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A Theoretical Analysis of the "Grid Pricing" Structure of the Beef Carcass Market

Michelle Beshear and James Trapp[1]

Carcass prices for varying yield and quality grades of fed cattle were estimated using five years of USDA reported prices for wholesale meat cuts. The estimated carcass prices were analyzed to determine seasonal patterns. Additionally, two samples of individual animal data were obtained to compare grid pricing to live weight pricing. The results show that beef carcass prices do exhibit a seasonal pattern. The seasonal patterns for both choice and select carcass prices follow the seasonal pattern of live fed steer prices. The level of pricing difference between animal values yielded on a live weight pricing system versus a grid pricing system is determined by three key factors identified in the study. Those factors are : quality of the animals in the pen in terms of both yield and quality grade, the time of year, and the contemporary cash market.

Introduction

Today's consumers want a lean, consistent cut of beef at a competitive price. The current beef pricing system is not fully communicating these desires to producers. The current marketing system for beef stimulates excess fat production by placing the same value on trimmable fat as edible lean (National Cattlemen's Association). Any time a pricing system fails to communicate consumer demand to producers, the system is inefficient and needs to be changed. However, the pricing system should be changed only if the benefits of the change will compensate for the costs of the change. The belief within the industry is that using a better marketing system would help the industry meet consumers' demands. It would accomplish this by rewarding producers for producing cattle with desirable slaughter characteristics and penalizing those who produce cattle with less desirable slaughter characteristics.

Grid pricing is believed by many in the industry to be designed to enhance price discovery and help communication among the phases of the beef industry (Fitzgerald and Stolle). Grid pricing is a pricing method where the Choice Yield Grade 3 (Choice Y3) carcass price is typically used as the base price with other quality and yield grade carcasses priced at premiums and discounts to the base price (McClelland). Thus, a "pricing grid" arises where a 2 by 4 matrix or "grid" of prices is determined with one dimension reflecting quality grade and the

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other yield grade. Generally, premiums are paid for Prime carcasses, and Yield Grade 1 (Y1) and Yield Grade 2 (Y2) carcasses. Discounts are applied to carcasses which are non-conformers to packer specifications, such as Standards, Yield Grade 4 (Y4), Yield Grade 5 (Y5), dark cutters or carcasses weighing more than 950 pounds or less than 550 pounds. A grid pricing system is fairly complex and requires the reporting of prices in a timely manner in order to obtain the base price, quality and yield grade spreads, and volume traded.

Objectives

The general objective of the study is to provide a comparison of the current live weight pricing system with an alternative formula-based grid pricing system. The specific objectives of the study are: (1) to determine the seasonal price patterns for beef carcasses by yield and quality grade, (2) to determine the variance in individual animal values for both live weight and grid pricing on over 100 pens of cattle, and (3) to determine the difference between the formula grid value of the animals in each pen with the estimated live value of the animals.

Seasonal Carcass Price Patterns

This study will estimate seasonal price patterns for carcasses by quality and yield grade by using the OSU Boxed Beef Calculator developed by Dolezal, Gill and Gardner, together with USDA reported wholesale meat prices by cut as reported weekly in the Livestock, Meat and Wool Market News. Prices were collected for the following cuts which are used in the "Boxed Beef Calculator": ribeye, shoulder clod, chuck roll, brisket, knuckle, inside round, gooseneck round, striploin, bottom sirloin, tenderloin, flank steak, inside skirt, cap and wedge meat, back ribs, 80% lean trim and 50% lean trim. The meat prices were collected for the period, January 1991 to December 1995. A 53 week moving average of the weekly prices was taken and used to compute seasonal indices. The computed indices and average price of each cut over the five year period considered were then imported into the "Boxed Beef Calculator." The indices and their respective five-year average prices were used with the "Boxed Beef Calculator" to generate typical seasonal prices for each meat cut.

