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Practitioner's Abstract:
Controlling a variety of feeder cattle characteristics, and market and sale conditions, we estimate that certified vaccinations claims along with at least 30 days weaning claims bring in a premium of $6.13/cwt, which is nearly two times of that for similar uncertified claims, compared to no vaccinations and weaning claims at all in Iowa feeder cattle auctions. This indicates that the third party certification is supported in the market as a tool to signal quality in terms of vaccinations and weaning claims towards preconditioning.

Keywords: Asymmetric information, Quality, Third-party certification, Feeder cattle auctions

Introduction:
U.S. beef industry is striving to meet higher and consistent quality demands of consumers in domestic and foreign markets amid health concerns such as Bovine Spongiform Encephalopathy (BSE) and foot and mouth diseases, and intense competition from other animal protein sources. As discussions and efforts continue towards establishing a national ID system, whether the effective and efficient transmission of information on quality attributes in a segmented chain structure such as beef industry can be coordinated by market incentives and mechanisms remains as the main issue. In that regard, a critical point in beef supply chain is feeder cattle auctions where the bulk of cattle are transferred from ranchers to feeders (possibly backgrounders and stockers in between), and yet these transactions can be subject to information asymmetry problem (Chymis, et al., 2004 and Hueth and Lawrence, 2002). When buyers buy cattle in feeder auctions, they are typically uncertain about the heterogeneous characteristics of the cattle. The traits valued by consumers can be learned at much later stages in production such as slaughter or even at the consumption stage. Even though there can be objective means of measuring the quality of cattle, the measurement cost prohibits such efforts as transactions at auctions are done very quickly at a large volume. Feedlots typically hire order buyers, who are experienced in visually assessing cattle but this of course has limitations.

In such a situation, sellers have incentive to step in and bear the cost of acquiring information by making some degree of information available from transactions costs economics perspective. Chvosta, et al., (2001) studied such information provisions at bull auctions. Sellers also need to signal quality to prevent Type 1 (rejecting high quality cattle) and Type 2 (accepting low quality cattle) errors on the side of buyers. However, sellers have incentive to overstate the condition of their animals, or not to state any unfavorable information at all, which may be related to vaccinations, treatment, nutrition history, weaning status, etc. And, yet the performance of cattle in feedlot and the quality of their meat at slaughter are associated with this sort of information (Busby, et al., 2004, and Faber, et al., 1999). Reputation concerns of sellers may not be of enough discipline in feeder auction environment, where the majority of producers are selling a small number of cattle once or twice a year. Moreover, reselling based on speculative motives is not uncommon, and buyers and sellers are not negotiating one-to-one as in contract environments. Alternatively, sellers can make their claims more credible via third party certification, which can include the official state-sanctioned green or gold tag vaccination and/or preconditioning programs (where all vaccinations are done by a veterinarian, and documented) or similar private company programs.[2]

Although the third party verification programs have potential to mitigate the asymmetric information problem, there are potential issues as well. In essence, the asymmetric information problem is not actually solved but shifted from sellers to third party agents. Then, the issue becomes the reputation of these programs rather than the reputation of sellers. Buyers should trust the integrity of programs and procedures. There are multiple protocols and procedures, which are not equally monitored and controlled. As these programs are costly and possibly valued by buyers, some producers can simply imitate the third party programs by doing the vaccinations themselves, and make vaccination claims that are identical to the third party programs. It is known that feedlots routinely revaccinate the cattle they receive partly due to lack of trust in vaccinations claims or the commingling of cattle of with multiple protocols from various regions (Chymis, et al., 2004). Also, the cattle certified by a third party should be offered at enough volume to be of some value to buyers.

The value of preconditioning programs in terms of price premiums created is reported in the literature (Ward and Lalman, 2003, Avent, Ward and Lalman, 2004, King, 2004, Corah, et al, 2006). But none of these studies have explicitly focused on the value to the source of the claims made in terms of third party versus sellers themselves. In this paper, we study the perceived value of the third party certification of claims on vaccinations along with weaning vis-à-vis similar uncertified claims, and ultimately aim to provide insights to the asymmetric information problem in feeder cattle auctions.

