Beef Cattle Management and Marketing Programs:
Do They Add Value for Ranchers in the Western United States?

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Introduction

Consumers' demands for an ever expanding and diverse suite of beef and cattle production characteristics continue to drive ranchers to diversify the quality attributes of their cattle. More today than ever, purchasers of food products derived from animals are interested in quality characteristics that go beyond the physical features of the product itself. Instead, buyers are more focused on how animal welfare, how they are raised (Li et al. 2018; Lagerkvist and Hess 2011; Lusk and Norwood 2011) and what feed, supplements, implants or antibiotics are administered (Key and McBride 2014; McKendree et al. 2013). Simultaneously, the collection of value-added management, vaccination, and marketing programs available to ranchers continues to grow. The combination of these two trends adds substantial ranch-level complexity for cattlemen who must determine which programs and practices will maximize the value of their cattle at time of sale. While the vast majority of these programs will add costs to beef operations, the additional revenue generated from enrolling in these programs is uncertain and highly variable (Zimmerman et al. 2012; Blank, Saitone, and Sexton 2016).

This paper uses data from the largest satellite video auction in the Western United States, Western Video Market (WVM) Auction, and a hedonic regression framework to estimate the premiums/discounts associated with value-added management, vaccination and marketing practices used by ranchers in 2017. Satellite video auctions operate much like traditional auctions with several alterations: i) allowing sellers access to a geographically-broader buyer base by facilitating bidding from remote locales, ii) mitigating cattle stress and incremental hauling costs by not transporting cattle to the auction location before delivery to the buyer, iii) permitting sellers to differentiate their cattle by including comprehensive descriptions of the programs and on-ranch practices used, and iv) allowing ranchers to market lots of cattle for future delivery. From a research perspective, these satellite video auctions provide unique opportunities to analyze lot-level sales data with comprehensive details on the specific programs and practices associated with each lot of cattle sold. These data then allow researchers to provide ranchers with information about the marginal valuation associated with each program or practice employed.

Studies utilizing satellite video auction data and employing a hedonic regression framework began with the advent of these types of sales and systematic data collection (e.g., Bailey and Peterson 1991; Bailey, Peter-

Table 1. Summary Statistics for Calves and Yearlings Sold at Western Video Market (WVM) Auction, 2017

Variables	Calves (N=998) Mean	S.D.	Yearlings (N=715) Mean	S.D.
Price ($/cwt.)	157.45	14.79	137.46	10.15
Weight (cwt.)	5.68	0.54	8.40	0.56
Heifers	0.41	0.49	0.34	0.47
Split Load	0.17	0.37	0.08	0.27
Miles to Omaha, NE (100s of miles)	11.87	4.30	14.00	4.13
Weaned (30 days or more)	0.54	0.50	-	-
Age and Source Verified (ASV)	0.20	0.40	0.26	0.44
Implanted	0.11	0.31	0.26	0.44
Persistent Infection (PI) Negative	0.01	0.08	0.00	0.07
Global Animal Partnership (GAP) Certified	0.08	0.27	0.13	0.33
Non-Hormone Treated (NHT)	0.11	0.32	0.17	0.38
Organic	0.01	0.11	0.02	0.12
Non-GMO	0.02	0.14	0.07	0.25
Natural (WVM/Owner Certified)	0.24	0.43	0.16	0.37
Natural (Third-Party Certified)	0.07	0.26	0.14	0.34
Variability Within Lot				
Even	0.16	0.36	0.09	0.29
Moderately Uneven	0.20	0.40	0.20	0.40
Uneven	0.65	0.48	0.71	0.45
Vaccination (VAC) Programs				
WVM Calf VAC	0.07	0.25	-	-
Zoetis Select PreVAC	0.10	0.30	-	-
WVM Weaned Calf VAC	0.11	0.32	-	-
Zoetis Select WeanVAC	0.08	0.28	-	-
Feeder VAC	-	-	0.03	0.17
Zoetis Select Stocker VAC	-	-	0.00	0.04

