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FACTORS INFLUENCING CASH MARKETING DECISIONS FOR FED CATTLE

by

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ABSTRACT

The reason for the failure of individual carcass-based pricing systems to supplant average-price-based pricing systems in the cash market for fed cattle remains unresolved. Competing hypotheses in the literature associated with this issue are empirically tested using survey data collected on the marketing behavior of cattle producers.

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INTRODUCTION:

According to the Packers and Stockyard Administration's 1992 report (Packers and Stockyards Statistical Report: 1990 reporting year, pp. 21-24), in the U.S. during 1990, 39.9% of steers/heifers and 38.1% of cattle (steers, heifers, bulls, and cows) were purchased on a carcass basis (grade, weight, yield, guaranteed yield, or combination thereof). The proportion of total carcass-based purchases increased from 27.4% in 1980 to 44.6% in 1994. The PSA statistics can be used to infer that a carcass-based pricing alternative to live weight has had limited success in attracting producers. The debate over why individual carcass-based pricing systems have failed to supplant average-price-based pricing systems (eg., live weight) remains unresolved. The literature on this issue argues that producers face economic and psychological barriers when considering VBM for their cattle.

This issue is important because groups associated with the beef industry have been promoting value based marketing (VBM) for finished cattle. In the Value Based Marketing Task Force's final report (sponsored and published by the National Cattlemen's Beef Association (NCBA) 1990), the task force strongly recommended a new marketing system (application of discounts and premiums beyond dressed weight & grade) that will encourage producers to raise leaner cattle that still will grade USDA low choice or higher. In turn, leaner cattle will reduce revenue loss due to fat (estimated at \$2 billion per year) and increase consumption of leaner beef by fat conscious consumers.

Firms in the beef packing industry have developed a number of value based pricing systems, commonly referred to as grid pricing systems, as an alternative marketing method for producers. How successful this effort by the industry to reduce the use of average pricing by producers will be

dependent on whether the barriers to VBM perceived by producers can be overcome.

The purpose of the paper is twofold: 1) to discuss the opposing hypotheses on the failure of the carcass-based pricing systems to supplant average-price based pricing systems; and 2) empirically test the opposing hypotheses using data collected from a recent survey of fed cattle producers.

LITERATURE DISCUSSION:

The NCBA report and recent articles in the animal science literature (Cross and Whittaker 1992, Cross and Savell 1994) clearly implicate current cash marketing alternatives for fed cattle as a major obstacle to improving beef's competitive position in the domestic market. This view is articulated in the NCBA report (Consensus point 7): "Fed cattle should be valued on an individual carcass basis rather than an average live price." Proponents of a new VBMS argue that the current multiple alternative cash marketing system for fed cattle (live; dressed weight; dressed weight & grade) is a barrier to the transmission of consumer preferences for a particular type of beef product to the fed cattle producer. The barrier arises because cattle are sold on a lot basis, and this implies that above-average cattle in the lot are paid less than their market value and below-average cattle in the lot are paid more than their market value. Thus, the price discovery mechanism fails because information to the producer on individual animal market value is not provided or is distorted.

The VBM literature argues that the current three marketing alternatives are flawed and partially responsible for beef's declining market share, that live and dressed weight alternatives are inadequate systems because of average pricing, and while the dressed weight & grade alternative is value based, it is also a barrier because it is unpopular among producers (see consensus point 7 in the NCBA report). The NCBA report argues that the dressed weight & grade alternative has been rejected by the majority of producers because: 1) humans grade the carcass; and 2) there is a time lag between the sale of an animal and payment for the animal associated with the dressed weight & grade

marketing alternative. The validity of this assertion will be discussed within the context of the price discovery literature.

In the price discovery literature, Ward (1987), Fausti and Feuz (1995) offer an alternative explanation for the failure of carcass-based pricing systems to dominate the cash market. Their work suggest that risk aversion the part of producers is responsible for the failure of a carcass-based pricing system to dominate the cash market for slaughter cattle.

Other possible explanations include: 1) producers mistrust packer scales and prefer to be paid on the live weight of the cattle leaving their lot; 2) Large feedlots may prefer to sell all lots for that week at the same price. This practice reduces the time and costs involved in marketing and also has implications for customer relations. A custom cattle feeder does not have to explain to a cattle owner or an investor in cattle why their inferior lot of cattle received a lower price if all cattle are priced the same; 3) if feeder cattle are bought on an average live weight and fed cattle are sold on an average live weight, then a feedlot operator's main concern is with weight gain and the cost of gain. Quality and yield grades are of very limited concern; and 4) Another issue that may limit participation in dressed weight & grade pricing is that producers have viewed it as a system of discounts. Rather than referring to this pricing system as "grade and yield" producers have referred to it as "grade and steal".