Data Sources:

Data was collected by four recorders hired by Iowa Beef Center at Iowa State University from 105 sales that took place in nine sale barns located on mostly Southern, South-Western, and Western Iowa over the time period from October 20, 2005 to February 24, 2006. The survey

[2] In Iowa green tag program, calves must be vaccinated for IBR, BVD, BRSV, PI-3, 7-Way Clostridia, 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 and/or implanted with growth promotant but these are optional. All vaccinations and health procedures must be done by a veterinarian. For gold tag level, calves must be revaccinated two weeks or later after the first round of vaccinations. Once these are done, green or gold tag are placed in the upper part of left ear of calf by the veterinarian. Calves can be sold as green or gold tagged but they are not considered as preconditioned yet, and are not supposed to be represented as such. To obtain preconditioning certificate, calves must be weaned at least thirty or forty-five days for green and gold tag programs, respectively. In the certificate, additional information on weaning ration, breed type, and 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.

included detailed items that are relevant to price formation and our recorders worked with USDA market reporters that were present in the sales. There were 20 preconditioned, 5 featured sales, and the rest were regular “special” sales. After excluding the extreme and/or problematic lots, which accounted for nearly 2% of the data originally entered, we could incorporate 20,066 lots of cattle sold in this analysis. In addition, daily live cattle futures prices were obtained from Livestock Marketing Information Center. Daily corn prices were obtained from Iowa State University Extension database.

Modeling

We postulate that buyers are interested in the uncertainty over quality (the potential for quality grade, yield grade, feedlot performance, health and overall condition) of animal. Buyers form their beliefs on these performance measures based on some associated signals (captured by the explanatory variables considered here) they receive. To an extent that these signals have impact on buyers’ expected profit, they are reflected in their bidding behavior, and therefore, on the price that feeder cattle receive. For example, the amount of gain that an animal can put on each day depends on the genetic potential, sex and health condition of the animal.

We model the price received by feeder cattle as a linear function of a set explanatory variables or characteristics. This type of modeling, called hedonic pricing models, is commonly used in the literature studying the valuation of feeder cattle (Dhuyvetter and Schroeder, 2000, Ward and Lalman, 2003, Avent, Ward and Lalman, 2004, King, 2004, Corah, et al, 2006). We adopt a rather simple structure here as in Avent, Ward and Lalman (2004) rather than interacting all variables with weight and weight squared as in Dhuyvetter and Schroeder (2000). The latter approach can make sense for some variables, and help fit performance too, but it makes the interpretation of coefficients difficult for reader.

The hedonic pricing equation can be generically written as

$$P = \beta_0 + \beta_1 X_1 + ... + \beta_K X_K + u \qquad (1)$$

, where P stands for average lot price per hundred weight, X_i for $i = 1,...,K$ are the explanatory variables (characteristics), and β_i for $i = 1,...,K$ are the corresponding parameters, and β_0 is the intercept parameter, finally u is the disturbance term to the equation. Note that including the intercept term, we consider thirty explanatory variables in equation (1) (that is, $K = 29$). Below, we introduce our variables. Tables 1 and 2 present the summary statistics on the select variables.

Dependent variable: <u>*Price*</u> (P): The average lot price in our data set is around $120/cwt. The distribution of price appears to be normal. A nearly $90 price range is covered here.

Explanatory Variables- Animal Specific:

Weight and Weight Squared (X_1 and X_2) are continuous variables. The previous literature consistently confirmed that price and weight have a negative relationship. The lower is weight, the more weight that animal can gain for the buyer. However, if weight is really low, it can be also indicator of health problems or poor nutrition in the past. The squared term is added to capture the curvature for which there is no a priori expectation. Weight of animal increases with preconditioning, which will decrease price per hundred weight. However, the net impact on total revenue is not known a priori. Furthermore, with preconditioning there is a chance of marketing cattle to upward trending market due to seasonal price trends. The average cattle in our data set weigh nearly 590 lbs from Table 1. A nearly 900 lbs weight range is covered in this study.

Age: Yearling (X_3) is a dummy variable, which takes the value of one if cattle are yearlings, and zero if they are calves. Lots with calves are the base. The impact of age variable is not estimated in the previous literature. Yearlings are mature enough to prove their health and can be assumed as preconditioned.

