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Economics of Increased Beef Grader Accuracy

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Economics of Increased Beef Grader Accuracy

Practitioner's abstract

Carcass data from more than 38,000 cattle was used to compare the called and measured yield grade in two different periods: before and after the slaughter plant incorporated another grader in the line to improve grading accuracy. The study shows that the graders accuracy significantly increased. The higher accuracy affected all yield grades, but most notably resulted in more called yield grade 4 and 5 carcasses. This analysis will develop insight of what will be the effect of instrument grading that will be more accurate than previously called grades.

The results are expressed as the conditional distribution of the called yield grade for a given value of the measured yield grade. The pricing grid currently used by the industry was used to analyze the effect of the graders errors on the expected values of the premiums on both periods and by yield grade. The results show that the company has an incentive to improve accuracy of grading. Simulating the results of measured vs. called yield grade over prices at the time and a standard industry grid showed that the plant can benefit by $1.32 per head by increasing grading accuracy.

Keywords: cattle, carcass grading, accuracy, economics of grading

Introduction

On October 23, 2006 USDA's Agricultural Marketing Service (AMS) formally approved image-based instrument grading to evaluate marbling scores in beef carcasses. The two specific vision camera systems (the VBS2000 and Computer Vision System) had previously been approved for assessment of USDA yield grades and both were found to accurately predict marbling scores. The incorporation of this technology will allow USDA graders to predict quality and yield grades more precisely at line speed (Wheeler, Shackelford and Koohmaraie) with the following consequences:

- It will permit the packers to better sort carcasses to the product that maximizes carcass value. (Peck, 2006)
- It will help more accurately pay the producer for the true quality of their carcasses eliminating the situation where lower quality carcasses are subsidized by higher quality carcasses because of grading errors. (Peck, 2006)
- Increased accuracy will help producers better understand the effects of their management decisions on the final quality and value of their product creating an incentive to track their animals individually and keep better records. Wheeler, Shackelford and Koohmaraie

Cross and Whittaker (1992) stated the need to develop a system for instrument assessment of carcass value because the people raising cattle feel that the present subjective system did not give sufficient confidence to the producer.

The consequence of grading errors is that some material is classified in a grade different that the one it really belongs. The “contamination” of high quality product with low-quality product and vice versa is reflected in the prices of both, so that the market fails to properly reward the technological investment, paying a higher-than-deserved price to non-invested producers and more importantly a lower-than-deserved price to invested producers (Chalfant and Sexton, 2002). This uncertainty in the grading and testing mechanisms results in a systematic underinvestment under a price-grade type incentive structure (Hennessy, 1996; Chalfant et. al., 1999). “The problem may be particularly relevant for products where quality is hard to identify in raw product, or where quality is at a significant premium.” (Hennessy, 1996)

While not the case for beef, an additional but not less important problem is that the grading is often conducted by the processor and it can be arbitrary, making the producer vulnerable to manipulation as pointed out by Hennessy in 1996. This is another cause of underinvestment because some producers that don’t trust the industry will not consider investing in quality improving technologies, even when incentives for better quality outweigh the costs of producing it. A different result was obtained by Bogetoft and Ballebye (2003), who found that in a competitive environment when trading occurs before grading, grading errors do not create incentive problems. Bogetoft and Ballebye considered that the processors will use more high-powered incentives to compensate producers for the lack of reliable information (because competition will lead them to do so), while Chalfant et. al., 1999 considered that processors will use less powered incentives to protect themselves for the lack of reliable information.

But the equipment and other costs associated with its use are not inexpensive. Peck (2006) estimates that the price tag is about $250,000/system, and there are other costs that go along with it such as cost of service contracts, software updates, training, etc. Therefore the use of the new system should return the companies at least these costs.

There is a concern between some participants of the beef industry about the increasing number of carcass called yield grade 4 and yield grade 5. Hueth, Lawrence and Marcoul (2004) showed that the graders errors in the predictions of the yield grade shift the proportion of the called yield grade to the middle of the distribution. They also explained that even though there is not incentive structure for the graders, calling yield grades 4 and 5 would draw more attention to their work given the high discounts associated with these grades. Therefore an increase in the accuracy of the graders would probably increase the percentage of called yield grades 4 and 5 as well as yield grades 1. Accuracy of yield and quality grade is expected to improve in the future as USDA approves and packers adopt instrument grading because it provides a more objective method of determing grades.

