Effects of Feeder Cattle Grades on Performance and Net Return

By Hub B. Baggett IV, Clement E. Ward, and M. Dan Childs

Abstract

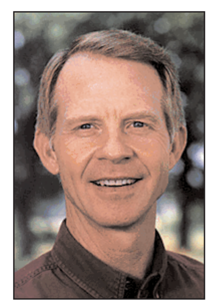
Buyers pay premiums/discounts for feeder cattle according to differences in frame size and muscle thickness. Little research has addressed the economic effects associated with these feeder cattle attributes. In this study, frame size and muscle thickness had limited significant effects on stocker, feedlot, and carcass performance and virtually no significant effects on stocker, feeding, and stocker-feeding net returns.

Introduction

The stocker cattle enterprise is very important to the Southern Plains, especially to the winter wheat grazing areas of Oklahoma, Kansas, and Texas and the summer grazing areas in Kansas and Oklahoma (Peel). Data on stocker cattle numbers are sparse. Peel estimates that possibly 20 percent of the January 1 total cattle inventory and 8 percent of the July 1 inventory may be stocker cattle. Many stocker operators then retain ownership of cattle through the feedlot to harvest.

One question raised by managers of stocker and feeder cattle is whether or not returns differ for feeder cattle with various frame sizes and muscle thickness scores. Both frame size and muscle thickness are important beef cattle traits that affect several aspects of feedlot and carcass performance and both are components of official U.S. Department of Agriculture (USDA) feeder cattle grades. Research confirms that frame size and muscle score affect performance (Adams et al.; Camfield et al.; Dolezal, Tatum, and Williams), including such measures as average daily gain (ADG), days on feed, harvest weight, muscle-to-bone ratio, quality grade, marbling score, and fat thickness. These variables, in turn, affect both cost of production in the feedlot and end-product value.





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Since feeder cattle with different frame sizes and muscle scores perform differently, buyers pay price premiums or discounts commensurate with frame size and muscle thickness traits (Buccola; Faminow and Gum; Lambert et al.; Mintert et al.; Sartwelle et al.; Schroeder et al. 1988; Smith et al.; Troxel et al.; Turner, McKissick, and Dykes). Typically, buyers pay significant premiums for larger frame, thicker muscled feeder cattle. In theory, price differences should reflect expected performance and end-value differences. Thus, it can be hypothesized that if markets value feeder cattle efficiently for frame size and muscle thickness, there should be no significant net return differences between buying animals with a given frame size and muscle thickness versus another. Expected performance and end-value differences caused by frame size and muscle score will be reflected in price differences for these attributes.

Little research has addressed directly the economic effects on performance and net returns for feeder cattle with different frame sizes and muscle scores. This article reports results of an experiment to assess performance and net return differences of feeder cattle through the stocker, feeding, and combined stocker-feeding stages for different frame sizes and muscling scores of feeder cattle. Results are intended to provide useful information to cattle managers and consultants in assessing how feeder cattle purchases affect net returns for the stocker, feeder, and combined retained ownership enterprises. Conventional thinking associated with considering physical performance alone is challenged when assessing the economics of feeder cattle purchases.

Experimental Design and Data

USDA has three feeder cattle frame scores (Large, Medium, and Small) and four muscle thickness scores (1, 2, 3, 4). This project focused on beef cattle, so only large, medium, and small frame feeder cattle and #1 (thick) and #2 (thin) muscled feeder cattle were considered. A 3x2 factorial experimental design was implemented. An experienced cattle buyer was asked to purchase 20 feeder cattle weighing 450 pounds in each of the six feeder cattle grade classes. Calves were purchased at local auctions from November 6, 2000 until January 23, 2001. Calves purchased were predominately of Angus genetics and were bought individually or in small lots. Feeder cattle were uniformly processed the day after being bought, backgrounded on hay and feed until small-grain pasture was ready, and then officially graded by current and former market reporters from the Oklahoma Department of Agriculture and the USDA. All cattle were implanted once, at the beginning of the small-grain pasture phase. Sick or unhealthy cattle were treated as needed. Data were kept on individual animals, including purchase price and feeder cattle traits such as flesh, color, sex, horn status, purchase location, date, and weight. Production data included ADG during backgrounding, feed and hay cost during backgrounding, vaccination costs, and medicine costs.