Sex: Steer (X_4) is a dummy variable which takes value of one if a lot consists of steers and zero otherwise. Also, bull (X_5) is dummy variable takes value of one if a lot consists bulls and zero otherwise. Lots with heifers are the base for both variables. We expect that steers and bulls have higher premium versus heifers, and this premium relatively higher for steers. The difference in value between steers and bulls is the value of castration, one of the requirements of preconditioning.

Table 1: Data Summary: Part I

Variable	**Mean**	**Std Dev**	**Min**	**Max**	**N[*]**
Price ($)	120.38	14.56	90	186	20,066
Weight (lb)	589.51	131.79	305	1,265	20,066
Lot Size (head)	8.41	12.12	1	229	20,066
Sale size (head)	2,002.98	805.94	360	3,995	20,066
Live Cattle Futures ($)	86.76	2.53	82	97	20,066
Corn Cash Prices (cents)	166.23	14.51	143	187	20,066

[*]N: Number of Observations

Color: Black and black mixed (X_6) is a dummy variable, which takes value of one if a lot includes black cattle and zero otherwise. Base is non-black lots. Black hair coat is an indicator Angus breed genetics. The previous research indicated significant breed effects in price formation.

Horns: Lots with cattle with horns (X_7) is a dummy variable which takes value of 1 if there are cattle with horns in a lot and zero otherwise. Base is lots with cattle without horns.

Fleshy: Fleshy (X_8) is a dummy variable which takes value of 1 if cattle are fleshy in a lot and zero otherwise. Lots without fleshy cattle are the base. No a priori expectation in terms of sign of this variable. Fleshy look can be sign of health but it can decrease the potential gain for the buyer.

Table 2: Data Summary: Part II

Variables	**Count**	**%***
Yearling	879	4.4
Steer	10,445	52.1
Bull	606	3
Black and Black Mix	13,802	68.8
Certified Vaccinated and Weaned Calves	7,931	41.3
Uncertified Vaccinated and Weaned Calves	4,592	23.9
Vaccinated but Not Weaned Calves	4,137	21.6
Weaned but Not Vaccinated Calves	849	4.4
Not Vaccinated and Not Weaned Calves	1,678	8.7

* Percentages are out of 19,187 lots for calves-only-categories, otherwise, out of 20,066 lots.

Health and Appearance: Dummy variables, which take value of one if cattle have the corresponding condition, and zero otherwise. Lots with healthy and not dirty cattle are the base. Equation (1) includes X_9, X_{10} and X_{11} for not healthy and dirty, not healthy and not dirty, and healthy but dirty cattle, respectively. Not healthy includes cattle that are sick and/or non-conformant, such as rat-tail, lame, bad foot, bad eye, etc. Dirty cattle include dirty and muddy cattle and may be discounted because it may signal poor previous management practices and accommodations. We expect that the order of discount from highest to lowest should be for not healthy and dirty, not healthy and not dirty, healthy but dirty cattle with respect to the base. Preconditioned cattle is conditioned to have stronger immunization system and more likely to be healthy, and therefore, avoid these discounts.

Explanatory Variables-Sale related:

Lot Size: Dummy variables, which take value of one if the number of head in a lot lies within the given bounds, and zero otherwise. Base is lots with a single head, X_{12} is for lots size more than 1 but less than 5 head, X_{13} is for lot size at least 5 but less than 10 head, X_{14} is for lot size at least 10 head but less than 20 head, X_{15} is for lot size of at least 20 but less than 60 head, X_{16} is for lot size of at least 60 head. We prefer the discrete formulation of this variable over the continuous one as used in the previous literature, and there is minor effect on the fit performance of the model *per se*. The cut-off points are obtained from the distribution of lot size, where 5 head is the median size, 10 head is close to 75th percentile, 20 head is 90th percentile, and 60 head is close to 95th percentile.

<u>Sale Size</u>: Dummy variables, which take value of one if the size of a given sale lies within the corresponding bounds, and zero otherwise. Sale size with less than 1,500 head is the base. Denote the sale size of at least 1,500 but less than 2,500 head with X_{17} , and the sale size of at least 2,500 head with X_{18}. Although sale size variable is originally continuous (as we report in Table 1), we find the preceding discrete formulations as more readily informative to readers. The cut-off points were chosen around the 25th and 75th percentiles. This is to capture any sale size effect that may be present, which can make buyers more confident about the quality of cattle, and/or attract buyers with high willingness to pay for quality. Note also that sales where only preconditioned cattle sold are mostly large sales in our data set.

