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FACTORS INFLUENCING BIDS FOR VACUUM PACKAGED RETAIL BEEF: AN EXPERIMENTAL ECONOMICS APPROACH

George W. Borden
Dale J. Menkhaus
Glen D. Whipple
Ray A. Field
Elizabeth Hoffman*

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* Graduate Research Assistant, Professor, Associate Professor, And Professor, University of Wyoming, and Professor, University of Arizona. This research was funded by the Beef Industry Council of the National Live Stock and Meat Board and the Wyoming Beef Council.

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Tobit analysis was used to identify factors influencing the value consumers place on beef steaks in a vacuum skin package relative to steaks in an overwrapped styrofoam tray. Experimental economics was used to obtain value information. Results suggest that information regarding the vacuum skin package enhances the value of beef.

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Changing consumption patterns among meats have received considerable attention from economists over the last decade. Specific to the beef industry, at the center of the debate is the identification of factors responsible for the recent decline in the demand for beef (Purcell). The beef industry has been affected greatly by these changes and is presented with the challenge of winning back market share. The marketing success of competing proteins - chicken, turkey, and seafood has helped energize and direct the beef industry towards increased marketing related activities. These include advertising, promotional schemes, and new merchandising techniques.

An area which has received attention in the literature but has yet to sustain any real change at the retail level is beef packaging. Vacuum skin packaging is an alternative beef package which has recently received attention by the beef industry. According to Seidman (1975), the advantages of the vacuum skin package include: 1) reduction in weight loss from evaporation and trimming; 2) preservation of meat color; 3) increased hygienic control; and 4) enhanced palatibility due to controlled aging. Additional benefits for consumers are 1) capable of storing beef up to seven days in refrigerator; 2) eliminates leakage of juices; 3) provides a clear view of entire piece of beef; and 4) better protection from freezer burn (Fielding).

Research by Lynch, Kastner, and Kropf (1986) addressed the issue of consumer acceptance of the vacuum skin packaged beef. Results of this study suggest that informed consumers were more likely to indicate positive purchase intentions, while uninformed consumers were more apprehensive to purchase.

Since consumer acceptance is essential in the development of any new product, further consumer studies involving vacuum skin packaged retail cuts of beef are necessary to better determine the marketing potential of this product. Past studies

have considered purchase intentions by consumers as the basis for acceptance of the vacuum skin packaged retail cuts of beef. From a marketing standpoint, an additional issue is the value consumers place on the vacuum skin package relative to the value they place on the traditional overwrapped styrofoam tray.

The objective of this study was to identify factors which influence the value consumers place on alternative retail beef packages. Specifically, individual demographic characteristics, meat usage patterns, opinions of fresh beef and beef packaging, and varying levels of package information were related to values bid by consumers for the vacuum skin package relative to the overwrapped tray in a laboratory experiment.

PROCEDURE

Since market price data are not available for the vacuum skin package, an experimental economics technique served as the primary procedure to elicit the value of beef rib-eye steaks in the vacuum skin package (VS) relative to the value of beef in the overwrapped styrofoam tray (OST). The experimental economics procedure is a unique tool which can be useful in marketing research, particularly in addressing issues related to determining the value of a test product relative to a control product. Basically, experimental economics is a laboratory experiment which creates a manageable model of a real world phenomenon (e.g., purchase of a product) where adequate control can be maintained and accurate measurements of a relevant variable (e.g., price) is guaranteed (Wilde). Specific features and assumptions of experimental economics are provided by Hoffman and Spitzer. Demand revealing properties of certain kinds of auction mechanisms have been verified by experimental economists (Cox, Roberson and Smith). For this study a sealed-bid-uniform-price (or Vickrey) auction was used. This auction type is characterized by all units being sold at the same price, which is equal to the highest rejected bid. For example, if

four packages of beef were offered for sale in an auction (as was the case in this study), the four highest bidders would win and pay the fifth-highest submitted bid.