Note: With the exception of Price, Weight, and Miles to Omaha, NE the variables in this table are indicator variables and can be interpreted as the share of lots with that characteristic.

son, and Brorsen 1991) and have continued to appear in the literature as both the analytical sophistication and programs and practices employed by ranchers using these sales outlets has expanded (e.g., Zimmerman et al. 2012; Schulz, Dhuyvetter, and Doran 2015; Blank, Saitone, and Sexton 2016; Saitone et al. 2016). The analysis in this paper builds on Blank, Saitone, and Sexton (2016) using the most recent sales data available from WVM in calendar year 2017. Relative to the previous literature, this paper provides the most up-to-date information about premiums associated with value-added management, vaccination and marketing programs employed by western ranchers.

Data and Empirical Model
Western Video Market Auction serves as a marketing outlet for 14 western states.[1] In 2017, more than 286,000 head were sold through 12 auctions held throughout the year. Prices for calves and yearlings were analyzed separately (Anderson and Trapp 2000; Blank, Saitone, and Sexton 2016). Calves were classified based on the

1   The states include: AZ, CA, CO, ID, MT, ND, NE, NM, NV, OR, SD, UT, WA, and WY.

average anticipated weight of the lot, at time of delivery, being between 450 and 650 lbs. in order to focus on price effects at time of weaning. Yearling lots had average anticipated weights at time of delivery in the 750 to 950 lb. range. In total, 998 lots of calves and 715 lots of yearlings were analyzed. Lots consisting of cows, pairs and bred heifers were not included in the analysis.

A hedonic regression model, analogous to Blank, Saitone, and Sexton (2016), was used to analyze the 2017 auction data. Summary statistics for variables included in the models are provided in Table 1.

Price, expressed in dollars per hundredweight (cwt.), is the dependent variable in both the calf and yearling models. As a result, all of the coefficient estimates reported can be interpreted as the incremental premium/discount for that attribute in dollars/cwt. terms. Across the 12 sales conducted by WVM Auction in 2017, the average price for calves (yearlings) was $157.45/cwt. ($137.46/cwt.).

Basic lot-level physical characteristics are common across models and include i) *Weight*, expressed in cwt., is the anticipated average weight of the cattle in the lot at time of delivery, ii) *Heifers* is an indicator variable for a lot consisting of only heifers iii) *Split Load* is an indictor variable that identifies lots comprised of both steers and heifers, and iv) within-lot variability delineated into 3 categories: even, moderately uneven, and uneven. For lot characteristics that are accounted for using indicator variables, the mean reported in Table 1 can be interpreted as the percentage of lots with that characteristic. For example, 41 percent of the calf lots sold during 2017 were comprised of only heifers.

The distance variable (*Miles to Omaha, NE*), used to measure spatial dispersion of lots of cattle sold, is expressed in driving distance in hundreds of miles from Omaha, Nebraska. Omaha, Nebraska is used as a focal point to represent the location of the preponderance of the cattle feeding and processing capacity in the United States (Blank, Saitone, and Sexton 2016; Saitone et al. 2016; Saitone 2018; Crespi and Saitone 2018) and a key hub for price determination in cattle markets (Tomek 1980; Schroeder 1997). Specific to the calf model, *Weaned* is an indicator variable that is equal to 1.0 when a lot of calves was weaned 30 or more days prior to delivery.

Age and Source Verified indicates that the cattle in the lot are enrolled in one of two U.S. Department of Agriculture programs (Process Verified Program or Quality System Assessment Program). This designation is needed for buyers that are targeting beef sales in export markets where traceability is required. The indicator variable *Implanted* = 1.0 denotes that cattle have received an anabolic implant (e.g., Synovex, Ralgro, etc.). *PI Negative* = 1.0 indicates that the lot has tested negative for persistent infection bovine viral diarrhea (BVD).