The "Boxed Beef Calculator" model is a Lotus-based spreadsheet which uses input information on the animal's carcass weight, yield and quality grade together with available price data to calculate the live and carcass value of individual animals. The model essentially contains a set of technical parameters that indicate the pounds of twenty-five different wholesale meat cuts yielded by cattle of differing weights and yield grade. In brief, the model defines how Yield Grade #1 cattle (Y1) yield more pounds of meat per pound of carcass weight than Yield Grade #2 (Y2) animals, and Y2 animals yield more pounds of meat per pound of carcass than Y3 animals. Perhaps more importantly the model describes the change in the mix of meats that different yield grades of cattle yield. Thus given that different cuts of meat sell at different prices, Y1 through Y4 cattle will produce different aggregate meat values per pound of carcass or in general per carcass for carcasses of the same weight. These values/prices, and their seasonal patterns for choice and select yield grades 1 through 3, will be determined by

combining the descriptive ability of the "Boxed Beef Calculator" model with a time series of USDA reported prices for different cuts.

Grid Versus Live Weight Pricing

In order to examine the differences in individual animal values under the two pricing systems, two samples of data on individual animals were obtained. The data sets included a total of 142 pens of cattle with information on the individual animal's live weight, hot carcass weight, yield grade, quality grade, and whether or not the animal was a dark cutter. One sample of 30 pens sold in 1995 and 1996 was provided by a participating feedlot. The data obtained from the feedlot will be referred to in the study as "Feedlot X" data. A second, larger sample was obtained from the Cattlemen's Carcass Data Service (CCDS). The CCDS data set included information on approximately 10 pens randomly chosen each month for the time period, February 1993 to December 1993. The distribution of the sample pens by yield and quality grade are compared with the distribution of the 1995 National Beef Quality Audit (NBQA) in Figures 1 and 2.

The live value of each animal in each pen was determined by the following equation:

$$1)\ LV_{it} = LW_i * CP_t$$

Where the live value of the animal i in week t (LV_{it}) is determined by the live weight of the animal (LW_i) multiplied by the cash price (CP_t) for that week for the given quality of the pen. The cash price used was obtained from the Livestock, Meat and Wool Market News. Prices are reported for 4 to 5 quality categories based on the pen's percentage of choice cattle. The cash price for each pen was matched to the pens' sell date and percentage of cattle grading choice.

The value of each animal i in week t (GV_{it}) on the grid pricing system was determined from the following equation:

$$2)\ GV_{it} = BP_t + Y1_t + Y2_t + P - Se_t - St - Y4 - Y5 - LHC - DC$$

Where BP_t is the base price for Choice Y3 cattle in week t as determined by the "Boxed Beef Calculator" using wholesale meat price data from week t. Premiums are added to the base price if the animal graded prime (P) or was a $Y1_t$ or $Y2_t$ carcass; discounts are subtracted from the base price for select (Se_t) and standard carcasses (S), yield grade 4 ($Y4$), yield grade 5 ($Y5$), light and heavy carcasses (LHC), and dark cutting carcasses (DC). The premiums for Y1 and Y2 carcasses and discounts for select quality carcasses are time varying since they can be estimated with the "Boxed Beef Calculator". Premiums and discounts which are not estimated by the Boxed Beef Calculator were specified as the average of 9 random "spot" quotes of these premiums and discounts by a leading beefpacker over a 12 month period.

The difference in animal values yielded from the two pricing systems can be determined by the following equation:

$$3)\ LV_{it} - GV_{it} = DIF_{it}$$

Where the difference (DIF_{it}) is determined by subtracting the grid value of the animal (GV_{it}) from the live value of the animal (LV_{it}). A simple average of the animal values in the pens and the differences is calculated in order to determine whether the pen on average received a higher value from grid pricing than from live weight pricing and to determine the average amount of the difference in animal values from the two pricing systems.