The objective of the empirical section of the paper is to determine if there is any evidence to support or reject the competing hypotheses on the failure of carcass-based pricing to supplant average-based pricing in the market for fed cattle. The data for the study was collected through a survey. Two hundred and twenty five cattle producers who had participated in the South Dakota State University Retained Ownership Program over a five year period were surveyed with respect to marketing practices, opinions concerning structure of cash market, risk preference, demographic characteristics, and farming practices. The individual producer survey data was merged with the carcass data belonging to the producer's animals in the retained ownership

program. A probit procedure was used to analyze producers preference for selling their cattle through a carcass-based pricing system versus an average-price-based pricing system.

THE DATA:

Two hundred and twenty five questionnaires were sent to producers who have participated in the SDSU Retained Ownership Program (Wagner 1991-95). The group included cow-calf producers, small private feedlots, and other producers who engage in some type of retained ownership. One hundred and fifty five questionnaires were returned, a response rate of 68.9%. Of those returned, 60 were filled out completely.

A data set was constructed from the completed questionnaires. Fourteen variables were constructed from the information contained in the 60 questionnaires. The dependent variable (Y) indicates the cash marketing method the producer uses when selling fed cattle. A cumulative frequency distribution was used to plot each independent variable against the dependent one, and categorical data were combined according to these distributions. Cut-off points to transform continuous variables into dichotomous variables were decided from their respective continuous frequency distributions. The independent variables were selected in order to test the alternative hypotheses in the literature on why average pricing continues to dominate the cash market for slaughter cattle. Table 1 provides summary statistics of the variables in the data set. Appendix I contains a complete description of the eleven constructed variables used in the empirical analysis.

Table I: The number of observations, mean value, standard deviation, minimum value, and maximum value of variables considered for the model.²

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
Y	60	0.5666667	0.4997174	0	1.0000
TIMELAG	60	0.8500000	0.3600847	0	1.0000
USDA	60	0.6500000	0.4809947	0	1.0000
SLAUGHT	60	0.9166667	0.2787178	0	1.0000
PROGRAMS	60	0.2333333	0.4265219	0	1.0000
ASSOC	60	0.3833333	0.4903014	0	1.0000
NRISK	60	5410.50	2774.73	0	10000
AGE	60	0.3833333	0.4903014	0	1.0000
SPOUSE	60	0.4000000	0.4940322	0	1.0000
OFEMPLOY	60	0.4666667	0.5030977	0	1.0000
ASSET	60	0.6666667	0.4753827	0	1.0000
MQG	58	2.6169848	0.2595177	2.00000	3.3000
MYG	58	2.6597023	0.3892916	2.00338	3.6526
MQV	58	-0.8555406	1.4510067	-5.40000	1.5000

THE MODEL AND EMPIRICAL ANALYSIS:

The discrete choice model selected to conduct the empirical analysis is the Probit Model due to the non linear relationship between the probability of selecting a particular cash marketing channel and the independent variables. The empirical model is defined so that the probability of a beef producer marketing slaughter cattle dressed-weight and grade is defined as $P(Y=1)$:

$$1) P(Y=1) = \beta_1 + \text{TIMELAG}\beta_2 + \text{USDA}\beta_3 + \text{SLAUGHT}\beta_4 + \text{PROGRAMS}\beta_5 + \text{ASSOC}\beta_6 + \text{NRISK}\beta_7 + \text{AGE}\beta_8 + \text{SPOUSE}\beta_9 + \text{OFEMPLOY}\beta_{10} + \text{ASSET}\beta_{11} + \epsilon,$$

where β_1 is the intercept, β_2 through β_{11} are the parameter estimates, and epsilon is the error term. The Maximum Likelihood Estimation Procedure was used to generate the parameter estimates reported in table II.

² Statistical analysis was done using PC SAS.

Table II: Parameter estimates, standard errors, chi-square test statistics, p-values, and standardized estimates for the intercept and independent variables.