Value Added Management and Marketing Programs
Beginning in 2009, a proliferation of value-added management and marketing programs included in WVM catalog descriptions was observed (Blank, Saitone, and Sexton 2016). While most programs remain available to ranchers, participation in these programs, as well as the associated returns, vary considerably over time (Zimmerman et al. 2012; Blank, Saitone, and Sexton 2016).

"Natural" is a designation that means cattle have never been fed or injected with any antibiotics, never fed ionophroes, not implanted with synthetic hormones, nor given any feed or supplements containing animal by-products. WVM Natural = 1.0 indicates that the owner of the cattle has signed an affidavit that his or her cattle have been raised in a manner consistent with the natural definition. Alternatively, some ranchers choose to participate in a third-party certified natural program (*Verified Natural* = 1.0). Non-Hormone Treated Cattle (*NHT*) = 1.0 denotes that lot is participating in a third-party certified program that ensures that cattle are not given hormonal growth promotants. NHT is often also required for export markets and thus, is typically paired with Age and Source Verification. Global Animal Partnership (*GAP* = 1.0) is a nonprofit alliance that has established a third-party certified animal welfare program.

Two new programs found in the 2017 WVM sale catalogs are i) *Organic* = 1.0 which indicates that cattle have been raised in a manner that complies with USDA Organic Standards, and ii) *Non-GMO* = 1.0 which denotes lots of cattle that are not fed GMO feeds and indicates compliance with the voluntary GMO labeling system.

Vaccination Programs

Apace with value-added management programs, self-certified and third-party-certified vaccination programs have expanded rapidly over time. In 2017, catalog descriptions focused on four branded vaccination programs for calves and two for yearlings. The self-certified (WVM) programs require the same vaccines as the third-party (Zoetis) programs with the Zoetis programs requiring ranchers to use Zoetis-brand vaccines.[2]

The *WVM Calf VAC* and *Zoetis Select PreVAC* programs require that, 2 to 6 weeks prior to shipping, cattle are vaccinated with a 7- or 8-way vaccine for Clostridial/blackleg, a respiratory vaccine (4-, 5-, 6-, or 9-way) to guard against the IBR/BVD/PI3/BRSV respiratory complex, and pasteurella. Deworming for both programs is optional. The "weaned" versions of these programs (*WVM Weaned Calf VAC and Zoetis Select WeanVAC*) require that lots be re-vaccinated (i.e., receive a second vaccination) for both Clostridial and IBR/BVD/PI3/BRSV, be dewormed, and be weaned 45 days prior to shipping. Finally, both WVM and Zoetis have feeder/stocker vaccination programs (*WVM Feeder VAC and Zoetis Select Stocker VAC*).

Beyond the variables summarized in Table 1, the regression models also include breed fixed effects and sale month fixed effects as controls. The Eicker-Huber-White process was used to obtain heteroskedasticity-consistent standard error estimates (White 1980).

Results

Estimation results for 2017 for the calf and yearling models are provided in Table 2. For both calves and yearlings two models were estimated. The initial models, column (1) for calves and column (3) for yearlings, include all of the variables discussed in the foregoing section. The second set of models, column (2) for calves and column (4) for yearlings, do not include the indicator variables that delineate the vaccination programs for the respective classes of cattle. Throughout the results section, the initial model estimates will be discussed. The different model specifications will be discussed when a detailed review of the vaccination program results is provided at the end of this section. It should be noted that the coefficient estimates are very robust across model specifications.

Consistent with previous results in the literature, the price-weight relationship, given the quadratic specification in the calf models, is declining in the relevant weight range. When the same quadratic weight specification was included in the yearling models, neither coefficient (linear or squared) was significantly different from zero. As a result, a linear weight specification was estimated for the yearling models. Regardless of specification, larger animals received lower prices per cwt., ceteris paribus. This is consistent with the fact that smaller animals have greater potential for gain, and thereby profitability.

