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## ECONOMIC HOMOGENEITY OF GRADE CLASSIFICATIONS UNDER THE NEW AND OLD FEEDER CATTLE GRADING SYSTEMS

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In 1979, the USDA implemented a new feeder cattle grading system that is distinctly different from the old, both in concept and terminology. Under the old grading system, the traditional grade categories of Prime, Choice, Good, and so on were used. Animals were graded according to their ability to satisfy a number of qualitative characteristics. The new system is based upon a dual criterion of framesize and muscling. Cattle are graded as either having large, medium, or small framesizes and No. 1, No. 2, or No. 3 muscling (thickness).

Casual observation of the two grading systems indicates that cattle graded as Choice under the old system will in most cases be classified as Medium Frame, No. 1 Muscled cattle under the new system. Likewise, cattle previously graded as Good will in most cases likely be graded as Medium Frame, No. 2 Muscled animals.

Under the old grading system, the Choice grade group evolved as the "base" grade group, i.e., it had the most frequently reported price and was the most actively marketed group. Causal observation of the new grading system indicates that the Medium Frame, No. 1 Muscle category will evolve as the "base" grade group under the new system. Preliminary survey work by Nelson supports this conclusion. His survey indicates that 57.4 percent of all feeder steers graded in 12 major markets during September and October, 1980, were classified as Medium Frame, No. 1 Muscled animals. Of the possible 9 grade categories, no other single category contained more than 20 percent of the total population. The preponderance of animals in the Medium Frame, No. 1 Muscle grade category makes it a natural "base" or key grade group for pricing. It also leads to a situation in which often not enough animals are available on any given day at a specific market to make an "adequate test" of the market price for other grade categories. Hence, meaningful prices cannot always be obtained and reported for other grades.

The premise herein is that the informational and functional value of a feeder cattle grading system is significantly dependent upon the economic homogeneity of the grade group whose

price and other market information is most frequently reported, i.e., what has been termed here as the "base" group. The less homogeneous the "base" group of a grading system, the less informative and functional will be the prices reported for it. This study addresses the question of whether the new or old feeder cattle grading system provides the most "economically" homogeneous base grade group.

### METHODOLOGY

This study assumes economic homogeneity to be equivalent to equality of market price. A group of cattle in one grade group is concluded to be more homogeneous than a group in another grade category if the price range paid on a given day for animals in that grade group, of a given sex and weight, is narrower than the price range of the second group.

Feeder cattle prices are typically reported as the average price and range of prices received for animals of a given grade, sex and weight group. Weight groupings are generally specified in 100- or 200-pound increments. If the cattle in a given category are economically homogeneous, the price range reported for cattle of a given grade, sex and weight group should be no larger than the price variation attributable to possible weight differences of cattle in the reported group. Depending upon various economic conditions, i.e., fat cattle prices, feed prices, and so on, various premiums and discounts will be associated with different weights of feeder cattle.

The procedure summarized in Table 1 has been used to determine a "coefficient of economic heterogeneity" for a given grade and sex of feeder cattle. Price data used in the example case reported in Table 1 are actual data for prices reported on a selected day for Choice grade feeder steers sold at the Oklahoma City Feeder Cattle Auction Market.

The first step of the procedure is to estimate the amount of premium (discount) associated with various weights of cattle at the market on a given day. To accomplish this, the midpoint of

**TABLE 1.** Data Transformations Used in Calculating a Coefficient of Economic Heterogeneity for Feeder Cattle Grades

Weight Range lbs.	Reported Daily Price Range \$/cwt	Price Range Mid-point \$/cwt	Reported Price Range \$/cwt	Price/Weight Equation's Predicted Range \$/cwt	Price Variation Attributed to Heterogeneity \$/cwt	Coefficients of Economic Heterogeneity percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)
300 - 400	82 - 100.00	91.00	18.00	13.08	4.92	.273
400 - 500	76 - 93.00	84.50	17.00	8.94	8.06	.474
500 - 600	66 - 76.00	71.00	10.00	6.61	3.39	.339
600 - 700	62 - 70.00	66.00	8.00	5.14	2.86	.358
700 - 800	59 - 65.00	62.00	6.00	4.15	1.85	.308
800 - 1000	55 - 59.00	59.00	4.00	6.35	0.00 <sup>d/</sup>	.000 <sup>d/</sup>
Average						
						.292

<sup>a</sup> Estimated Price Weight Relationship: Price = 1650.341 \* Wt<sup>-.494</sup>

<sup>b</sup> Column 6 is calculated as column 4 minus column 5.

<sup>c</sup> Column 7 is calculated as column 6 divided by column 4.