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	WALD CHI-SQUARE	PR > CHI-SQUARE	STANDARDIZED ESTIMATE
INTERCEPT	-4.8731	1.5580	9.7837	0.0018	.
TIMELAG	0.6604	0.6087	1.1772	0.2779	0.237806
USDA	0.4299	0.4113	1.0924	0.2959	0.206765
SLAUGHT	2.7098	1.0597	6.5396	0.0105	0.755280
PROGRAMS	1.9283	0.7874	5.9974	0.0143	0.822462
ASSOC	0.6207	0.4209	2.1745	0.1403	0.304348
NRISK	0.000147	0.000077	3.6787	0.0551	0.409251
AGE	0.7959	0.4577	3.0240	0.0820	0.390213
SPOUSE	0.2968	0.4242	0.4895	0.4842	0.146621
OFEMPLOY	0.0598	0.4099	0.0213	0.8840	0.030076
ASSET	-0.0971	0.4582	0.0449	0.8322	-0.046168

Two global tests were performed on the model. The tests labeled "-2 LOG L" and "Score" are based on a chi-square distribution.

The two tests were used to determine whether the variables were significant (the coefficients were statistically different from zero). While "Score" was significant at a five percent level of alpha ($p = .0446$), "-2 LOG L" was significant at the one percent level ($p = .0062$). See table III below.

Table III: Global Test Results.

Test	Results
-2 LOG L	24.602 with 10 DF ($p=0.0062$)
SCORE	18.674 with 10 DF ($p=0.0446$)

INTERPRETATION OF THE PROBIT MODEL PARAMETER ESTIMATES

In linear models, the coefficients estimate the relationship between the exogenous and endogenous variables. Because the model is linear, this relationship is constant, regardless of the value of the variables. According to Aldrich and Nelson (1984), probit models are not so simple to interpret because the relationship is not constant over the range of values the variables may take.

By definition, Z is a function of the exogenous variables:

$$2) Z = \sum \beta_k X_k,$$

and the probability of marketing slaughter cattle dressed-weight and grade is a function of Z:

$$3) P(Y=1) = F(Z).$$

The $P(Y=1)$ varies directly with Z, but the rate of change is not constant. Therefore, while the parameter estimate determines the direction of effect, the magnitude depends on Z, which in turn depends on the magnitude of all the exogenous variables. Thus, the effect of a change in one exogenous variable on the magnitude of $P(Y=1)$ is dependent on the value of all other variables in the model.

It is common practice to select interesting values for the independent variables and then conduct comparative static analysis. During comparative static analysis, everything is held constant except the variable being analyzed. With respect to the discussion below, all variables will be held constant at their respective means.

According to the literature on value-based marketing, the time lag between the sale of slaughter cattle and payment for them is a deterrent to marketing dressed-weight and grade. The possibility of errors made by human USDA graders also is cited as a deterrent. Both TIMELAG and USDA had the *a priori* anticipated signs, but neither variable was found to be significant in the model (p-values of .2779 and .2959 respectively). This indicates that neither variable is a significant influence in cash marketing decisions for slaughter cattle.

As discussed in the literature review, the number of slaughter cattle sold may influence cash marketing decisions. Large slaughter cattle producers (commercial or private feedlots) may focus on weight gain and average price as part of their management strategy and not devote attention to individual animal quality, and therefore benefit more from marketing cattle on an average basis (live-weight). While smaller producers may focus on quality to maximize

revenues. They would benefit more from marketing cattle on an individual basis (dressed-weight and grade). The positive, highly significant parameter estimate (p-value of .0105) supports *a priori* expectations that small beef producers will be more likely to market slaughter cattle dressed-weight and grade. Comparative static results indicate that the probability of marketing dressed-weight and grade increases by .6934 when producers raise 200 or fewer slaughter cattle as opposed to more than 200 head.

The role of livestock cooperative extension programs is to inform and educate cattle producers. Extension programs in South Dakota have promoted the practice of retained ownership and producer monitoring of cattle quality at the time of slaughter over the last decade. Therefore, in this sample, program participants should be more likely to market slaughter cattle dressed-weight and grade. PROGRAMS's highly significant (p-value of .0143), positive coefficient supports these *a priori* expectations. Comparative static results indicate that the probability of marketing dressed-weight and grade increases by .5212 if the producer participates in cooperative extension programs as opposed to not participating in them.

Membership in beef industry associations may also influence slaughter cattle marketing decisions, but in which direction is more difficult to predict. Stock grower associations focus on weight gain and production efficiency, beef associations focus on retail marketing and the economic benefits associated with improved animal quality. The two goals are not always complementary and lead to different marketing strategies. Considering the cumulative frequency distribution of the relationship between ASSOC and cash marketing preference, average pricing and industry group membership are positively related. Therefore, association membership is expected to decrease the probability of marketing slaughter cattle dressed-weight and grade. Although ASSOC is only slightly significant (p-value of .1403), the positive sign of its parameter estimate supports this *a priori* expectation.