Cattle were moved to small-grain pasture on the Noble Foundation's Red River Research and Demonstration Farm in Burneyville, Oklahoma on February 12, 2001 and were taken off pasture on May 1, 2001, a total of 77 days on small-grains pasture. Cattle were weighed, re-graded, priced by four independent order buyers, and sent to the Colorado State University research feedlot in Fort Collins, Colorado. As the cattle were moved off pasture and into the feedlot, they were priced by original treatment group as if they were being sold in the field directly to the order buyer.

Data collected at the feedlot included feed intake, morbidity, mortality, feed cost, feedlot processing cost, and ADG. Cattle were fed in treatment groups to estimate feed efficiency. Fifteen pens of cattle were fed with pen sizes of seven to twelve head. Cattle were sorted into pens of similar weight and anticipated finishing time within treatments. When the average of the pen of cattle had an estimated 0.4 inches of backfat, the pen was harvested. Cattle were harvested in three groups. The first group was harvested on September 9, 2001; the second group on October 24, 2001; and the last group on November 13, 2001.

Carcass data, including harvest weight, hot carcass weight, dressing percentage, overall maturity, ribeye area, quality grade, and yield grade, were obtained by meat scientists at Colorado State University. The price of cattle was assessed by live weight but cattle were actually sold on the Gelbvieh Alliance muscle grid. The muscle grid emphasizes yield grade, but pays premiums for quality grade so it can be used for cattle that fit both grade strengths. The live weight price used for comparison was the Cattle-Fax U.S. average fed cattle price for the three slaughter dates. Three other grids were also used to calculate simulated net returns had the cattle been sold differently. The USDA national average of reported grid price on the slaughter dates was used as one alternative. This grid was intended to be an average grid that emphasized both quality and yield grade. Two simulated grids were also used; one emphasizing quality grade, the other yield grade. The simulated grid premiums and discounts resembled those of commonly used industry grids.

Estimated net returns, i.e., returns to unpaid death loss, labor, transportation, selling, and management costs, were calculated for individual animals at each production phase, i.e., small-grain pasture (stocker) phase, feedlot phase, and combined stocker and feedlot phase (retained ownership).

Purchase price was adjusted to remove potential bias associated with an order buyer specifically trying to buy certain types of cattle at a given sale, i.e., had the auction market had a limited volume of that specific type of feeder cattle on the specific day when cattle were purchased. The actual purchase price was regressed on independent variables that describe the cattle bought, including frame size, muscle score, degree of flesh, hide color, horns, sex, weight, sale date, and sale location. Predicted values from this model are referred to as the adjusted purchase price.

Performance and net return differences were analyzed using Least Squares Means (LS Means). Performance measures were stocker ADG, feedlot ADG, feed efficiency (conversion), carcass weight, quality grade, and yield grade, among others. Net returns were compared for the stocker enterprise, feedlot enterprise when cattle were sold on a live weight basis, feedlot enterprise when cattle were sold on the Gelbvieh grid, all enterprises when cattle were sold on a live weight basis, and all enterprises when cattle were sold on the Gelbvieh grid.

Performance Effects

Neither frame size nor muscle thickness significantly affected ADG in backgrounding, on small-grain pasture, or in the feedlot (Table 1). While absolute differences can be seen in Table 1, differences were not statistically significant. These findings were somewhat unexpected, though early growth performance is affected by more than frame size and muscle thickness. Typically, however, higher stocker and feedlot growth rates are expected for larger frame, thicker muscled (#1) feeder cattle.

Table 1. Least Squares Means for Production Characteristics by Frame Size and Muscle Thickness (Adjusted to 0.4 in.).

		Frame Size			Muscle Thickness	
Trait	Units	Small	Medium	Large	No. 1 (Thick)	No. 2 (Thin)
Purchase Weight of Cattle	Pounds	462.333^{ab}	456.894^{a}	469.894^{b}	465	461.081
Standard Error		4.321	3.033	3.631	2.841	3.052
Backgrounding ADG	Pounds/Day	0.164	0.331	0.418	0.125	0.483
Standard Error		0.209	0.146	0.175	0.137	0.147
Pasture ADG	Pounds/Day	2.461	2.628	2.670	2.572	2.601
Standard Error		0.097	0.068	0.083	0.064	0.069
Feedlot ADG	Pounds/Day	3.490	3.546	3.491	3.496	3.523
Standard Error		0.118	0.083	0.099	0.077	0.083
Feed Efficiency In Feedlot	Feed/Pound of Gain	6.742^{a}	7.191^{b}	7.852^{c}	7.135^{a}	7.389^{b}
Standard Error		0.092	0.065	0.077	0.061	0.065
Days Fed in Feedlot	Days	106.064^{a}	129.611^{b}	148.791^{c}	125.69	130.620
Standard Error		3.710	2.604	3.118	2.439	2.620
Harvest Weight	Pounds	1095.733^{a}	1225.93^{b}	1312.24^{c}	1191.898^{a}	1230.704^{b}
Standard Error		17.704	12.427	14.878	11.638	12.502