Explanatory Variables for Market Conditions: Dhuyvetter and Schroeder (2000) found that fed cattle futures and corn futures (expected output and input costs to cattle feeding, respectively) are important factors for price-weight relationship (price-slides). Their study covered 46,081 lots over a 10 year period (1987-1996). We also considered these variables here:

<u>*Live Cattle Futures*</u>: (X_{19}) The fed cattle future price of the month at which cattle are expected to marketed. We used the same rule in Dhuyvetter and Schroeder (2000) to determine the expected marketing month for cattle with different weights. For cattle weighing in 300-499, 500-699, 700-899, 900-1199, more than 1200 lbs ranges, the fifth, fourth, third, second, and first distant contract were used, respectively.

<u>*Corn prices:*</u> (X_{20}) In Iowa, the main input of cattle feeding is corn, and we think that local cash prices (taken as Iowa average) are more relevant to farmers' feeding decisions rather than the corn futures as in Dhuyvetter and Schroeder (2000). In particular, during the time of this study corn basis was at very wide levels.

<u>*Monthly Time Dummy variables:*</u> They take value of one for the corresponding month, and zero otherwise. Base is October. Denote other monthly time dummies with X_{21}, X_{22}, X_{23}, and X_{24} for November, December January and February, respectively. These variables are mainly to capture seasonality but they may also reflect opportunity cost of labor, weather stress, and other non-price variables. We adopt rather simple structure here, which will yield average seasonality effect on all ages and all weights. It is known that from October to November, the biggest supply of non-weaned calves are brought to the market, which leads to lower prices compared to other months *ceteris paribus*. For example, prices for 400-500 lb steers were 3.7% and 5.9% higher on January, and February, respectively, whereas they were 4.9%, 3% , 2.4% lower on October, November, and December, respectively compared to the year average in Colorado over ten year period between 1991 to 2000 (Peel and Meyer, 2002).

Explanatory Variables for Vaccinations and Weaning Categories for Calves: Dummy variables, which take value of one if cattle belong to the corresponding vaccinations and weaning category, and zero otherwise. The base is not vaccinated and not weaned calves. Given their age, yearlings can be assumed to be preconditioned, therefore, no separate variable was considered for vaccinations and weaning claims for this age group.

Certified Vaccinated and Weaned at least 30 days Calves (X_{25}): The overwhelming majority of cattle in this category are vaccinated with respect to the green tag program (with their tags on) but it also includes private company programs, such as Merial ® Surehealth™, or gold tag programs. The weaning requirement to obtain preconditioning certificate in Iowa green tag program is at least 30 days, whereas in Merial ® Surehealth™ and Iowa gold tag program is at least 45 days.

Uncertified Vaccinated and Weaned at least 30 day Calves (X_{26}) In this category sellers made claims of vaccinations and at least 30 days weaning, which is considered here as competing claims to the preceding third-party claims. Vaccinations claims include variety of claims such as "green tag like" claims (including the green tag claim for calves without the tags on), a specific set of vaccinations, individual shots such as 7-way, or vaccinations claims without specifics, etc. The common denominator for these claims is that they are made by auctioneer on behalf of sellers and not certified by a third party agent.

Vaccinated and Weaned Other Calves: (X_{27}) Vaccinations claims may include certified or uncertified claims. In terms weaning claims, preconditioning requirements were not satisfied because either producers delivered the information that cattle were weaned less than 30 days or just made a weaning claim without specific weaning date or length of time. The overwhelming majority of weaning claims was in the latter category.

Vaccinated but Not Weaned Calves: (X_{28}) Vaccinations (certified or uncertified) claims were made but not weaning claim or buyers were provided information that calves were not weaned.

Weaned but Not Vaccinated Calves: (X_{29}) For these calves, weaning claim was made but either no vaccinations claim were made or sellers explicitly provided information that calves were not vaccinated.

Estimations and Results:

We estimated the model described in the previous section with Ordinary Least Squares (OLS) estimation procedure under standard assumptions. Given the size of sample here, the standard properties of OLS apply provided that the assumptions are correct (Wooldridge, 2002). We did the estimations in SAS econometric software by using the REG procedure. We report the estimation results under different tables although all of them are from the estimation of one model in equation (1). Note also that all coefficients represent price premiums in $/cwt unless otherwise noted.