Heifer only lots sold at an average discount of $16.71/cwt. for calves and $7.27/cwt. for yearlings. *Split loads*, lots consisting of both steers and heifers, are priced on a dollar per cwt. for steers and dollar per cwt. for heifers (i.e., the lot is associated with two prices, one for each sex). Thus, the coefficient on Split Load should be interpreted as the average discount for both prices (steers and heifers) in a lot comprised of both sexes. This means these mixed lots are discounted, relative to what they would have brought on sale day if they had been sold in same-sex lots, by $6.05/cwt. for calves and $4.00/cwt. for yearlings. All of these variables are significant at the 0.01 level in both the calf and yearling models.[3] Within lot variability earned a fairly consistent discount for calves but was not significantly different from zero at conventional levels in the yearling models.[4]

Consistent with earlier results from the Western U.S. (Blank, Saitone, and Sexton 2016; Saitone et al. 2016), the coefficient on *Miles to Omaha, NE* is negative and significant at the 0.01 level. In the calf regression, the price of each lot is, on average, discounted nearly $0.77/cwt. for every 100 miles that lot is away from Omaha, NE. For example, if a lot of cattle were sold and delivery originated in Redding, CA (1,642 road miles from Omaha, NE) the average estimated discount would be $12.64/cwt. For a lot of yearlings available for delivery

2   The WVM vaccination programs are owner certified via signed affidavit. For the WVM vaccination programs, any commercial brand of vaccine can be used.

3   This means that we are 99% confident that the point estimate is statistically different from zero.

4   Specifically for yearlings, the estimated discount for lots with some variability was significant at the 0.10 level while the coefficient estimates associated with lots with high variability were not statistically different from zero.

Table 2. Regression Results for Calf and Yearling Models, 2017

Variables	-1 Calves	-2 Calves	-3 Yearlings	-4 Yearlings
Weight (cwt.)	-67.48***	-61.08***	-4.56***	-4.56***
	-8.86	-8.84	-0.33	-0.32
Weight Squared	4.22***	4.19***		
	-0.78	-0.78		
Heifers	-16.71***	-16.70***	-7.27***	-7.26***
	-0.41	-0.41	-0.34	-0.34
Split Load	-6.05***	-6.05***	-4.00***	-3.98***
	-0.52	-0.52	-0.46	-0.46
Miles to Omaha, NE (100s of miles)	-0.77***	-0.77***	-1.15***	-1.15***
	-0.08	-0.08	-0.04	-0.04
Lots with Some Variability	-3.61***	-3.54***	1.03*	1.02*
	-0.73	-0.72	-0.61	-0.61
Lots with High Variability	-2.93***	-2.84***	0.52	0.52
	-0.66	-0.64	-0.52	-0.51
Weaned (30 days or more)	5.56***	5.68***		
	-0.52	-0.49		
Implanted	0.42	0.43	0.93***	0.93***
	-0.58	-0.56	-0.35	-0.35
Age and Source Verified (ASV)	3.23***	3.27***	-0.99	-0.99
	-0.76	-0.76	-0.62	-0.62
Global Animal Partnership (GAP)	-3.56***	-3.54***	-0.38	-0.36
	-1.08	-1.06	-0.95	-0.95
Non-Hormone Treated (NHT)	0.85	0.91	1.80*	1.80*
	-1.03	-1.02	-0.97	-0.96
Organic	7.92***	7.92***	6.60***	6.60***
	-2.45	-2.51	-2.55	-2.55
Non-GMO	6.94***	6.96***	3.03***	3.03***
	-1.36	-1.34	-1.05	-1.05
Persistent Infection (PI) Negative	-0.93	-1.1	-2.72	-2.71
	-1.11	-1.08	-1.67	-1.66
WVM Natural	0.65	0.64	1.93***	1.93***
	-0.5	-0.49	-0.49	-0.49
Verified Natural	-0.13	-0.1	3.25***	3.23***
	-1.17	-1.16	-1.04	-1.04
WVM Calf VAC	-0.11			
	-0.84			
WVM Wean Calf VAC	0.744			
	-0.62			
Zoetis Select PreVAC	0.6			
	-0.7			
Zoetis Select WeanVAC	0.37			
	-0.83			
Zoetis Select StockerVAC			-2.87	
			-1.8	
WVM Feeder Vac			-0.09	
			-0.73	
Constant	386.6***	367.3***	178.4***	178.3***
	-25.16	-25.09	-3.06	-3.02
Observations	998	998	715	715
R-Squared	0.84	0.84	0.85	0.85
Breed Fixed Effects	YES	YES	YES	YES
Sale Month Fixed Effects	YES	YES	YES	YES