On 06/30/2003 the slaughter plant where these cattle are slaughtered made an effort to increase the graders accuracy. This effort consisted in incorporating a second grader on the line. From then on one grader calls the quality grade and the other calls the yield grade, in that way both graders have more time to call the attribute and focus on only one grade. For the rest of the paper we will call Period 1 the period before 06/30/2003 and Period 2 the period after 06/30/2003.

This paper shows the percentage of measured yield grades and USDA called yield grades for two times periods (before and after the second grader was included) and analyzes the change in the graders accuracy compared to professionally measured carcass grades.

Materials and Methods

Individual animal data representing 38,856 cattle (28,146 steers and 10,710 heifers) fed in 12 Iowa feedlots between 2000 and 2006 were analyzed for this project. The dataset reports feedlot performance variables for each animal and carcass traits among other things. Carcass measurements for fat thickness (FT), ribeye area (REA), and estimated kidney, pelvic, and heart (KPH) fat are taken by trained and experienced technicians that collect carcass data daily in the plant.

The measured yield grade was estimated using the following USDA equation:

Predicted yield= 2.50 + 2.5*FT + 0.20*KPH+ 0.0038* HCW – 0.32* REA, where "HCW" is the hot carcass weight.

The predicted yield grade from the equation above is rounded to the next lower integer. For example; the yield grade 2 is for predicted yield between 2.0 and 2.99 (Hueth, Lawrence, and Marcoul, 2004).

The measured and called yield grade distribution was estimated for two different time periods (January 2000- June 2003 and July 2003 - June 2006) to see if they had changed over time. The graders' called yield grade was compared with the measured yield grade for each animal for the two different time periods. The results are expressed as the conditional distribution of the called yield grade for a given value of the measured yield grade.

Then the yield grade premiums were estimated for the called and the measured yield grade and the premiums were compared to see the effects of grading errors on received premiums and who benefited from them.

Results

The cattle in the dataset have significantly fewer yield grade 4 and 5 cattle than the national average. Much of this lower level can be attributed to management and careful sorting at slaughter. Even though the percentage of measured yield grade 4 and 5 decreased from 2.59% to 1.99% between these 2 periods (table 1), the percentage of called yield grade 4 and 5increased from 1.49% to 1.98%. Moreover the percentage of measured yield grade 1 increased from 7.37% to 9.36% but the percentage of called yield grade 1 increased even more, from 7.26% to 10.30%. The decrease in the percentage called yield grade 3 compensates the others.

Table 1: Evolution of the Measured and Called Yield Grade Distributions

	Measured Distribution		Called Distribution	
	Period 1	Period 2	Period 1	Period 2
YG 1	7.37%	9.36%	7.26%	10.30%
YG 2	49.82%	53.69%	50.61%	49.78%
YG 3	40.22%	34.96%	40.64%	37.95%
YG 4	2.56%	1.94%	1.46%	1.89%
YG 5	0.03%	0.05%	0.03%	0.09%

Comparing the diagonals in table 2 shows that the accuracy of the graders increased in the second period with respect to the first one for all the yield grades, and most of the increase in the accuracy are in the extreme yield grades where they were less precise in the past. For example: in the Period 1 they only predicted 58.2% of the yield grade 1 correctly but for the Period 2 they predicted 86.9% of the yield grade 1 correctly.

Table 2: Probability that the Called YG=i Given that the Measured Yield=j for Both Sexes in Both Periods ... Prob(YG=i | Yield=j)

Period 1 (before 06/30/2003)						**Period 2** (after 06/30/2003)					
i \ ***j***	Yield 1	Yield 2	Yield 3	Yield 4	Yield 5	***i*** \ ***j***	Yield 1	Yield 2	Yield 3	Yield 4	Yield 5
YG 1	<u>58.2%</u>	5.9%	0.1%	0.0%	0.0%	YG 1	<u>86.9%</u>	4.0%	0.0%	0.0%	0.0%
YG 2	41.0%	<u>76.8%</u>	23.2%	0.5%	0.0%	YG 2	12.7%	<u>86.3%</u>	6.5%	0.0%	0.0%
YG 3	0.8%	17.3%	<u>76.1%</u>	52.7%	0.0%	YG 3	0.4%	9.7%	<u>92.9%</u>	10.8%	0.0%
YG 4	0.0%	0.0%	0.6%	<u>46.4%</u>	42.9%	YG 4	0.0%	0.0%	0.5%	<u>87.1%</u>	11.1%
YG 5	0.0%	0.0%	0.0%	0.4%	<u>57.1%</u>	YG 5	0.0%	0.0%	0.0%	2.1%	<u>88.9%</u>

Note: The numbers in the diagonal of the table represent the percentage of observations predicted correctly for each yield grade.