Results

Seasonal Carcass Price Patterns

By processing the five year historical time series of USDA reported meat prices through the "Boxed Beef Calculator" model a historical series of prices for each cell of the carcass pricing grid for choice and select cattle with yield grades of 1 to 3 was generated. Seasonal indices of prices for Choice Y1, Y2 and Y3 cattle as well as Select Y1, Y2 and Y3 cattle were constructed. The seasonal price indices for Choice Y1, Y2, and Y3 cattle followed closely the seasonal index pattern for Texas/Oklahoma live steer prices (Figure 3). It should be noted that the Texas/Oklahoma seasonal price index used was a published monthly index (Trapp). The estimated linear relationship between the steer price index and the choice indices had an R^2 of .77. Although the general seasonal pattern of the indices were the same, the derived seasonal index exhibits more variability than the steer price index. The indices for the Select Y1, Y2 and Y3 prices also displayed similar patterns as the choice indices; however, the constructed indices for the select prices did not follow the indices for live cattle price as closely (Figure 4). The Select indices had an R^2 of .61 when linearly regressed against the steer price index.

In addition, the spread (premium/discount) between the grid prices was constructed and analyzed for seasonality. The results of calculating the price spreads between the various yield grades for choice and select carcasses are summarized in Table 1. Seasonal patterns were present in the price spreads between yield grades for both choice and select cattle; however, the range of the spread was generally less than one dollar. Given that the spreads are relatively constant throughout the year, the seasonal pattern will have minimal impact on producer marketing decisions. The spreads between yield grades of choice cattle are typically narrowest at mid-year and widest at the end of the year. The price spreads of select carcasses were narrowest a few weeks prior to the middle of the year, and peaked approximately five weeks prior. The select price spreads are widest at the beginning of the year and narrowest at mid-year for all of the select price spreads examined. The narrowest point in the select price spreads occurs a few weeks prior to the choice price spreads narrowest point.

Grid Versus Live Weight Pricing

When comparing the live value of the animals within a pen with the estimated grid value of the animals, the average live value of the pens was consistently greater than the average grid value for each month of the CCDS data set. Over the eleven months represented by the CCDS data, the average difference between the live value of the pens and the grid value was $41.46. The pooled data from Feedlot X also showed the average live value for the animals to be greater than the average grid value. However, the difference between the two pricing methods for Feedlot X cattle was only $12.43, which is substantially less than the difference between the pricing systems yielded by the CCDS data. Although, the data from Feedlot X had a higher average value using live weight pricing for all of the pens combined; eleven of the thirty pens in the sample had a greater average value when priced using the grid system than with the live weight pricing. A summary of the live and grid values of the pens, difference between the pricing systems, and contemporary cash market is shown in Tables 2 and 3 for the CCDS data and Feedlot X data, respectively.

In order to determine the cause of the differences in pen values under the two pricing systems; the animal values of the data from Feedlot X were reestimated holding the cash and grid price constant. The reestimated animal values showed that only two of the thirty pens yielded higher average values with the grid pricing system than the live weight pricing. The two pens that yielded the higher values on the grid system were the best quality pens in terms of yield and quality grade. The ranking of the values directly corresponded with the quality of the pen. Pens with higher percentages of Y1, Y2, and choice cattle showed a consistently smaller difference between the two pricing systems, while the pens with higher percentages of cattle grading standard, and Y4 and Y5 showed the greatest difference between the two pricing systems. These results indicate that the quality of the pen does have a significant impact on whether the cattle will have higher values if marketed on a grid system.

Animal values were then reestimated holding quality constant to test whether time of year had an impact on the differences in values between the two pricing systems. A pen containing approximately fifty percent choice and fifty percent select grading cattle in which less than ten percent of the animals were Y4s or Y5s was selected as the constant quality pen; the cash prices and base grid prices used were the actual 1995 weekly prices. The values obtained by holding quality constant show that at certain times of the year, the formula-based grid pricing system will place higher values on the animals than live weight cash pricing. The values received for the pen with both live weight and grid pricing are illustrated in Figure 5. These results show that grid pricing appears to be stronger relative to cash during the middle of the year from week 20 to week 40.