The study was conducted in Denver, Colorado and Los Angeles, California during May and August 1989, respectively. The dense populations and diverse demographics of consumers in both of these markets provide the basis for selection of representative samples, and allows for adequate testing of differences in consumer behavior between locations. Specific to this study, a total of 765 individuals participated in the laboratory experiment from both markets, 383 in Denver and 382 in Los Angeles. Of the 765 participants, 191 were male and 574 were female. Each study participant was screened on the basis of being a primary purchaser of meats in the household and purchasing beef steaks from a supermarket in the past month. This screening process provided some assurance that auction participants were informed bidders. Respondents were told they would be given $35 for participating in the study.

Upon arriving at the test site, study participants completed a background questionnaire designed to obtain information regarding their demographic characteristics and meat purchase behavior. After completing the questionnaire, participants were allowed to inspect choice rib-eye steaks weighing one pound (two - 8 ounce steaks per package) in both package types (overwrapped styrofoam tray and vacuum skin), which were displayed in meat cases to simulate a supermarket setting. Rib-eye steaks were used because they are relatively uniform, high valued, and can be cut to provide for uniform package weight.

Study participants, in groups of eight then were led to study rooms where the experiment instructions were presented. Following the instructions, participants took part in six purchase auctions (three for each package type) using the multiple unit Vickrey auction where four packages of steaks were auctioned off during each auction. One of three levels of information about the VS package were offered during each session of auctions. These levels of information included no

information, information regarding the benefits and chacteristics of the VS package, and information + demonstration of how the meat blooms to the familiar bright red color after the VS package is opened. For individual auctions, package types were presented in different order to eliminate any bias due to order. Four trial auctions, two for each package type, were conducted prior to the purchase auctions to acquaint participants with the procedure. During the trial auctions participants did not have the opportunity to purchase rib-eye steaks. Whether participants actually purchased rib-eye steaks during the purchase auctions was dependent on the price they bid. Participants submitting the top four bids in each of the six purchase auctions were declared winners and purchased that specific package type of rib-eye steaks at the fifth highest bid submitted, the market price. In case of ties at the market price, winners were determined by rolling a die.

At the conclusion of the final purchase auction, those winning the auction paid for the steaks they won. Winners were then given a slip of paper which entitled them to select steak in the package type they purchased in the auctions from the display case viewed prior to the auction.

MODEL DEVELOPMENT

SELECTION OF VARIABLES

The primary focus of this study was to identify factors influencing bids for beef in the VS package relative to bids for beef in the OST package. Variables used in the final analysis were classified into five categories including demographics, current concerns with beef and beef packaging, meat usage patterns, importance of steak and packaging characteristics in buying decisions, and experimental variables. Demographic variables were identified primarily based on their importance in past studies (Senauer). The experimental variables were specified according to the specific manner in which the study was conducted. Variables chosen from the remaining categories, since there was no a priori basis for their inclusion in the

model, were based on the specific criteria detailed below. Statistical tests used were the chi-square test, Pearson coefficient of correlation, and the log-likelihood ratio test. Data for demographics, current concerns with beef and beef packaging, meat usage patterns, and importance of steak and packaging characteristics in buying decisions were obtained from the background questionnaire administered before the auction.

A chi-square test was used to identify significant relationships between participant bids and responses to background questions. Specifically, responses to questions in the background questionnaire were crosstabulated with winners (bids greater than the market price) and nonwinners (bids equal to or less than the market price) for the VS package of beef rib-eye steaks in the auction. The null hypothesis states, that participant pre-auction attitudes about beef and beef packaging did not influence whether they were winners or nonwinners during the purchase auctions for the VS package. Any significant ($\alpha = 0.50$) variable, was given further consideration and was incorporated into an unrestricted model.

The unrestricted model was then tested using a Tobit model. A Tobit estimator was used because of the presence of zero observations for the dependent variable, i.e., bids for the VS package were zero (Tobin). Variables with a t-ratio of 1.0 or greater provided the basis for inclusion of a variable in the final model. Variables which were pairwise correlated ($r \geq 0.30$) were tested independently in the Tobit model and were chosen based on their strength (t-ratio) in the Tobit model. This then yielded the final or restricted model.