Note: Single, double, and triple asterisks (*, **, and ***) indicate significance at the 10%, 5%, and 1% level. Heteroskedastic-robust standard errors are reported in parentheses.

from the same location, the average discount is estimated to be $18.88/cwt. Although some cattle in the West may not be shipped directly to the Midwest, the concentration of feeding and processing capacity in the Central U.S. suggests that the majority will eventually be shipped to this region. Whether purchasing calves or year-lings, buyers know that their subsequent sales prices will be reduced due to these transportation costs (based on distance, anticipated shrink, and mortality risk). As cattle are sold downstream through the supply chain, producers will rationally reduce the price they are willing to pay to compensate for these anticipated future dis-counts.

Estimates Associated with Valued-Added Management and Marketing Practices

Table 2 identifies a number of value-added management and marketing programs that provide producers with statistically significant premiums. Based on the 2017 data, these programs seem to differ across the calf and yearling models.

Weaning (30 or more days prior to delivery) remains an important preconditioning practice and gener-ates a statistically significant premium of $5.56/cwt. This 2017 estimate is consistent with prior studies: Schum-acher, Schroeder, and Tonsor (2012) estimated a premium associated with weaning of $5.35/cwt., Williams et al. (2014) generated an estimated premium of $5.23/cwt., and Blank, Saitone, and Sexton (2016) estimated a premium of $3.97/cwt. in using data from 2012-13. The stability and persistence of this premium over time suggests that this is an important practice for cow-calf producers to engage in and denote in the sales catalog if it is feasible for their operation.

Also consistent with prior studies, the estimated premium associated with *Age and Source Verification* was statistically significant ($3.23/cwt.) for calves. This is somewhat higher than previous estimates using WVM data; Blank, Saitone and Sexton (2016) found a $2.32/cwt. using data from 2012-13. The same desig-nation for yearling cattle does not generate a premium that is statistically different from zero.[5] Conversely, lots of yearlings who received anabolic implants sold for an average premium of $0.93/cwt. (significant at the 0.01 level) while the same variable for calves is not estimated to be different from zero.

The two newest value-added management programs introduced by WVM suppliers are *Organic* and *Non-GMO*. Both of these programs generated positive and statistically significant premiums for calves and yearlings alike. A lot of calves (yearlings) that was raised in accordance to USDA Organic Standards sold for an average premium of $7.92/cwt. ($6.60/cwt.). Similarly, producers opting to voluntarily label for the *Non-GMO* Program earned an average premium of $6.94/cwt. ($3.03/cwt.) for calves (yearlings). Note that the confidence intervals associated with these estimates are quite large. This lack of precision is likely associated with the rela-tively few lots sold in 2017 using these programs. This is similar to observations drawn from earlier work with the estimated premiums associated with participation in the *GAP* Program. Lots sold through WVM with the *GAP* designation began selling as early as 2011 but in very small numbers, e.g., in Blank, Saitone, and Sexton (2016) only 29 lots of calves were sold under this program in 3 years. While the estimated premium (2009 – 2012) was $6.05/cwt. for calves, the confidence interval was very large, reflecting the models inability to pre-cisely estimate the average premium given how few lots were in the underlying data. This same issue is present in the 2017 data for the *Organic* and *Non-GMO* estimates where only one percent of calves were marketed as organic and only two percent were marketed using the voluntary non-GMO designation (Table 1).