The two samples of data used in this study represent two different time periods in the cattle industry in terms of fed cattle marketings. The CCDS data sample was from 1993, when fed cattle supplies were low and therefore resulting in a relatively high cash market with prices averaging approximately $76.50. The data from the participating feedlot was more recent data

from 1995-1996, a period of larger than normal supplies which resulted in a low cash market with an average price of $63. Thus given the extremely favorable cash market during 1993, the CCDS data can be expected to receive higher animal values with live weight pricing. Although the data in general represented high quality cattle with relatively low percentage of Y4, Y5 and standard cattle, the formula-based grid used in the study resulted in lower animal values than the price determined by the relatively high cash market.

A possible reason for this is that the grid pricing system used in the study was based on wholesale meat prices which are known to be less responsive in terms of price changes than the market for fed cattle. Moreover, during periods of low fed cattle supplies meatpackers are more likely to overvalue cattle when purchasing on a live weight basis due to the need to meet their demands. The data from Feedlot X represented lower quality cattle in general than the CCDS data, yet 36 percent of the pens had a greater average value on the formula-based grid than on the cash market. Although the cattle from Feedlot X received discounts for non-conforming quality factors, the formula-based grid pricing system yielded higher values in almost half of the pens. This is hypothesized to be due to the extremely low cash market at the time. Given the low cash prices the cattle had higher average values on the grid despite being penalized with heavy discounts for non-conformance. Based on these results, the study implies that the contemporary cash market is as significant as animal quality when determining which pricing method to use to market fed cattle.

Variance of Animal Values

The variance of animal values yielded with each pricing method were calculated and tested to determine if grid pricing is significantly more variable than live weight pricing. The study hypothesizes that the variance in individual animal values within a pen would be greater for the grid pricing system due to the varying quality of animals. However, it was hypothesized that variance in total pen values over all pens would not be significantly different. The variance of individual animal values within pens was found to be significantly different in 70 of the 142 pens used in this study, i.e. in 49% of the pens considered. However, when the variance in total pen values over all pens was calculated, the two pricing methods did not have significantly different variances for the pens studied. Thus, these results show that grid pricing did not exhibit greater volatility of revenues across all of the pens studied, but had a greater variance in individual animal values within pens for almost half of the pens analyzed.

Summary and Conclusions

With grid pricing becoming more prevalent in the fed cattle industry, an understanding of the linkages between live cattle prices and wholesale meat cut prices and their seasonal patterns is necessary for informed marketing and production decisions. This study finds that the seasonal indices for formula derived carcass prices follow closely the seasonal pattern of live cattle prices. Price spreads between differing yield and quality grades do exhibit seasonal patterns. Although seasonal patterns are present in the price spreads between yield grades, the

seasonal variation in the spreads is usually less than one dollar per hundredweight of the carcass. Thus, given the relatively constant spreads, the seasonal variation in the derived spreads will likely not have a significant impact on producers' marketing decisions.

The study also found that grid pricing does value cattle significantly different that live weight pricing. Whether the pen of cattle have a higher value with a formula-based grid pricing system than live weight pricing depends on three key factors identified by the study. The key factors are quality of the pen, time of year, and position of the contemporary cash market. Given the results here, the CCDS data showed that the live weight pricing yielded higher animal values than the alternative formula-based grid pricing system. However, at the time the cash market was fairly high with an average price of $76.50. The data from the individual feedlot during a period of lower than average cash price showed that formula-based grid pricing yielded higher animal values in approximately one third of the pens. Thus knowledge of the number of cattle on feed and their impact on the cash market is vital in determining whether to market cattle on a formula-based grid pricing system as opposed to typical live weight pricing.

The results also indicated that the within pen variation in individual animal values was greater with a grid pricing system for about one half of pens analyzed. However, the variances of the 142 total pen values found using each of the two pricing systems were not significantly different. Many producers are reluctant to use formula-based grid pricing because of its perceived variability of prices. The results here indicate that while individual animal values may be more volatile under the grid pricing system, one should not expect the variation in total pen values received over numerous pen to be any different under the two pricing systems.