Table 3 summarizes some diagnostics about the estimation of the model. The number of observations is 20,066 lots. The fit measure of adjusted R-Square ($\bar{R}^2$) equals 0.72, which is the same value reported in Avent, Ward and Lalman (2004). The variables weight and weight-squared by themselves account for nearly 50% of the variation. The additional variables without interaction with weight and weight-squared can contribute only incrementally to the fit measure. Nevertheless, the fit performance of the model might be still improved by additional controls such as muscle and frame score, whether home raised, etc. Because our data has time series component, we checked for the first-order serial correlation problem. We can not reject the null hypothesis of no serial correlation (with p-value 0.26). White and Breusch-Pagan tests strongly rejected the null hypothesis of homoskedasticity (with p-value less than 0.0001). Note that Avent, Ward and Lalman (2004) reported the same problem. Based on the inspection of residuals and fitted values, this is due to some low weight cattle that are predicted to be higher valued than actually they are. Given the controls we have here, that is somewhat expected. Low weight in cattle can be indicator of potential to gain but also can signal for the previous health problems. The latter we have no way of knowing as analysts unless commented by reporters, which we incorporated as information is provided. Perhaps, including muscle and frame score can mitigate that to some extend. In terms of inference, the problem has almost no bearing because heteroskedasticty robust standard errors and usual standard errors very close. We used robust standard errors in our inference and tests.

Table 3: Model Diagnostics
Number of Observations Used = 20,066 lots
Adjusted R-Square = 0.72
Model is significant (p-value < 0.0001)
No first order Serial Correlation problem (Durbin-Watson=1.5 with p-value=0.26)
Minor Heteroskedasticity Problem (White and Breush-Pagan tests reject homoskedasticity hypothesis with p-value less than 0.0001)

Table 4 presents the parameter estimates for intercept and animal specific variables. The estimates are consistent with the previous estimates such as Ward and Lalman (2003) and Avent, Ward and Lalman, (2004). Price and weight have a negative relationship, and this relationship is convex, that is, as weight increases price decreases but less and less. Yearlings have nearly $6.5 premium over non-vaccinated and non-weaned calves, which is close to the premium that certified vaccinated and weaned at least 30 days calves have over non-vaccinated and non-weaned calves from Table 7. Yearlings can be assumed as preconditioned *per se*. For the sex variable, both steers and bulls have premiums over heifers, which are $8.87 and $2.80, respectively. Note that nearly $6 relative premium steers have compared to bulls is the value of castration in the market, a preconditioning requirement. For breed effect, market values lots with black and black mixed cattle over lots over non-black cattle with $2.54 premium. Comparing this with the reported premiums for breed effects in the literature, Corah, et al (2006) had breed data recorded over five years 2001 to 2005 on 14,382 lots in Superior Livestock Auction. They found premium for black and black white faced lots $4.42 over Brahman influence cattle. Note that in

Table 4: Parameter Estimates for Animal Specific Variables ($/cwt)*

Intercept	$138.94
Weight	-$0.19
Weight Squared	$0.00008
Yearling (Base: Calves)	$6.49
Heifer	Base
Steer	$8.87
Bull	$2.80
Black and Black Mixed (Base: Non Black)	$2.54
Horns (Base: No Horns)	-$1.73
Fleshy (Base: Not Fleshy)	-$2.38
Not Healthy and Dirty	-$9.16
Not Healthy and Not Dirty	-$6.45
Healthy but Dirty	-$1.33
Healthy and Not Dirty	Base

*All significant with p-value < 0.0001.

our study, the premium appears to be lower but this is due to the fact that our base choice is non-black, which may include English and English crosses, English and Continental crosses, which had also premiums over Brahman influence cattle in Corah, et al (2006), too. For the variable regarding horns, lots including cattle with horns are discounted by $1.73, which shows the value the market places on dehorning requirement of preconditioning. Fleshy cattle are discounted in the market by $2.38, which may go against preconditioned cattle if they appear too fleshy. For health related variables; market discounts heavily lots including sick, non-conformant cattle, and/or dirty cattle compared to healthy and clean cattle at the amount of $9.16, $6.45, and $1.33 for not healthy and dirty, not healthy and not dirty, and healthy but dirty cattle, respectively. Because preconditioned cattle will go through better health care and management practices, they are more likely to avoid these discounts.