Both operator certified (WVM) natural ($1.93/cwt.) and third-party certified natural ($3.25/cwt.) earned producers a premium when selling yearlings. This is consistent with what was found in Blank, Saitone, and Sexton using WVM data from 2009-13; yearlings earned a premium for operator certified (third-party certified) of $2.51/cwt. ($3.33/cwt.) that was significant at the 0.01 level. During the same year, the average premium for the natural programs is not estimated to be statistically different from zero in the model for calves. While the NHT designation produced a statistically significant premium for yearlings in 2009-2013 (Blank, Saitone, and Sexton 2016), the coefficient estimate ($1.80/cwt.) and level of significant have declined when compared to the results based on the 2017 data.

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[5] The phenomenon wherein ASV is significant statistically and economically for calves and not for year-lings was also observed in Blank, Saitone, and Sexton (2016) and Saitone et al. (2016).

Estimates Associated with Vaccination Programs

Results (Table 2) indicate that buyers did not pay premiums for operator certified or third-party certified vaccination programs in 2017. None of the operator certified or third-party certified vaccination programs for either calves or yearlings are estimated to have been statistically different from zero. This does not imply that vaccines are not imperative to a healthy lot of calves or yearlings that will sell well. Rather it suggests that, in a video format with a detailed sales description, specific programs/protocols with names or labels are not bringing premiums over and above prices paid for other similar lots of cattle.

Given this suite of programs did not generate statistically significant premiums/discounts, the model was run without these programs included to ensure that results were robust. Table 2, columns (2) and (4), include model estimates without the suite of available vaccination programs. Both point and model fit estimates are robust to the exclusion of these variables.

Most previous studies have included variable(s) in their models to account for basic vaccines (e.g., 2-killed or 1-modified live respiratory vaccine). Yet, virtually all lots of cattle sold through WVM in 2017 met these criteria. Thus, it is no longer possible to estimate the incremental change in price from engaging in what now appears to be the industry standard in the West for lots sold via video auction. As a result, all of the operator and third-party certified programs should be interpreted as incremental compensation over basic vaccination protocols that are administered to the underlying population of calves and yearlings sold in 2017.

Implications

The importance of hedonic pricing models, which provide ranchers with the estimated incremental value of participating in a single value-added management, marketing, or vaccination program, grows with the proliferation of the options available to cattle producers. The ability to conduct these analyses that can inform ranch-level decision making is enhanced as more cattle are marketed through auctions that provide researchers with detailed data on the programs and practices advertised with each lot sold. This article provides ranchers in the Western U.S. with the most up-to-date estimates of premiums/discounts associated with various cattle production, quality, and management attributes relevant to cow-calf and stock operations. Relative to previous work, particularly Blank, Saitone, and Sexton (2016), this paper provides ranchers with more detailed information surrounding how agglomerating cattle into lots (e.g., same sex v. mixed sex) can affect average sales price.[6]

Ranchers in the West are at a locational disadvantage relative to the available feeding and processing capacity in the nation. As a result, ranchers must be vigilant and only adopt production practices that enhance profitability. Based on the most recent data available from Western Video Market Auction, producers should be ever cognizant of the basic production and sorting practices that will bring higher prices on sales day. These include: i) selling steers and heifers in separate lots to avoid the discount associated with split loads, ii) reducing within-lot cattle variability whenever feasible, and iii) weaning calves 30 days or more prior to delivery.

In terms of the value-added management and marketing programs available to producers, calves that were age and source verified (ASV) sold for statistically significant premiums in 2017. Also, during this time, lots of yearlings that were implanted, were raised under the standards of the natural designation (owner or third-party certified). Those producers that participated in the Non-Hormone Treated Program earned statistically significant premiums. Further in 2017, both calves and yearlings which were raised organic or designated as non-GMO sold for substantial premiums. However, producers should be cautious when considering enrolling in these relatively new programs. Premiums are often high when programs are initially introduced and are later eroded as more lots of cattle are sold under these designations. Producers should always consider the specifics of their on-ranch operations and the potential volatility of program premiums before investing in new programs or practices.

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6   Blank, Saitone, and Sexton (2016) only considered steers in their analysis. This work incorporates lots of only steers, lots of only heifers, and mixed lots sold.

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