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Table 1. Summary of Price Spreads for Yield Grades 1 - 3.

	Choice			Select		
	Y1-Y2	Y1-Y3	Y2-Y3	Y1-Y2	Y1-Y3	Y2-Y3
Average	4.74	9.58	4.84	4.63	9.22	4.59
Maximum	5.00	10.04	5.12	4.97	9.87	4.90
Minimum	4.34	8.92	4.57	4.42	8.78	4.33
Range	.66	1.12	.55	.55	1.09	.57

Table 2. Summary of CCDS Data: Live Versus Grid Pricing Values (Monthly Weighted Averages).

	Average Live Value	Average Grid Value	Average Difference	Average Cash Price
February 1993	$897.90	$836.79	$64.51	$80.81
March 1993	$865.18	$806.10	$57.08	$82.54
April 1993	$880.04	$836.328	$43.71	$81.79
May 1993	$935.83	$888.61	$47.22	$80.52
June 1993	$892.07	$845.59	$46.48	$78.77
July 1993	$862.14	$811.701	$50.44	$74.17
August 1993	$889.16	$865.25	$23.91	$74.74
September 1993	$871.02	$834.88	$36.14	$73.31
October 1993	$887.93	$853.14	$34.26	$71.31
November 1993	$841.13	$823.28	$17.86	$71.80
December 1993	$854.15	$819.69	$34.46	$71.80
Yearly Average	$879.64	$838.49	$41.46	$76.50

Table 3. Summary of Feedlot X Data: Live Versus Grid Pricing Values.

	# of head	Average Live Value	Average Grid Value	Average Difference	Cash Price
02/16/95	66	$798.45	$762.56	$35.89	$74.00
05/04/95	90	$803.37	$745.43	$57.94	$66.75
05/17/95	77	$762.69	$739.94	$22.75	$63.65
05/25/95	80	$737.72	$718.69	$19.03	$64.08
05/31/95	71	$753.00	$774.38	($21.38)	$64.00
07/25/95	91	$785.69	$755.78	$29.91	$61.94
08/24/95	51	$846.37	$770.77	$75.60	$63.46
08/29/95	55	$775.51	$746.37	$31.85	$60.06
09/26/95	68	$766.78	$746.76	$20.02	$63.96
09/26/95	80	$728.92	$686.11	$42.81	$63.98
09/26/95	60	$849.44	$745.02	$104.42	$63.98
10/26/95	55	$827.96	$759.97	$67.99	$65.85
11/15/95	97	$772.31	$739.16	$33.15	$68.86
12/06/95	49	$866.92	$800.51	$66.41	$67.11
01/05/96	26	$785.45	$842.12	($56.67)	$64.04
01/05/96	32	$859.31	$890.53	($31.23)	$64.64
02/29/96	60	$831.50	$840.38	($8.88)	$62.99
03/20/96	75	$765.06	$791.34	($26.28)	$62.34
04/06/96	93	$638.20	$657.77	($19.58)	$62.01
05/02/96	152	$697.28	$754.90	($60.62)	$57.09
05/07/96	89	$797.73	$799.54	($1.81)	$60.28
05/08/96	83	$704.93	$703.11	$1.82	$60.28
05/14/96	59	$742.75	$769.18	($26.43)	$60.06
05/14/96	52	$676.67	$696.46	($19.79)	$60.06
05/31/96	110	$722.93	$745.38	($22.45)	$59.90
06/04/96	97	$724.17	$718.42	$5.75	$59.85
06/06/96	73	$666.90	$665.62	$1.29	$60.42
07/31/96	49	$699.92	$668.04	$31.91	$63.13
07/31/96	78	$750.80	$709.64	$41.15	$62.85
08/14/96	93	$697.08	$651.86	$45.22	$65.97

