 = 1.23$¢, and on the basis of 4¢ per bushel per month, the storage expense is calculated as $s =$ 6¢/bu. Then, the expected corn price on December 15 is calculated as $X_{18}^1 = X_{18}^0 + r + s = 143 + 1.23 + 6 = 150.23$¢. Finally, the monthly time dummies take the values $X_{19}^0 = 1$ and $X_i^0 = 0$ ($i = 20, 21, 22$) and $X_{20}^1 = 1$ and $X_i^1 = 0$ ($i = 19, 21, 22$) because of sale dates for both options.

With the use of explanatory variables and parameter estimates from Table 2 in Equation (1), the expected prices in the selling at weaning option and preconditioning options are predicted in Equation (2). Note that carat ($\hat{}$) denotes the estimated values of parameters and the dependent variable. Moreover, the following notation is used to refer to all explanatory variables; $X^0 \equiv (X_1^0, X_2^0, \ldots, X_{22}^0)$ for selling at weaning without the preconditioning option and $X^1 \equiv (X_1^1, X_2^1, \ldots, X_{22}^1)$ for the preconditioning option, respectively.

The predicted price for the selling at weaning option, denoted by $\hat{P}(X^0)$, is calculated as

$$\hat{P}(X^0) = \hat{\beta}_0 + \sum_{i=1}^{i=22} \hat{\beta}_i X_i^0$$
$$= 122.83 - 0.15 \times 500$$
$$+ 0.000046 \times (500)^2 + 8.92 \times 1$$
$$+ 3.34 \times 1 + 0.33 \times 10 \tag{2}$$
$$- 0.00217 \times (10)^2 + 2.6 \times 2$$
$$- 0.29 \times 2^2 + 0.7 \times 85.65$$
$$- 0.05 \times 143 + 1.74 \times 1$$
$$= \$130.85.$$

The part of the predicted prices accounted for by the explanatory variables (X^1) under the preconditioning options, denoted by $\hat{P}(X^1)$, can be calculated as

$$\hat{P}(X^1) = \hat{\beta}_0 + \sum_{i=1}^{i=22} \hat{\beta}_i X_i^1$$
$$= 122.83 - 0.15 \times 600$$
$$+ 0.000046 \times (600)^2 + 8.92 \times 1$$
$$+ 3.34 \times 1 + 0.33 \times 10 \tag{3}$$
$$- 0.00217 \times (10)^2 + 2.6 \times 2$$
$$- 0.29 \times 2^2 + 0.7 \times 85.65$$
$$- 0.05 \times 150.23 + 0.94 \times 1$$
$$= \$119.33.$$

The differences between Equations (2) and (3) are accounted for by the price slide (−\$10.34), the effect of higher expected corn price in December (−\$0.37/cwt), and the lower premium for December calves relative to November calves (−\$0.81/cwt).

Finally, the market offers \$6.15/cwt premium for TPC preconditioned calves and \$3.35/cwt for the self-claimed fully preconditioned calves. Adding these premiums to Equation (3) completes the prediction of the prices for TPC calves, $\hat{P}(X^1, Z_1)$, and self-claimed preconditioned calves, $\hat{P}(X^1, Z_2)$, as follows:

$$\hat{P}(X^1, Z_1) = \hat{P}(X^1) + \hat{\theta}_1 Z_1$$
$$= 119.33 + 6.12 \times 1 = \$125.45, \tag{4}$$

$$\hat{P}(X^1, Z_2) = \hat{P}(X^1) + \hat{\theta}_2 Z_2$$
$$= 119.33 + 3.35 \times 1 = \$122.68. \tag{5}$$