<sup>d</sup> Assumed to be zero since the predicted price range exceeded the actual.

the price range for each of the 6 weight groups reported was calculated (column 3) and regressed against the midpoint value of the weight range with which it was associated. For this purpose, a double logarithmic functional form was found to work best. The estimated equation provides a weight/price relationship that can be used to estimate and remove price variation relative to weight. It is maintained that by subtracting the predicted price range for each weight category (as calculated from the weight/price relationship and reported for this case in column 5) from the reported price range (column 4), a value is obtained that reflects the price variation resulting from economic heterogeneity within a given grade group. This value is then divided by the total price variation observed, as reflected by the price range reported in column 4. The percentage figure derived is referred to as the "coefficient of economic heterogeneity." It is interpreted as the percentage of price variation existing for a group of feeder cattle not accounted for by the animals' weight, grade, or sex, and therefore it is attributable to various other factors making the group of animals economically heterogeneous. Several major factors likely to create this variability or economic heterogeneity include the animals' condition (fatness), health, and perceived breeding. In this case, an average of 29.2 percent of the price variation reported was not explained and is attributed to economic heterogeneity of the animals.

The above procedure was applied to daily prices reported by the USDA for feeder cattle sold at the Oklahoma City Feeder Cattle Auction Market over one-year periods in order to evaluate the ability of the new and old feeder cattle grading systems to classify animals into homoge-

neous groups. The Oklahoma City market was chosen since it is, perhaps, the most predominant market for which feeder cattle prices are reported. It is inductively hypothesized that other markets would demonstrate results similar to the Oklahoma City market. Even if this hypothesis is rejected, it is argued that deterioration of the homogeneity of the base grade group in the Oklahoma City market would have significant implications, given the size and significance of the market.

Since the new and old feeder cattle grading systems were never in use simultaneously, two different annual time periods had to be used to compare the systems. The two periods selected were October, 1978, through September, 1979, and January, 1980, through December, 1980. The two periods were selected to be as close together as possible, but allowing a three-month transition or start-up period for the new grading system to be established, i.e., from October, 1979, through December, 1979. One-year periods were chosen to avoid possible seasonal bias.

Coefficients of economic heterogeneity were calculated for each day over the annual periods considered for each grading system. The daily coefficient values were then averaged (columns 1, 2, Table 2). Values were calculated only for days when prices were reported for three or more weight groupings, resulting in a total of 184 days being considered for the old grading system and 167 days for the new grading system. As reflected by the values recorded for number of observations in columns 3 and 4 of Table 2, none of the weight groups for either grading system was reported for every day considered.

It is postulated that comparison of the two grading systems over two different time periods

TABLE 2. Coefficients of Economic Heterogeneity and Related Statistical Values for the Old Choice Grade and the New Medium Frame, No. 1 Muscled Grade

Weight Range	Mean Values of the Calculated Coefficients of Economic Heterogeneity		Number of Observations		Estimated Standard Deviation of $U_n - U_o$	$H_0: U_n = U_o$	
	$U_o$	$U_n$	$U_o$	$U_n$		$H_A: U_n > U_o$	T-test Value
	Choice Grade	Medium #1 Grade	Choice Grade	Medium #1 Grade			Significance Level
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
300-400	.2554	.4009	151	136	.0170	8.57	.0001
400-500	.4126	.4855	160	149	.0180	4.05	.0001
500-600	.4226	.5052	171	160	.0210	3.76	.0001
600-700	.4301	.3819	170	155	.0293	2.30	.9893
700-800	.3711	.3944	170	149	.0216	1.08	.1401
800-1000	.1284	.1396	169	119	.0133	.60	.2745
Weighted Average	.3384	.3943	991	886	.0077	7.31	.0001

is valid because of the manner in which the coefficient of economic heterogeneity is calculated. Two forms of possible bias resulting from change over time are postulated to have been removed by the procedure. First, the use of a unique weight/price relationship for each day considered has the intent of removing possible discrepancies resulting from changes in premiums and discounts for various weights of animals over time. The average  $R^2$  value of the weight/price equations used to perform this task was .981. Second, expressing the coefficient of economic heterogeneity as a percentage term normalizes the measure over different price levels that may exist over time.

## RESULTS

The results of applying the methodology presented in the previous section to prices for feeder steers sold in the Oklahoma City Feeder Cattle Auction Market are reported in Table 2. For 5 of the 6 weight categories reported, the average coefficients of economic heterogeneity were larger for the Medium Frame, No. 1 grade group in the new feeder cattle grading system than for the choice grade group in the old grading system. The weighted average coefficient of economic heterogeneity over all 6 weight groups was found to be 16.5 percent larger for the new grading system. The above casual comparisons of the coefficients of economic heterogeneity reported in columns 1 and 2 of Table 2 would seem to indicate that the old Choice grade group was a more homogeneous group of animals than the new Medium Frame, No. 1 Muscled group. Statistical tests sustain this conclusion. Letting  $U_n$  repre-