Figure 1. Distribution of Yield Grades

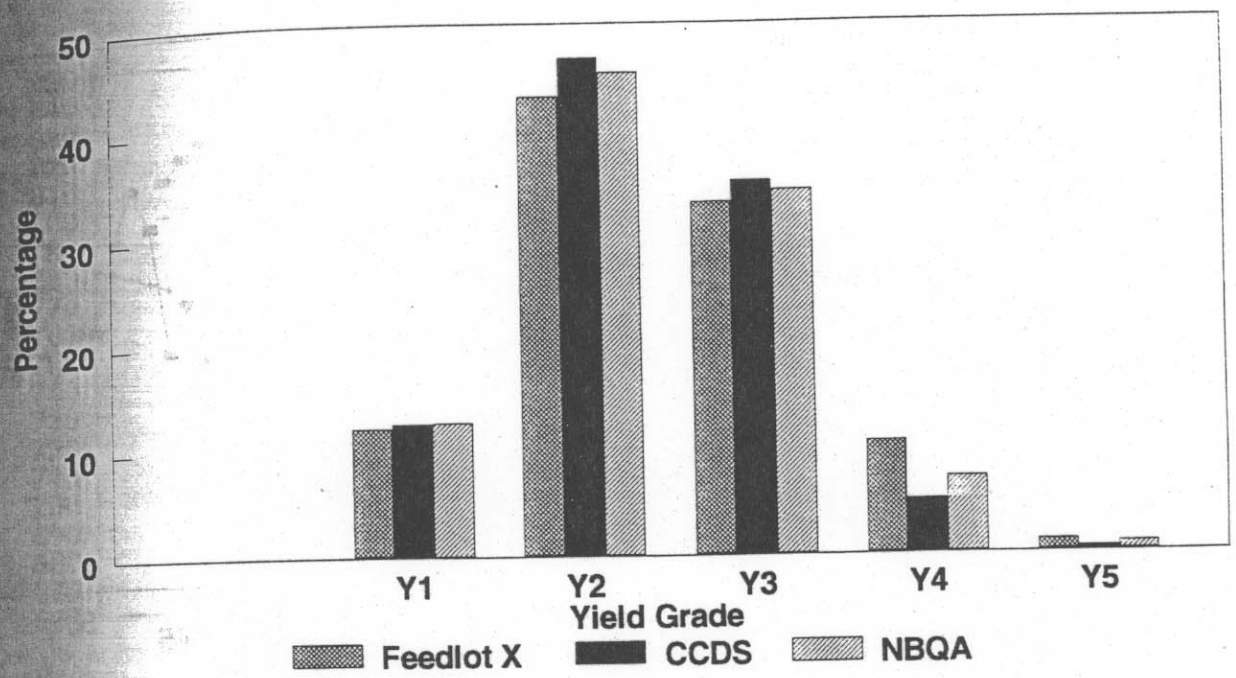

Figure 2. Distribution of Quality Grades