As stated in the literature review, the level of a producer's risk aversion is expected to influence his/her cash marketing decisions for

slaughter cattle. Higher levels of risk aversion should decrease the probability of marketing slaughter cattle dressed-weight and grade. The significance of NRISK (p-value of .0551) indicates that risk aversion does influence slaughter cattle marketing decisions, and its positive parameter estimate confirms a *priori* expectations. This provides evidence in favor of the price discovery literature hypothesis that producers' levels of risk aversion significantly influence cash marketing decisions for slaughter cattle. Comparative static results indicate that the probability of marketing dressed-weight and grade increases by .0919 for a \$1000 increase in the respondents risk aversion measure.

An interesting issue regarding NRISK is its mean of 5410.50, indicating that respondents to this survey are, on average, risk preferring. This conflicts previous empirical studies which have found individuals to be generally risk averse, and a number of possible explanations follow: The sample size may be too small to accurately represent beef producers. The source of the mailing list may bias the data toward risk-preferring individuals. Respondents may not have restrained considerations to the framework of the question. The level of possible loss specified in the question may not have been large enough to be considered significant by respondents. Finally, outliers may bias the data; if the range of NRISK is restricted to one standard deviation above and below the mean, the new mean is 4945.24, indicating slight risk aversion.

Although a producer's age should affect his/her cash marketing decisions for slaughter cattle, it is difficult to predict in which direction. Older individuals usually have more experience, and should know that dressed-weight and grade, on average, will benefit them the most. However, older individuals also may be set in their ways, and refuse to switch from the traditional live-weight marketing alternative. Age and experience in cattle production were highly correlated in this sample. Age was selected because it had greater explanatory power. Judging from the cumulative frequency distribution of AGE against the dependent variable, an individual's age is expected to be

positively correlated with the probability of marketing slaughter cattle dressed-weight and grade. The significance of AGE (p-value of .0820) supports the assertion that age influences marketing decisions, and the positive parameter estimate supports *a priori* expectations that age's influence is positive. Comparative static results indicate that the probability of marketing dressed-weight and grade increases by .2830 if the respondent is older than 45 rather than younger.

The amount of input that the spouse has may influence the marketing decisions of the producer. However, the direction of influence the spouse's input has is also difficult to predict. One suspected determinant is the spouse's level of formal education. Higher levels of education are expected to improve logical thinking, and improve openness to new ideas. Therefore, higher levels of a spouse's education should increase the probability of marketing slaughter cattle dressed-weight and grade, but only if he/she has at least some input into marketing decisions. Although SPOUSE was not statistically significant (p-value of .4842), its parameter estimate did support *a priori* expectations. Even though it was insignificant, SPOUSE was left in the model because it improved the Goodness-of-Fit Statistic. This implies that although a spouse's educated input does not significantly influence slaughter cattle marketing decisions by itself, it may in combination with other factors.

A producer with some source of outside income should be more likely to market slaughter cattle dressed-weight and grade than a producer with no outside income, since diversification allows greater risk taking. OFEMPLOY's parameter estimate is positive, as expected *a priori*, but the variable was not statistically significant (p-value of .8840). OFEMPLOY was left in the model to improve the Goodness-of-Fit Statistic, indicating that it may influence marketing decisions in combination with other factors.

According to Pratt's measure of relative risk aversion (1964), individuals with higher levels of wealth should be less risk averse. The value of assets is used as a proxy for wealth, and is therefore expected to

positively influence the probability of marketing slaughter cattle dressed-weight and grade. ASSET's parameter estimate did not have the a priori expected sign, however this could be due to its extremely low level of statistical significance (p-value of .8322).

As discussed in the literature review, it is suspected that sorting may take place in the cash market for slaughter cattle. A producer could maximize profits by marketing high-quality cattle on an individual basis (dressed-weight and grade), while marketing low-quality cattle on an average basis (live-weight). Therefore, a producer with high quality cattle should be more likely to market them dressed-weight and grade. Since no quality variables were significant in the model (they were dropped to improve the global tests), there is insufficient evidence to support the hypothesis that animal quality influences cattle marketing decisions; there is no evidence that sorting is taking place.