The log-likelihood values of the restricted model (-830.72) and unrestricted model (-821.35) were then compared. The null hypothesis states, that the estimated coefficients associated with variables in the unrestricted model, not included in the restricted model, are equal to zero. At a significance level of 0.10 the null

hypothesis cannot be rejected[1]. Thus, it was concluded that variables not included in the restricted model did not contribute significantly toward explaining the variation in the dependent variable, the value consumers place on beef in the VS package relative to beef in the OST package.

MODEL

The model used to explain the value participants placed on the VS package of beef rib-eye steaks relative to the beef in the OST package follows. All independent variables were 0-1 or dummy variables with the exception of the variables age, total income, education, and number of persons in the household. The dependent variable included each participant's average bid for the VS package relative to the average bids for beef in the OST package over a series of three purchase auctions for each package type. Incomplete questionnaires and zero average bids for the OST package were excluded from the total sample. This then yielded a total sample of 692 used to estimate the final Tobit model. Average bids for each package type were used because it was believed that this measure would be a good indicator of total participant activity throughout the series of auctions. Specifically, the Tobit model takes the following form.

$$\text{Ave Bid VS / Ave Bid OST} = B_0 + B_1X_1 + \ldots\ldots\ldots + B_{34}X_{34} + e$$

Variables included in the final model (restricted) are identified in Appendix I.

RESULTS AND DISCUSSION

Tobit results for the model are presented in table 1. The estimated normalized coefficients for the Tobit estimator cannot be directly interpreted but are used to

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[1] $-2(\max LL\ w/o - \max LL\ w)$, where LL is the log likelihood function without (w/o) restrictions and with (w) restrictions, under the null hypothesis is distributed asymptotically as X^2 with the degrees of freedom equal to the number of restrictions to be tested (23 in this case).

TABLE 1 - TOBIT REGRESSION RESULTS
(DEPENDENT VARIABLE, AVERAGE BID FOR THE VS PACKAGE
RELATIVE TO THE AVERAGE BID FOR THE OST PACKAGE)

INDEPENDENT VARIABLE	NORMALIZED COEFFICIENT	STANDARD ERROR	REGRESSION COEFFICIENT[1]
X1 Time Of Day (1:30 PM)	0.047	0.114	0.038
X2 Time Of Day (4:30 PM)	0.054	0.115	0.043
X3 Time Of Day (7:00 PM)	0.026	0.121	0.021
X4 Trt 2 (Information)	0.275*[2]	0.095	0.221
X5 Trt 3 (Info + Demo)	0.361*	0.095	0.290
X6 Monitor 1	-0.289*	0.109	-0.232
X7 Monitor 3	-0.310*	0.110	-0.249
X8 Monitor 4	-0.337*	0.110	-0.271
X9 Order	0.235*	0.082	0.189
X10 Location	0.149*	0.084	0.119
X11 Age	-0.002	0.003	-0.001
X12 Income	0.061*	0.025	0.049
X13 Sex	-0.019	0.098	-0.015
X14 Education	0.007	0.040	0.006
X15 Number Of Persons In Household	-0.017	0.032	-0.013
X16 Marital Status	-0.130	0.113	-0.104
X17 Employment Status	-0.162*	0.094	-0.130
X18 Freeze For Later Preparation	0.073	0.081	0.059
X19 Not Well Trimmed - Too Much Fat	-0.111*	0.084	-0.089
X20 Packages Are Not Sturdy Or Strong	0.178*	0.104	0.143
X21 Eating Too Much Not Good For Health	-0.168*	0.086	-0.135
X22 Not Easily Prepared	-0.331*	0.220	-0.266
X23 Eating Fresh Beef Less	-0.028	0.092	-0.022
X24 Eating Poultry More	0.053	0.100	0.043
X25 Eating Fish More	0.138*	0.085	0.111
X26 Opinion Of Fresh Beef Good	-0.142	0.120	-0.114
X27 Opinion Of Fresh Beef Packaging Good	0.082	0.083	0.066
X28 Juicy, Not Dried Out	0.075	0.136	0.061
X29 Nutritional Value	0.092	0.082	0.074
X30 Greater Amount Of Marbling	-0.179*	0.088	-0.144
X31 Cost	-0.129*	0.082	-0.104
X32 Labelled "All Natural"	0.177*	0.091	0.142
X33 Beef Looks Appetizing And Attractive	0.089	0.135	0.071
X34 Overall Shape	-0.106*	0.083	-0.085
Constant	1.336*	0.366	1.073