By combining Equations (3), (4), and (5) with the corresponding weights, the revenues on a per-head basis can be calculated for nonpreconditioned calves, $\hat{R}(X^0)$, TPC preconditioned calves, $\hat{R}(X^1, Z_1)$, and self-preconditioned calves, $\hat{R}(X^1, Z_2)$, as follows:

$$\hat{R}(X^0) = \hat{P}(X^0) \times (X_1^0/100)$$
$$= 130.85 \times 5 = \$654.27, \tag{6}$$

$$\hat{R}(X^1, Z_1) = \hat{P}(X^1, Z_1) \times (X_1^1/100)$$
$$= 125.45 \times 6 = \$752.69, \tag{7}$$

$$\hat{R}(X^1, Z_2) = \hat{P}(X^1, Z_2) \times (X_1^1/100)$$
$$= 122.68 \times 6 = \$736.08. \tag{8}$$

On the cost side, assuming that the self-claimed preconditioning is truthful, its cost, $C(Z_2)$, includes the following items along with the respective notation in parentheses: the feed cost (c^f), possible death loss (c^d), possible treatment cost (c^t), medical supplies cost (c^v), labor and equipment cost (c^l), and interest expense (c^r). The feed cost is calculated on the basis of a diet necessary to achieve the targeted gain of 100 lb in 45 days, which uses 9.2 bushels of corn at the price of 143¢/bu, 0.13 tons of hay at the price of \$60/ton, and 32 lb of supplement at the price of \$23.1/lb, so that $c^f = 9.2 \times 1.43 + 0.13 \times 60 + 0.32 \times 23.1 =$ \$28.35. The possible death loss of revenue is calculated on the basis of a 0.25% probability and the predicted revenue from Equation (8) as $c^d = 736.08 \times 0.0025 =$ \$1.84; the treatment cost is estimated on the basis of \$20/head cost at 5% probability as $c^t = 20 \times 0.5 =$ \$1/head. The cost of medical supplies is taken as \$8; that is, $c^v =$ \$8/head, which is consistent with Avent, Ward, and Lalman. The labor cost is taken as \$5/head; that is, $c^l =$ \$5. Finally, on the basis of a 7% annual interest rate, interest expense on predicted revenue at weaning from Equation (6), the estimated feed cost, and medical supplies cost is calculated as $c^r = (0.07/365) \times 45 \times (654.27 + 28.35 + 8) =$ \$5.96. Then, the total cost of self-claimed preconditioning can be calculated as

$$C(Z_2) = c^f + c^d + c^t + c^v + c^l + c^r$$
$$= 28.35 + 1.84 + 1 + 8 + 5 + 5.96 \tag{9}$$
$$= \$50.15.$$

The cost of TPC preconditioning, $C(Z_1)$, equals all the cost items in self-claimed preconditioning in Equation (9) plus a death cost adjustment and the participation cost, c^p. The death loss adjustment is from higher revenue under TPC preconditioning (compare Equations [7] and [8]) and the same probability of death (0.25%) under both options. The participation cost is additional marketing expenses, including ear tags and commissions paid to a third party and is taken as c^p = \$5/head, consistent with Avent, Ward, and Lalman and the high-cost scenario in Dhuyvetter, Bryant, and Blasi. Re-expressing the notation for revenues $\hat{R}(X^1, Z_1)$ in Equation (7) with $\hat{R}_1^1$ and $\hat{R}(X^1, Z_2)$ in Equation (8) with $\hat{R}_2^1$, the cost of TPC preconditioning is calculated as

$$\begin{aligned} C(Z_1) &= C(Z_2) + (\hat{R}_1^1 - \hat{R}_2^1) \times 0.0025 + c^p \\ &= 50.15 + 0.04 + 5 = \$55.19. \end{aligned} \tag{10}$$

Combining the estimated numbers for revenue and cost components in the preceding equations for the corresponding option, the postweaning return for not preconditioned calves, $\pi(X^0)$, TPC preconditioned calves, $\pi(X^1, Z_1)$, and self-preconditioned calves, $\pi(X^1, Z_2)$ can be calculated, respectively, as

$$\hat{\pi}(X^0) = \hat{R}(X^0) = \$654.27, \tag{11}$$

$$\begin{aligned} \pi(X^1, Z_1) &= R(X^1, Z_1) - C(Z_1) \\ &= 752.69 - 55.19 = \$697.50, \end{aligned} \tag{12}$$

$$\begin{aligned} \pi(X^1, Z_2) &= R(X^1, Z_2) - C(Z_2) \\ &= 736.08 - 50.15 = \$685.94. \end{aligned} \tag{13}$$