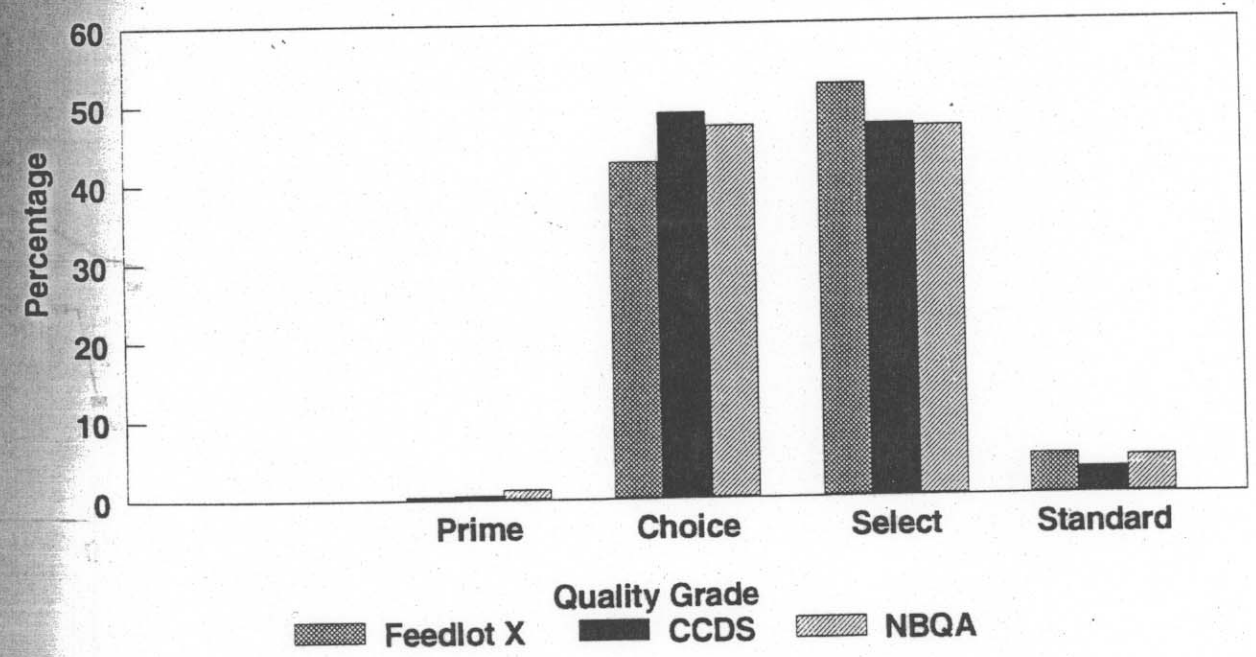

Figure 3. Choice Y2 Seasonality

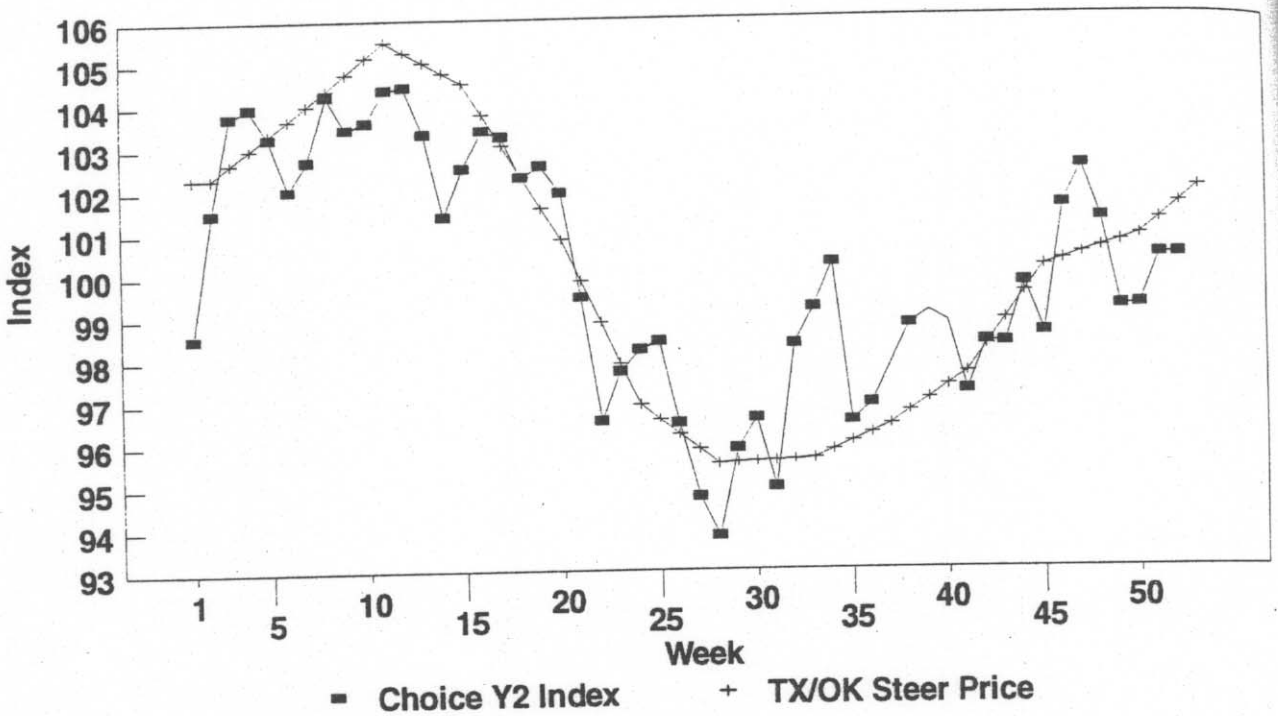