The distribution of the yield grades is pretty much concentrated around yield grade 2 and 3 (table 1), therefore it is expected that under no aditional information or when there are doubts the graders tend to call yield grade 2 or 3, shifting the distribution of the called yield grade to the mode of the sample yield grade 2 or 3. It can be seen that the errors in measured yield grades are asymetric where for example is more likely to call a yield grade 3 than a yield grade 1 when the measured yield grade is 2. Similarly it is more likely to call a yield grade 2 than a yield grade 4 when the measured yield grade is 3. Hueth, Lawrence, and Marcoul (2004) developed a behavioral model for the graders where they show how do the errors compare with the actual yield grade expected value and distribution.

What motivates a packer or industry to invest in more accurate grading? Table 3 shows the expected value of the called yield grade premiums and the expected value of the measured yield grade premiums if no errors were made by the graders. One interesting thing to see is that the graders errors in the first period caused the packer to pay an average of $1.32/head more premiums that they would pay if the yield grade could be measured without errors. In the second period packers paid an average of $0.15/head less premiums that they would pay if the yield grade could be measured without errors. Both differences are different than zero with 95% confidence but this difference is close to zero for the Period 2. This is a plant that slaughtered approximately 9,000 head per week. Therefore, if this dataset were representative of the animals slaughtered by the plant the grading errors cost the plant approximately $11,880/week in period 1 and they were reduced to $1350/week benefit in period 2. The cost of buying the equipment would be paid off in approximately 21 weeks if they were able to eliminate the errors in period 1. In period 2 the plant is not losing money because of the errors therefore there is no incentive to buy the equipment other than build trust among the producers that supply their cattle.

Table 3: Measured and Called Yield Grade Premiums ($/head) for Both Periods

		Period 1 (before 06/30/2003)			**Period 2** (after 06/30/2003)		
		Mean	St. Dev.	# obs	Mean	St. Dev.	# obs
A	Measured YG premium	9.940	20.830	21703	12.320	20.260	17161
B	Called YG premium	11.240	17.950	21703	12.170	20.680	17161
	Difference (*A-B*)	**-1.310**	15.560	21703	**0.150**	9.510	17161

Table 4 shows the premiums paid by the Grid for each yield grade and the premiums that the producers received for a carcass grading each of the 5 grades in both periods. It can be seen that even though the premium offered by the grid for a yield grade 1 animal was $6.50/cwt in average a producer sending a yield grade 1 animal got only $4.81/cwt in period 1 as a result of the grading errors. The similar situation was observed in the yield grade 4 where the discount offered by the grid were $12/cwt, but a producer sending a yield grade 4 animal was discounted only $5.63/cwt on average. This creates a decrease in the incentives to better manage or sort the cattle for slaughter. What it is really interesting to see if how much the situation improved in period 2 when the grading errors decreased and the average premiums gotten by the producers in each yield grade consistently approximated the premiums offered by the grid.

Table 4: Premiums Offered and Received by the Grid

	Grid Premiums ($/cwt)		
	Without Errors	With Errors (Period 1)	With Errors (Period 2)
YG 1	6.50	4.81	5.97
YG 2	2.50	2.30	2.42
YG 3	0.00	0.51	0.10
YG 4	-12.00	-5.63	-10.87
YG 5	-20.00	-16.57	-19.11

Conclusions

The grader errors caused some yield grade 1's to be called 2 or 3 resulting in lower premiums for producers that send low yield grade cattle, while some yield grades 4's and 5's are called 3 resulting in higher premiums for producers that send high yield grade cattle. Therefore, grader errors reduce the incentives causing underinvestment for improving yield grade.

Hueth, Lawrence and Marcoul found that the errors tend to shift the proportions to the middle of the distribution. Therefore, it is possible that the increase in accuracy is what is causing that more yield grade 4's and 5's to be called giving the idea that the called yield grade is increasing. However, it is not clear that other plants have adopted the two grader system or are using approved instrument grading to improve accuracy. The changes in this one plant are not enough to account for national trends.

The $1.32/head higher premium that the slaughter plant was paying in the first period is probably a good motivation to incorporate the second grader to increase the accuracy. But there are still some errors and they not only cause some level of underinvestment but also creates some loss of confidence of producers in grading. Implementing instrument grading could not only improve accuracy but also reduce the subjectivity level of the measure helping to increase producers confidence in the grading system.

Further research may include the expected change in the incentives when the grading accuracy increases with the introduction of instrument grading.

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