a,b,c indicate means in the same row for the same item with a different superscript letter differ (P>.05).

Feed conversion (efficiency) was affected both by frame size and muscle thickness (Table 1). Small-framed cattle had significantly lower (better) feed conversion or increased efficiency compared with medium-framed cattle, while large-framed cattle had significantly higher feed conversion or lower efficiency than medium-framed cattle. Number 1 muscled cattle also had significantly lower feed conversion than #2 muscled cattle. As with ADG, larger frame, thicker muscled (#1) feeder cattle are typically associated with better feed conversion than smaller frame, thinner muscled animals.

Frame size and muscling significantly impacted the harvest weight of cattle (Table 1). Larger frame cattle required more days on feed to reach the projected finish point (i.e., 0.4 fat thickness) and were heavier when they reached their physiological end point. Thicker muscled (#1) cattle required fewer days on feed to reach their target fat thickness and were lighter when harvested than thin muscled cattle. These results confirm USDA's use of frame size and muscle thickness to estimate the harvest weight of cattle.

USDA quality grade for carcasses is influenced by marbling in the carcass and maturity of the animal. Frame size and muscle thickness had no significant effect on average marbling and overall maturity, thus had no significant effect on carcass quality grade (Table 2). These results were expected. Quality grade is largely influenced by genetics and management. The most significant management variable in a normal feeding regime is length of the feeding period or days on feed.

Table 2. Least Squares Means for Carcass Characteristics by Frame Size and Muscle Thickness (Adjusted to 0.4 in.).

Trait	Units	Frame Size: Small	Frame Size: Medium	Frame Size: Large	Muscle Thickness: No. 1 (Thick)	Muscle Thickness: No. 2 (Thin)
Average Marbling	Scale	385.346	385.291	368.031	378.141	380.971
Standard Error		9.754	6.847	8.197	6.412	6.888
Overall Maturity	Scale	58.337	63.686	59.164	60.840	59.951
Standard Error		3.231	2.289	2.716	2.137	2.282
Quality Grade	Scale	2.690	2.702	2.792	2.749	2.708
Standard Error		0.104	0.073	0.087	0.068	0.073
Hot Carcass Weight	Pounds	657.765[a]	748.777[b]	799.793[c]	725.195[a]	745.695[b]
Standard Error		11.033	7.745	9.271	7.253	7.791
Ribeye Area	$Inches^2$	12.129[a]	13.405[b]	13.944[b]	13.280	13.039
Standard Error		0.283	0.199	0.238	0.186	0.200
Adjusted Fat Thickness	Inches	0.443[ab]	0.471[a]	0.392[b]	0.427	0.444
Standard Error		0.029	0.019	0.024	0.019	0.020
Percent KPH	%	1.911	1.987	1.923	1.918	1.962
Standard Error		0.071	0.050	0.059	0.046	0.048
Yield Grade	Scale	2.501	2.453	2.462	2.39[a]	2.554[b]
Standard Error		0.078	0.054	0.065	0.051	0.055

a,b,c indicate means in the same row for the same item with a different superscript letter di

USDA yield grade of carcasses is influenced by carcass weight, fat thickness, ribeye area, and percent kidney-heart-pelvic (KPH) fat. In accordance with harvest weight, large frame cattle had significantly higher hot carcass weights and small frame cattle had lower carcass weights compared with medium frame cattle (Table 2). Frame size had mixed effects on ribeye area. Small frame cattle had a smaller ribeye area than medium frame cattle but there was no difference in ribeye area between medium and large frame cattle. Intuitively, one would expect larger animals, both larger frame and heavier cattle, to have a larger ribeye area. Frame size had mixed significance on adjusted fat thickness. While there was no difference between small and medium frame cattle, medium frame cattle had unexpectedly higher fat thickness than large frame cattle. Frame size did not affect percent KPH. Combined, frame size did not significantly affect the USDA yield grade, as expected. Yet, frame size affected three of the four components that make up the composite yield grade, i.e., hot carcass weight, fat thickness, and ribeye area, but not percent KPH.