Our results show that sale related variables are economically and statistically significant in extracting value in cattle marketing. Table 5 summarizes the estimated coefficients for these variables. We found that buyers distrust lots with single cattle as a premium of $5.15 can be obtained simply by increasing the number of heads up to 5 heads. As the number of head increases more and more, the premium continues to increase but less and less. It picks up again when lot size increases to 60 and more, which partly captures the additional value from sales where only high number of sorted cattle can be sold. These premiums show that the sorting and pooling of cattle by sellers are valued in the market, and this is proportional to truck load size. There is also additional value in selling in a larger sale *ceteris paribus*.

Table 5: Parameter Estimates for Sale Related Dummy Variables ($/cwt)*

Lot Size = 1 head	Base
Lot Size >= 1 but < 5 head	$5.15
Lot Size >= 5 but < 10 head	$7.73
Lot Size >= 10 but < 20 head	$9.45
Lot Size >= 20 but < 60 head	$10.75
Lot Size >= 60 head	$13.37
Sale Size < 1,500 head	Base
Sale Size >= 1,500 but < 2,500 head	$0.86
Sale Size >= 2,500 head	$1.79

*All significant with p-value < 0.0001.

As in Dhuyvetter and Schroeder (2000), we also found that live cattle futures and corn prices as statistically significant variables in determining feeder cattle price but economic impacts are rather lower here (see Table 6). This could be due to the fact that these variables were not interacted with weight and weight squared here, therefore the estimated values have on average interpretation for all weights. Dhuyvetter and Schroeder (2000) showed that the lower cattle weigh, the more responsive they become to these variables, and we include much heavier cattle in our data set compared to their study. We find that a $1 increase in live cattle futures increases the price for cattle by $0.62. Also, a $0.01 increase in corn price would decrease the price for cattle by $0.04. For monthly time dummies, the observed trend in our estimations shows there is significant premium for waiting and marketing preconditioned calves in January and February compared to October. The reason that the price premium for December is not statistically different compared to October could be the fact that we do not separately control for weather factor.

Table 6: Parameter Estimates for Variables for Market Conditions ($/cwt)*	
Live Cattle Futures	$0.62
Corn Prices	-$0.04
Monthly time dummy for October	Base
Monthly time dummy for November	$1.24
Monthly time dummy for December	$0.50
Monthly time dummy for January	$3.34
Monthly time dummy for February	$6.22
*All Significant with p-value < 0.0001 except December dummy (p-value 0.16) and Corn prices (significant at 1%).	

Table 7 presents the parameter estimates for vaccinations and weaning categories, and the results of various tests regarding these coefficients. All parameter estimates are individually and therefore jointly significant (with p-value less than 0.0001). Implying that the vaccinations and weaning status categories are statistically important determinants of price. Calves without vaccination and weaning claims are being base, calves with certified vaccination claims and weaned at least 30 days have premium of $6.13, whereas calves with uncertified vaccinations claims and at least 30 days weaned bring in $2.86. The relative premium between the two categories, which account nearly $3.27 is statistically significant (p-value of less than 0.0001). If calves were brought to market without 30 days weaning claim (either no date mentioned or mentioned that weaned less than 30 days) and vaccinations claim made, then they earn premium of $3.06 on average compared to the base. In fact, this premium is not statistically different than the one for uncertified vaccinations and at least 30 days weaning claim. In addition, calves with the vaccinations and weaning claims together bring in statistically higher premium compared to calves without claims on either or both components based on the corresponding tests in Table 7. Making vaccinations claim but not weaning claim or vice versa is not statistically different than from each other (with p-value of 0.53). Finally, having a claim in either component bring in statistically higher premium (nearly $2) compared not claiming at all. In the following, we compare these findings to those of the previous literature.