sent the appropriate reported mean coefficient of economic heterogeneity for the new grading system, the null hypothesis that  $U_n = U_o$  was tested against the alternative hypothesis of  $U_n > U_o$  for each of the 6 weight groups and the weighted average value of the groups. The calculated coefficient of economic heterogeneity was concluded to be significantly greater under the new system for the first 3 weight groups, less for the 600-700 pound weight group, and not significantly different for the last 2 weight groups (see column 7 of Table 2). More important, the weighted average coefficient of economic heterogeneity was found to be significantly higher for the Medium Frame, No. 1 Muscled grade group than for the old Choice grade group. An estimated difference of 5.59 percentage points was found between the two weighted average coefficients with an estimated standard deviation of only .77 percentage points. While the difference between these two coefficients is not large in absolute terms, it is highly significant statistically and represents a 16.5-percent (.0559/.3384) superior performance of the old feeder cattle grading system in providing a homogeneous "base" grade group.

Several reservations may exist in using only the January, 1980, through December, 1980, time period to measure the performance of the new feeder cattle grading system. First, it may be contended that the three-month transition period from October, 1979, through December, 1979, is not long enough. Initial lack of familiarity and experience with the grading system by the graders may have resulted in progressive refinement and improved consistency of the system over time. Second, the abnormally dry summer of 1980 may have caused a period of unusual variation in the quality of animals sold, particularly

with respect to non-graded factors such as condition and health. In response to these concerns, four additional one-year periods were considered for the new feeder cattle grading system. Each period considered was commenced three months later than the previous period. The weighted average coefficients of economic heterogeneity over all weight groups and associated t - test values for each period considered are reported in Table 3. In order to link Table 3 to Table 2, the first period reported in Table 3 is the same period considered in Table 2 for the new feeder cattle grading system.

The coefficients of economic heterogeneity given in Table 3 present an unexpected result. The coefficients actually increase in size over time, indicating that the grading process has tended to group cattle in less homogeneous groups over time. The coefficients do appear to stabilize in magnitude after the July, 1980, through June, 1981, period. The last three values of the table, i.e., .4836, .4996, and .4941 are not significantly different from each other ( $P < .02$ ).

The t - test values for the hypothesis of greater economic heterogeneity under the new grading system continue to be highly significant for all periods considered. The test was based upon comparisons to the values found for the old Choice grade as reported in Table 2. Limited

TABLE 3. Coefficients of Economic Heterogeneity for the Medium Frame: No. 1 Muscled Grade Group Over Different Time Periods

Period	Weighted Average Coefficient of Economic Heterogeneity Over All Weight Levels	T-test Value for <sup>a/</sup> $H_0: U_n = U_o$ $H_A: U_n > U_o$
Jan. 80 - Dec. 80	.3943	7.31
April 80 - March 81	.4292	12.10
July 80 - June 81	.4836	20.24
Oct. 80 - Sept. 81	.4996	15.50
Jan. 81 - Dec. 81	.4941	21.62

<sup>a</sup>  $U_n$  is defined as the weighted average coefficient of Economic Heterogeneity for the Medium Frame, No. 1 Muscled grade in the time period considered and  $U_o$  is a similar value for the Choice grade group over the period October 1978 through September 1979, i.e. the coefficient reported for the Choice grade in Table 2.

tests of the sensitivity of the coefficient of economic heterogeneity for the old Choice grade group to changes in the time period were conducted. No particular pattern or highly significant changes in the weighted average coefficient of economic heterogeneity were found. Hence, it may be more correct to infer that a difference of approximately 15.57 percentage points (.4941 - .3384) exists between the weighted average coefficients of economic heterogeneity for the two grading systems, rather than the 5.59 percentage points reported in Table 2. A difference of 15.57 percentage points translates to a 46-percent (.1557/.3384) superior performance of the old feeder cattle grading system in providing an economically homogeneous "base" grade group.

## IMPLICATIONS

The evidence developed here indicates that the new feeder cattle grading system provides a less meaningful economic classification of feeder cattle than the old grading system. This conclusion is based upon results indicating that the dominant grade category of the new grading system displays 16.5 to 46.0 percent less economic homogeneity than the old grading system's dominant grade group. Because of the reduced degree of economic homogeneity for the dominant grade group in the new grading system, the prices reported under the new feeder cattle grading system will likely have less informational and functional content than prices reported under the old system. The results also support the conclusion that price ranges reported for the new Medium Frame, No. 1 Muscled grade group will be wider than those reported for the old Choice grade group.

In closing, it should be noted that the criteria presented here do not constitute a comprehensive comparison of the effectiveness and value of the new versus the old feeder cattle grading system. However, the results raise questions about whether the new feeder cattle grading system has made a positive contribution toward improving the informational content and functionality of feeder cattle price reporting.

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