Muscle thickness affected only one component of yield grade (hot carcass weight) yet significantly affected the overall yield grade. Thick-muscled (#1) animals had lower harvest weights (Table 1) and hot carcass weights (Table 2). But muscle thickness did not affect fat thickness, ribeye area, or percent KPH. Yet, thick-muscled cattle had significantly lower yield grades than thin-muscled cattle. This result supports USDA's use of muscle scores to predict yield grades of finished cattle and carcasses.

Net Return Effects

Net returns were calculated in several alternative ways and the terminology used here is important to understanding differences in reported net returns. The term actual assumes actual purchase prices for calves and actual sale prices for fed cattle. Adjusted (Adj.) refers to adjusted calf purchase prices for potential bias imposed by the order buyer in purchasing certain types of cattle. Recall this was accomplished by regressing actual calf purchase prices on frame size, muscle thickness, degree of flesh, hide color, horns, sex, weight, sale date, and sale location. Average (Avg.) refers to averaged fed cattle sale prices over the three harvest dates due to the sharp decline in prices following September 11, 2001.

Stocker Enterprise

No significant differences were found in adjusted net returns to the stocker enterprise (Table 3). Thus, neither frame size nor muscling thickness significantly affected net returns. While this may be mildly unexpected, recall there were no significant differences in ADG during the pasture phase associated with either frame size or muscle thickness.

Table 3. Least Squares Means for Net Returns in the Stocker and Feedlot Enterprise by Frame Size and Muscle Thickness (Adjusted to 0.4 in.).

Trait	Units	Frame Size: Small	Frame Size: Medium	Frame Size: Large	Muscle Thickness: No. 1 (Thick)	Muscle Thickness: No. 2 (Thin)
Adj. Net Returns from Stocker Enterprise	$/hd.	58.193	50.898	40.299	54.532	45.061
Standard Error		8.434	6.041	7.270	5.606	6.078
Avg. Net Returns from Feedlot Enterprise (muscle grid)	$/hd.	-95.750	-83.893	-87.576	-98.326	-79.819
Standard Error		13.992	9.822	11.888	9.257	9.882
Avg. Net Returns from Feedlot Enterprise (live)	$/hd.	-55.438	-50.269	-45.682	-59.546	-41.381
Standard Error		12.479	8.760	10.602	8.256	8.813

Feeding Enterprise

Net returns to cattle feeding were considered with live weight sale prices and the Gelvieh muscle grid. No significant differences in average net returns in the cattle feeding phase were found for either pricing method (Table 3). As in the stocker phase, neither frame size nor muscle thickness significantly affected net returns. Feed efficiency, feedlot ADG, and days on feed all affect net returns in cattle feeding (Langemeier, Schroeder, and Mintert; Lawrence, Wang, and Loy; Schroeder et al. 1993). Frame size affected feed conversion and days on feed but not ADG. Small frame cattle required less time on feed and were more feed efficient, thus could have been expected to have had higher net returns. Muscle thickness affected feed conversion but not days on feed or ADG. Thick muscled (#1) cattle were more efficient but not enough so to significantly increase net returns. Few significant differences were found for carcass traits that could be attributed to frame size and muscling, especially for quality grade and yield grade, both of which can affect prices received. Thus, no differences in net returns could have been anticipated.

Stocker and Feedlot Enterprises Combined

Frame size and muscle thickness had no significant effect on combined net returns from the pasture and feeding phases except in one case (Table 4). A significant frame size effect was found when actual liveweight prices for fed cattle were used. This reflects the significant differences in price level after September 11, 2001 when each of the three groups of cattle was harvested. In all other cases, no significant frame size and muscle thickness effect was found. This result held both for average live weight pricing and grid pricing of the cattle with four different premium-discount grids. Recall there were no significant differences in ADG during the pasture phase associated with frame size and muscling and no difference in net returns. While there were significant differences in feeding performance, they were not large enough to affect net return differences, especially given that few differences were found for carcass traits.