SUMMARY OF EMPIRICAL RESULTS AND CONCLUSIONS:

The results of the probit model indicate that the significant variables explaining producer marketing decisions are: 1) participation in extension programs; 2) risk aversion; 3) number of slaughter cattle sold; and 4) age of producer. The insignificant variables are: 1) distrust of USDA grading system; 2) payment-time-lag associated with carcass-based pricing; 3) membership in beef association; 3) cattle quality; and 4) all other demographic variables.

For this group of producers, the results of the empirical study indicate: 1) that risk aversion does pose a barrier to carcass-based pricing for this group of producers; 2) that age, which was highly correlated with beef production experience in our data, increased the probability of selling cattle through a carcass-based pricing system; 3) that participating in extension programs increased the probability of selling cattle through a carcass-based pricing system; and 4) that being a large producer decreases the probability of selling cattle through a carcass-based pricing system.

The caveats associated with this study are: 1) small population; 2) non random sample drawn from the population; 3) results of the study can not be generalized beyond the population group. However, the results of the study does provide insight into which factors affect the producer's cash marketing decision process. The study's results also lends support to the risk aversion hypothesis championed in the price discovery literature and the effect education can have on producer marketing behavior. However, it is clear that further work is needed to gain greater understanding of producer marketing behavior in the cash market for fed cattle

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APPENDIX I:

Dependent Variable

Y This variable indicates the marketing method used by a particular producer. Y takes a value of one if the producer markets dressed-weight and grade, and a value of zero if the producer markets live-weight or dressed-weight.

Independent Variables

TIMELAG This dichotomous variable determines how much of a deterrent the time lag between sale of slaughter cattle and payment for them is to marketing dressed-weight and grade. TIMELAG takes a value of zero if the time lag is "the most important deterrent" or "a major deterrent" and a value of one if the time lag is "a minor deterrent" or "no deterrent" to marketing slaughter cattle dressed-weight and grade.

USDA This dichotomous variable determines how much of a deterrent the producer's distrust of USDA graders is to marketing slaughter cattle dressed-weight and grade. USDA takes a value of zero if the producer's distrust of USDA graders is "the most important deterrent" or "a major deterrent" and a value of one if the producer's distrust is "a minor deterrent" or "no deterrent" to marketing slaughter cattle dressed-weight and grade.

SLAUGHT This dichotomous variable determines the size of the producer's slaughter cattle operation. SLAUGHT takes a value of zero if the producer sells more than 200 slaughter cattle per year. SLAUGHT takes a value of one if the producer sells 200 or fewer slaughter cattle per year; this includes producers who do not sell any slaughter cattle.

PROGRAMS This dichotomous variable determines whether the producer has participated in extension cooperative programs besides the South Dakota Retained Ownership program. PROGRAMS takes a value of zero if the producer has not participated in any other programs, and a value of one if he/she has.

ASSOC This dichotomous variable determines whether the producer belongs to beef industry associations such as the South Dakota Cattleman's Association. ASSOC takes a value of zero if the producer does belong to beef industry associations, and a value of one if he/she does not.

NRISK This continuous variable assigns levels of risk aversion to producer so that they can be ordered accordingly. While NRISK values less than 5000 designate risk averse individuals, values greater than 5000 indicate risk preferring individuals. Values of 5000 indicate risk neutrality.

AGE This dichotomous variable determines the age of the producer. AGE takes a value of zero if the producer is less than 45 years old, and a value of one if the producer is older than 45.

SPOUSE This dichotomous variable represents the input a producer's spouse has into cash marketing decisions for slaughter cattle. SPOUSE takes a value of zero if the producer is unmarried, his/her spouse has no input into marketing decisions, or his/her spouse has less than a formal two-year degree. SPOUSE takes a value of one if the producer is married, his/her spouse has at least some input into marketing decisions, and his/her spouse holds a formal degree higher than a high school diploma or equivalent.

OFEMPLOY This dichotomous variable determines whether the producer has some source of off-farm income. OFEMPLOY takes a value of zero if neither the producer nor his/her spouse is employed outside of their farm. OFEMPLOY takes a value of one if either the producer or his/her spouse is employed outside of their farm.

ASSET This dichotomous variable determines the level of the producer's total asset value. ASSET takes a value of zero if the producer has a total asset value under \$50,000, and a value of one if the producer's total asset value is greater than \$50,000.

MQG This continuous variable is the average quality grade of the producer's animals in retained ownership program at slaughter.

MYG This continuous variable is the average yield grade of the producer's animals in retained ownership program at slaughter.

MQV This continuous variable is the average overall grid determined quality value of the producer's animals in retained ownership program at slaughter.