Value of Log-Likekihood Function = -830.72

[1] The regression coefficient is equal to the product of the normalized coefficient times the standard error of estimate (Capps). The standard error of estimate is equal to 0.80319.

[2] Asterisks indicate significance at $\alpha = 0.10$.

calculate regression coefficients (Capps). From the total sample of 692, there were 685 non limited observations (average bids of VS package relative to OST package greater then zero) and seven limited observations (average bids of VS package relative to OST package equal to 0). The squared correlation between observed and expected values was equal to 0.11, which indicates that approximately 11 percent of the total variation of the dependent variable is accounted for by the independent variables. This is appropriate for cross sectional data (Capps, et al.).

Several experimental factors significantly affected the average bids for the VS package of beef rib-eye steaks relative to the average bids for beef in the OST package. The level of information regarding the VS package significantly influenced the average bids for the VS package of beef rib-eye steaks relative to the average bids for the OST package ($0.22 when information was provided (X4) and $0.29 when information and demonstration was provided (X5), compared to the no information treatment). Average relative bids were not significantly different between the information and the information + demonstration treatments. This suggests that information regarding the VS package is important to enhance the value perception of beef in the VS package, but a demonstration of how the meat blooms to the familiar bright red color upon opening is not warranted. Average relative bids for the monitors 1, 3, and 4 (X6, X7, and X8), were significantly lower than the average relative bids received by monitor 2 by $0.23, $0.25, and $0.27, respectively. There was no significant difference in average relative bids obtained by monitors 1,3, and 4.

The order (X9) which the different package types were offered during the purchase auctions significantly influenced the relative average bids. When the VS package was offered first, the relative average bid increased on average by $0.18. Location (X10) had a significant affect on the average relative bids with Los Angeles participants submitting, on average, bids which were about $0.12 higher for the VS package relative to the OST package as compared to Denver participants.

The time of day the auction was conducted did not significantly influence the average bids for the VS package relative to the OST package. As compared to the morning session, relative average bids during the early afternoon, late afternoon, and evening sessions were not significantly different nor were they different among sessions 2, 3, 4 (X1, X2, X3, respectively).

Demographic characteristics of participants were not particularly important explanators of relative average bids. Income and employment status were the only two demographic factors which significantly influenced relative bids for the two package types. While age, sex, education, number of persons in household, and marital status were not significant influences. As income increased by $10,000, average bids for beef in the VS package relative to average bids for beef in the OST package increased by $0.05. As compared to participants employed full time, relative average bids by those not employed full time were $0.13 lower.

Several concerns related to beef and beef packaging, as indicated by study respondents, significantly contributed towards explaining relative average bids. When not well trimmed-too much fat left on (X19) was expressed as a concern, the average bids for the VS package relative to the average bids of the OST package decreased by $0.09. The full visibility of beef in the VS package could explain this result. Other concerns which significantly decreased the relative average bids included eating too much not good for health and not easily prepared,($0.13 and $0.26, respectively).

When packages are not sturdy or strong was expressed as a concern (X20), the average bids for the VS package of beef rib-eye steaks relative to the average bids for OST package significantly were higher by $0.14. Durability and strength of the VS package compared to the OST package may provide an explanation for this result. An examination of the influences of meat usage patterns (beef, poultry, fish) by participants suggests that only eating fish more (X25), significantly increased the

average bids for the VS package of beef rib-eye steaks relative to the average bids for the OST package ($0.11).