Because the producer's postweaning decision will be based on the maximum of Equations (11), (12), and (13), the producer would choose TPC preconditioning over the other two options. In particular, TPC preconditioning brings in an additional \$43.23/head (subtract Equation [11] from Equation [12]) postweaning return over not preconditioning calves and an additional \$11.57 (subtract Equation [13] from Equation [12]) over the self-claimed preconditioning option. Therefore, the producer would be relatively worse off by choosing self-claimed preconditioning over TPC preconditioning. However, the producer is still better off by choosing self-claimed preconditioning over simply selling calves at weaning (compare Equation [13] with Equation [11]).

Conclusion

In this paper, we investigate the values of the sources and types of preconditioning claims on feeder calves under the recognized information asymmetry problem at feeder cattle auctions. To this end, a hedonic pricing equation that includes a variety of feeder cattle characteristics, market and sale conditions, and preconditioning categories is defined, and five hypotheses concerning the coefficients of preconditioning categories are proposed. The model is estimated on the basis of data from 19,046 feeder cattle lots sold at auctions in Iowa between October 2005 and February 2006. The model performs well in terms of fit performance and passes standard diagnostics tests; all explanatory variables and preconditioning categories are statistically significant at conventional levels (see Table 2). Finally, on the basis of the estimated premiums for preconditioning categories, the hypotheses of interest are tested (see Table 3).

Primarily, it has been found that the preconditioning claims with TPC obtain a statistically higher premium (\$6.12) than the premium (\$3.35) for uncertified preconditioning claims. Furthermore, the difference exceeds the average participation cost of TPC (\$1/cwt). This implies that the same preconditioning efforts, whenever not certified, can lose more value than the cost savings obtained by avoiding the third-party participation cost. As a result, sellers could be relatively worse off by not certifying their preconditioning claims through a third party, as demonstrated in the Application section. This evidence is consistent with the hypothesis in the literature (Chymis et al.; Nyamusika et al.) that a low-cost TPC can partially separate feeder cattle in preconditioning claims under asymmetric information.

Moreover, the premium for uncertified preconditioning claims is found to be not statistically different from the premium for partial preconditioning claims, which includes vaccinations but fails the minimum 30-day weaning requirement (either no date specified or specific information of less than 30 days weaning provided). This implies that whenever not certified by a third party, full preconditioning claims lose credibility and are discounted toward partial preconditioning claims. This is consistent with the hypothesis that buyers make their pricing decisions on the basis of average quality regarding these indiscernible attributes if they are not provided with a credible signal (such as TPC) under asymmetric information.

The premiums for other partial preconditioning (those without claims on either vaccinations or weaning components) are estimated as significantly lower than the premium for partial preconditioning with claims on both vaccination and weaning components. These findings point out the possibility of a value loss if information is not delivered to the market, even though preconditioning was actually done. For example, the value loss would be more than half the premium if the information on weaning is not delivered to buyers for the 30-days weaned calves with the certified vaccinations. As a result, these calves are discounted as vaccinated without weaning, therefore bring a premium of $2.41/cwt instead of $6.12/cwt.

The estimated premiums for certified preconditioning claims are found to be higher compared with some previous studies (Avent, Ward, and Lalman; Ward and Lalman) but are consistent with others (Corah et al.; King and Seeger). The parameter estimates for other explanatory variables are also consistent with the previous literature and are discussed in the Estimations and Results section. The explanatory variables and preconditioning categories considered in this study take into account the main aspects of feeder cattle marketing decisions. Therefore, the estimated regression equation should have practical value to producers for evaluating alternative production, preconditioning, and marketing strategies by inserting the relevant information. An example for a typical scenario is provided in the Application section.

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