Avent, Ward, and Lalman (2004) provided evidence from three consecutive-day sales in Missouri in 2000. Relative to the regular sale, they found $3.30 premium in the single protocol preconditioning sale and $1.94 premium in the multiple protocols preconditioning sale. They considered the possibility that the lower premium in the latter was due to the multiplicity of protocols. They concluded that these premiums by themselves were not enough to cover marginal cost of preconditioning, and less than the perceived value of preconditioning by the surveyed feedlots managers (on average $5.25). On the other hand, Ward and Lalman (2003) estimated two models to determine the premiums paid for cattle enrolled in Oklahoma Quality

Table 7: Parameter Estimates for Vaccinations and Weaning Categories ($/cwt)	
1-Certified Vaccinated and Weaned at least 30 days	$6.13
2-Uncertified Vaccinated and Weaned at least 30 days	$2.86
3-Vaccinated and Weaned Other	$3.06
4-Vaccinated but Not Weaned	$1.99
5-Weaned but Not Vaccinated	$1.77
6-Not Vaccinated and Not Weaned	Base
Tests on the Estimated Coefficients*:	
All individually significant with p-value < 0.0001	
Reject 1=2 with p-value <0.0001	
Do not Reject 2=3 with p-value 0.34	
Reject 2=4 with p-value <0.0001	
Reject 3=4 with p-value <0.0001	
Do not reject 4=5 with p-value 0.53	
***Using heteroskedasticity robust standard errors and p-values are based on Chi-Square Distribution	

Beef Network (OQBN) program (a preconditioning program along with third party verification) seven sales at 2001 and seven sales 2002. In one of the models, variables were treated as independent, whereas in the second model, they introduced a dummy variable combining various requirements of the preconditioning variable. This dummy variable took the value of one for lots which have the following features: "lots that have at least 10 cattle, polled, dehorned, healthy, uniform, managed under certain protocol and certified" and zero otherwise. The base was lots where at least one of these requirements was not satisfied. They reported a premium range of $2.28 to $11.58 for ten sales out of twelve sales in the second model, which they claimed to be typically higher and more consistent across sales compared to the premiums in the first model. Note that these premiums are for the total value of all these preconditioning requirements. In our study, premiums are decomposed into individual components of preconditioning.

Other studies, such as King and Seeger (2004) and Corah, et al., (2006), reported higher premiums for preconditioned requirements. Both studies were based on the data from Superior Livestock Auction's video auctions and have similar findings. Note that the variety of information on cattle can be made more readily available to buyers in video auctions compared to regular auctions. The more up-to-date one, Corah, et al (2006) covered 25,847 lots over the time period from 1995 to 2005. They compared different levels of vaccinations protocols, Vac 45 (full vaccinations program including respiratory viral and clostridial diseases plus boosters and weaned 45 days before sale), Vac 34 (vaccinated for respiratory viral and clostridial diseases but not weaned) and NT (vaccinated only for clostridial diseases and not weaned). NT protocol is being the base, the premiums for Vac 45 ranged from $2.47 in 1995 to $7.91 in 2004. The premium for Vac 34 over NT was relatively lower as expected. Although we focus mostly on the source of claims, these findings are still consistent with ours.

Conclusion:

We have shown that certified vaccination and weaning (at least 30 days) claims bring in significantly (both in statistical and economic sense) higher premium vis-à-vis similar uncertified claims. This shows that the third party certification in preconditioning claims can be a tool to segment cattle with heterogeneous quality attributes in the market. It also shows that significant value can be lost if information is not delivered to the market even all work is really done, which refers to the pricing based on average quality. The estimated premiums for certified vaccinations and weaning claims are found to be higher compared to early studies but consistent with the most recent ones. This may indicate that the reputation of these programs improved over time. We found strong complementarities between weaning and vaccinations claims in extracting premium in the market. We also found strong premiums for sorting and pooling cattle as captured by higher lot sizes. Combining the certified vaccinations and at least thirty days weaning claims with other preconditioning features, and selling as a large lot and in a large sale can bring in the best value. Finally, buyers value cheap effective visual signals (rat-tail, blue-eye, dirty, etc), which is consistent with the asymmetric information hypothesis in feeder cattle auctions. The parameter estimates for other variables relevant to the price formation are consistent with the previous literature.

For future work, we can include muscle and frame score, and whether cattle are home raised as additional controls. Given our interest in signals regarding the end-quality performance, muscle and frame scores are definitely relevant but how much heterogeneity exist in our data set regarding this variable remains to be seen. We will also look at the value of certified programs on other variables such as source verification, electronic ID, birth dates, and their interaction with preconditioning programs.

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