Selected factors influencing the buying decision for steaks also affected the average bids for the VS package of beef rib-eye steaks relative to the average bids for the OST package. For example, when greater amount of marbling (X30) was identified as encouraging purchases of steaks, the relative average bid was lower by an average of $0.14. Similarly when cost was identified as a factor encouraging purchases of steaks, the average bids were $.10 lower.

When labelled "All Natural" was identified as influencing steak buying decisions, the average bids for the VS package of beef rib-eye steaks relative to the OST package were significantly higher by an average of $0.14. Participants receiving information about the VS package (two-thirds of total sample), were told that quality beef has a "natural" burgundy color. Statements such as this, may have contributed to a perception that the VS package of beef rib-eye steaks was somehow more "natural". In addition, environmental issues (such as bio-degradable) were commonly mentioned by participants in regards to the unsafe disposal of the traditional OST package type.

When overall shape of beef was identified as encouraging buying decisions for steaks, average bids for the VS package of beef rib-eye steaks relative to the OST package were significantly lower by $0.08. Consumers are more accustomed to thick cuts of beef and under the VS packaging process the beef tends to appear flatter and more compressed.

CONCLUSIONS

The purpose of this study was to identify factors which influence the value consumers place on the VS package of beef rib-eye steaks relative to the OST package. Final conclusions are based on the Tobit regression results.

Results suggest that information is very important in the marketing of the vacuum skin package. When study participants received information about the VS package, they valued the beef in the VS package significantly higher than the beef in the OST package. A demonstration of opening the VS package did not significantly increase the value of the VS package over the information treatment. This conclusion translates into a potential cost savings to retailers and the beef industry, if a demonstration is not necessary and consumers only require information about the VS package.

Dissatisfaction with current beef packaging (OST) is implied by consumers. Sturdy packages appear to be an important attribute to consumers, thus increasing the value of the VS package relative to the OST package. Health concerns still appear to be a major issue facing the beef industry. The value of the VS package decreased relative to the OST package when eating too much not good for health was a concern, indicating that an alternative package (VS) will not lesson health concerns among consumers. As a result, additional areas of merchandising efforts need to be addressed such as advertising and labeling.

Physical appearance of the beef continues to play a major role in purchasing decisions of consumers, with fat and marbling significantly decreasing the value of beef in the VS package relative to beef in the OST package. These areas become more important when considering the VS package because consumers can see both sides of the beef. If the VS package is introduced, packers and retailers are faced with increased quality control related to fat and marbling.

Implications from this study regarding the value for the VS package relative to the OST package, provides additional information about consumer attitudes with respect to retail beef packaging. Study results suggest that the introduction of the VS package for retail beef appears to be warranted from the perspective of the consumer.

REFERENCES

Capps, Oral Jr., Moen, Daniel S. and Branson, Robert E. "Consumer Characteristics Associated with the Selection of Lean Meat Products," Agribusiness, 4:549-557, 1988.

Capps, Oral Jr. "Qualitative and Censored Response Models," American Agricultural Economics Association Workshop, Purdue University, 1983.

Cox, J.C, Roberson, B. and Smith, V.L. "Theory and Behavior of Single Object Auctions," Research in Experimental Economics, JAI Press Inc., 2:1-43, 1982.

Fielding, William G. "Beef Makes a Comeback - by Listening to Consumers," Marketing U.S. Agriculture - 1988 Yearbook of Agriculture, U.S. Government Office, 133 - 136, 1988.

Hoffman, E. and Spitzer, E.L. "Experimental Law and Economics: An Introduction," Columbia Law Review, 85: 991 - 1030, 1985.

Lynch, N.M, Kastner C.L. and Kropf, D.H. "Consumer Acceptance of Vacuum Packaged Ground Beef as Influenced by Product Color and Educational Materials," Journal Of Food Science, 51:253-255, 1986.

Purcell, Wayne D. "The Case of Beef Demand," Choices, Second Quarter, 16-19, 1989.