Different pricing methods affected the absolute level of net returns, but the effects differed little for frame size and muscle thickness traits (Table 4). The relative differences among frame sizes and between muscle scores were not significantly affected by pricing method or the premium-discount grid used.

Table 4. Least Squares Means for Net Returns in the Combined Stocker and Feedlot Enterprise by Frame Size and Muscle Thickness (Adjusted to 0.4 in.).

		Frame Size			Muscle Thickness	
					No. 1	No. 2
Trait	Units	Small	Medium	Large	(Thick)	(Thin)
Adj. Net Returns from All Enterprises (live)	$/hd.	28.631[a]	10.672[ab]	-15.151[b]	2.960	13.141
Standard Error		12.705	9.101	10.952	8.444	9.156
Avg. Net Returns from All Enterprises (live)	$/hd.	-3.287	-7.536	-9.350	-10.896	-2.552
Standard Error		12.773	8.966	10.852	8.450	9.021
Adj. Avg. Net Returns from All Enterprises (live)	$/hd.	-30.380	-15.906	-21.377	-28.946	-16.163
Standard Error		13.423	9.615	11.571	8.922	9.674
Adj. Net Returns from All Enterprises (muscle grid)	$/hd.	-13.975	-20.594	-50.717	-33.168	-23.689
Standard Error		14.117	10.113	12.170	9.383	10.174
Avg. Net Returns from All Enterprises (muscle grid)	$/hd.	-43.599	-41.160	-51.243	-49.677	-40.991
Standard Error		14.238	9.994	12.097	9.419	10.055
Adj. Avg. Net Returns from All Enterprises (muscle grid)	$/hd.	-30.380	-15.906	-21.377	-28.946	-16.163
Standard Error		13.423	9.615	11.571	8.922	9.674
Adj. Avg. Net Returns from All Enterprises (Nat. Avg. Grid)[c]	$/hd.	-52.001	-35.696	-53.495	-51.089	-43.039
Standard Error		9.840	7.049	8.483	6.540	7.092
Adj. Avg. Net Returns from All Enterprises (Sim. Quality Grid)[d]	$/hd.	-46.104	-29.945	-42.446	-44.849	-34.148
Standard Error		11.628	8.330	10.024	7.729	8.380
Adj. Avg. Net Returns from All Enterprises (Sim. Yield Grid)[d]	$/hd.	-32.697	-15.379	-27.262	-29.700	-20.525
Standard Error		10.536	7.548	9.083	7.003	7.593

a,b indicate means in the same row for the same item with a different superscript letter differ (P>.05).
c indicates a grid using the National Average of premiums and discounts reported by USDA.
d indicates a simulated grid based on industry premiums and discounts which places respective emphasis on quality grade

Implications and Conclusion

In 2000, new USDA feeder cattle grades were instituted. Results from this single study indicate that the new grades are effective in predicting harvest weight and yield grade at Choice quality grade. In particular in this study, frame size affected harvest weight, and muscle thickness affected yield grade.

Stocker, feedlot, and carcass performance associated with frame size and muscle thickness was not significantly different in many cases. Consequently, neither did frame size and muscle thickness affect net returns in the stocker, feeding, and combined stocker-feeding phases. If markets are efficient in valuing feeder cattle attributes, net returns from purchasing cattle with different frame sizes and muscle scores would not be significantly different. Expected net return differences affected by expected performance differences would be adjusted by purchase price differences to the point of eliminating expected net return differences. Based on this experiment, it appears the market valued differences in feeder calves close to what would be considered efficient, in the sense that price differences did not lead to significant net return differences. One caveat needs to be stated: this was a single experiment and more research is necessary to substantiate findings reported here.

There has been a trend among many cattlemen to favor large frame cattle. Large frame cattle are expected to grow faster, perform better, and result in more pounds of beef sold. However, when adding economics to the physiological differences in cattle, net returns in this study were not significantly higher for large frame cattle compared with small and medium frame cattle. Therefore, cattle managers and those consulting with producers need to carefully assess prices paid for feeder calves with different frame sizes and muscle scores. Heavily discounted, smaller frame, thinner muscled calves may return as much or more than paying large premiums to purchase larger frame, thicker muscled calves. Thus, when bought properly, neither of the two components of feeder cattle grades (frame size or muscle thickness) should adversely affect net returns in the stocker, feeding, and stocker-feeding phases.

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