Figure 4. Select Y2 Select

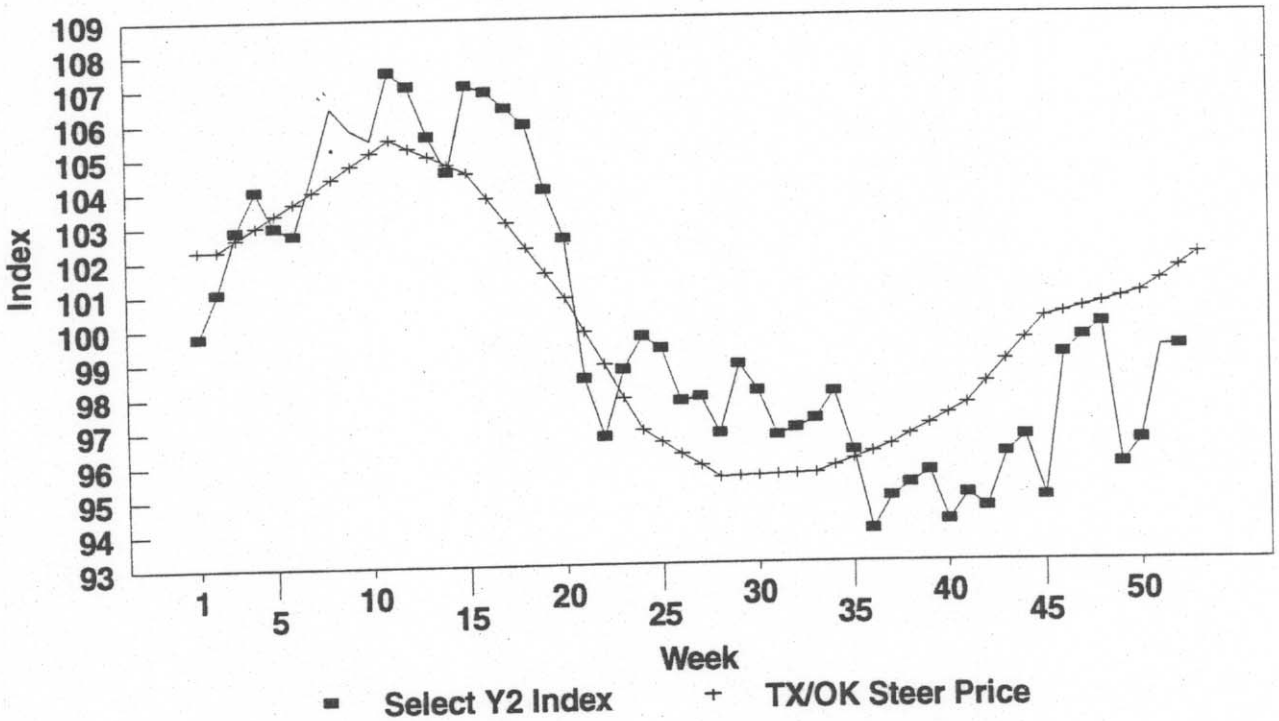

Figure 5. Animal Values with Quality Held Constant