Seidman, S.C. "The Effect of Degree of Vacuum on the Physical and Organoleptic Properties of Vacuum Packaged Beef Wholesale Cuts" Thesis, Texas A and M University, College Station, 1975.

Senauer, Ben. "Discussion: Effects of Demographic Factors," The Economics of Meat Demand, edited by Rueben C. Buse, 297-303, 1986.

Tobin, James. "Estimation of Relationships for Limited Dependant Variables," Econometrica, 26:24-36, 1958.

Wilde, L. "On the Use of Laboratory Experiments in Economics," The Philosophy of Economics, edited by Joseph Pitt, D. Reidel Publishing Co., 1981.

APPENDIX I
(VARIABLES IN RESTRICTED MODEL - DEFINED)

Ave Bid VS Package/ Ave Bid OST Package = each participant's average bid for the beef in the VS package divided by the average bid for the beef in the OST package over a series of three auctions.

X1 = time of day auction conducted, 1 if session 2 (1:30 PM), 0 otherwis[1];

X2 = time of day auction conducted, 1 if session 3 (4:30 PM), 0 otherwise[1];

X3 = time of day auction conducted, 1 if session 4 (7:00 PM), 0 otherwise[1];

X4 = level of information provided about VS package (Trt 2), 1 if information, 0 otherwise[2];

X5 = level of information provided about VS package (Trt 3), 1 if information + demonstration, 0 otherwise[2];

X6 = monitor, 1 if monitor 1, 0 otherwise[3];

X7 = monitor, 1 if monitor 3, 0 otherwise[3];

X8 = monitor, 1 if monitor 4, 0 otherwise[3];

X9 = order in which OST and VS packages were offered in the three purchase auctions, 1 if the VS package first, 0 otherwise;

X10 = location, 1 if Los Angeles, 0 if Denver;

X11 = age;

X12 = income, 1-11 variable with $10,000 increments;

X13 = sex, 1 if female, 0 if male;

X14 = education, 1-6 variable with 1-3 equivalent to four years of high school or less and 4-6 equivalent of college work;

X15 = number of persons in household, 1-7 variable with 1 person increments;

X16 = marital status, 1 if married, 0 otherwise;

X17 = employment status, 1 if employed full time, 0 otherwise;

X18 = 1 if freeze fresh beef for later preparation, 0 otherwise;

X19 = 1 if not well trimmed-too much fat left on is a concern; 0 no concern;

X20 = 1 if packages are not sturdy or strong is a concern, 0 no concern;

X21 = 1 if eating too much not good for health is a concern, 0 no concern;

X22 = 1 if not easily prepared is a concern, 0 no concern;

X23 = 1 if eating fresh beef in general less, 0 same or less;

X24 = 1 if eating poultry more, 0 same or less;

X25 = 1 if eating fish more, 0 same or less;

X26 = 1 if overall opinion of fresh beef is good, 0 otherwise[4];

X27 = 1 if overall opinion of beef packaging is good, 0 otherwise[4];

X28 = 1 if juicy not dries out encourages buying decision, 0 otherwise[5];

X29 = 1 if nutritional value encourages buying decision, 0 otherwise[5];

X30 = 1 if greater amount of marbling encourages buying decision, 0 otherwise[5];

X31 = 1 if cost encourages buying decision, 0 otherwise[5];

X32 = 1 if labelled "All Natural" encourages buying decision, 0 otherwise[5];

X33 = 1 if beef looks appetizing and attractive encourages buying decision, 0 otherwise[5];

X34 = 1 if overall shape encourages buying decision, 0 otherwise[5];

e = error term

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[1] Session 1 (9:00) was the base.

[2] No information was the base.

[3] Monitor 2 was the base.

[4] Ratings were based on a "5" point scale where "5" = excellent and "1" = poor. Transformed by combining 3,4,5 for good (1) and 1,2 for not good (0).

[5] Ratings were based on a "9" point scale where "9" = strongly encourages buying decision and "1" = strongly discourages buying decisions. Transformed by combining responses 7,8,9 = encourages (1) and 1,2,3,4,5,6 discourages (0).