ESSAYS IN THE BEEF INDUSTRY: GRID PRICES, MEATPACKING FIRM MERGERS, AND ADVERTISING IMPACTS ON BEEF CONSUMPTION

By

JONG-IN LEE

Bachelor of Science
Kangwon National University
Chunchon, Korea
1987

Master of Science
Kangwon National University
Chunchon, Korea
1993

Master of Science
University of Missouri
Columbia, Missouri
1997

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment for
the Degree of
DOCTOR OF PHILOSOPHY
December, 2000

ESSAYS IN THE BEEF INDUSTRY: GRID PRICES, MEATPACKING FIRM MERGERS, AND ADVERTISING IMPACTS ON BEEF CONSUMPTION

Thesis Approved:

Thesis Advisor

Dean of the Graduate College

ACKNOWLEDGEMENTS

I wish to express my sincere appreciation to my major adviser, Dr. Clement E. Ward, for his kindness, constructive guidance, and intelligent supervision. His financial support, encouragement, and inspiration made this study possible. I also would like to thank and extend my deep appreciation to my committee members, Dr. Brian D. Adam, Dr. Derrell Peel, and Dr. Don Gill, whose guidance, assistance, and encouragement were also invaluable. Thanks also goes to Dr. James Trapp, Head of the Department of Agricultural Economics, Oklahoma State University, who offered financial support. I wish to express my gratitude to Dr. Ted C. Schroeder at Kansas State University for providing data.

I owe a debt of gratitude to my teachers who taught and gave me inspiration since elementary school. My special thanks goes to Drs. Jong-Tae Ko, Seo-Hyun Ha, Byung-Oh Lee, Kyung-Ryang Kim, Woon-Sung Jeon, and Hae-Shik Shin. They taught me when I studied at Kangwon National University and encouraged me to study in U.S. I also owe a considerable debt to my friends and fellow students who encouraged me, studied with me, and willingly shared their time and knowledge. Especially I would like to thank Gi-Sung Moon, and Drs. Kyung-Sung Jeon, Yoon-Sang Choi, and Dong-Hyun Kim for their friendship and help.

I express my gratitude to God and members of Korean Baptist Churches in Columbia, MO and Stillwater, OK. His love and the member's prayers provided me constant encouragement and support. Finally, and most importantly, I express my deepest love and heartfelt thanks to my parents, Kyu-Hong Lee (a great educator) and Sung-In Kang. Without their prayer, devotion and untold sacrifice, this study would never have been accomplished. I also express my sincere love and gratitude to my brothers (Jong-Ho, Jong-Ik, and Jong-Cheol), sisters (Jeong-Sook, Jeong-Ja, and Jeong-Wha), sisters-in-law (Hye-Soon Ko and Ji-Young Ko), and brothers-in-law (In-Whan Oh and Kyung-Seok Lee), who have prayed and tolerated with patience during the completion of this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

Introduction

The production and marketing of meat animals totaled 65,692 million pounds and 81,915 million pounds, respectively in 1997 in the U.S. Cattle and beef products were 41,111 million pounds or 62.6% of meat animals products. The beef and cattle industry is one of the biggest livestock industries in the U.S.

There are many farms, plants, organizations, employees, marketing channels, and government offices involved in the beef industry. Each segment in the industry is assumed to pursue its profit or utility maximization in an economic sense. However, they are confronted with many problems because there are complexities in the profit or utility maximization between members. For example, profit maximization of feedlots may reduce the profits of packers, and the preference change of consumers may claim excessive efforts or money to be accomplished by the beef industry.

This paper consists of 5 chapters attempting to solve selected problems in the beef industry. Chapter two is about a feedlot and packer problem. Feedlots and packers have arguments about beef quality and beef procurement costs. Feedlots think they do not receive enough for their cattle, even though they have cattle that have good quality. In the meantime, packers complain that they over-paid for cattle that had poor quality. The chapter two shows price variability associated with a pricing method that has arose in response to their arguments.

In chapter three, the market efficiencies of meat packers were analyzed. Packers try to increase their market efficiencies or profits through mergers. However, each firm should consider the effects of mergers, because each firm may have positive or negative effects from the results of mergers. Two firms were considered in this chapter, a merged firm of two larger plants and a merged firm of two smaller plants.

As per capita beef consumption decreases, the beef industry tries to increase beef demand. One of the efforts is advertising based on the 'Beef Promotion and Research Act of 1985'. The beef industry has increased advertising expenditures for beef since the Act was enacted, however per capita beef consumption has not increased as much. The advertising effects on per capita beef consumption were studied in chapter four. Brief conclusions are mentioned in chapter five.

CHAPTER II

Short-Term Variability in Grid Prices for Fed Cattle

The value of a good is evaluated by its price, and economic agents that are involved with the good try to find the correct price. All characteristics and inputs of the good are reflected in its price. When the characteristics of the good are well known, the process of price discovery will be relatively simple. In the sense of economics, price is just the sum of value added. If all agents have perfect information about the good, namely in the perfect competition market, all resources will be allocated efficiently from this price discovery process.

This is not the case in the beef industry. All economic agents, for example cattle feeders, packers, etc., have been trying to evaluate the correct value of the good, beef. However, Schroeder argues that it is an arduous task to obtain the value of fed cattle for identifying beef quality. The efforts to assess the value of fed cattle caused marketing changes from terminal auctions to direct selling to packers (Feuz), and live-weight pricing (Ward; Packer and Stockyards Administration) to carcass-weight pricing (Schroeder) in the beef industry since the 1970's. Table 2.1 shows the carcass-basis purchases in cattle by firm size from 1986 to 1997.

A study by Ward showed most cattle were sold on a live-weight basis in 1979. The reason was explained by Schroeder that "cattle feeders and beef packers do not want to change the live animal pricing system to reduce costs of negotiating price by setting the same average price". He also reported that "pricing fed cattle on an average was detrimental to the industry because it did not send appropriate price signals to cattle feeders and, ultimately, cow-calf producers." In other words, the live-weight pricing does not effectively consider the traits of individual cattle.

Another way to identify beef quality is carcass based pricing. As seen in Table 2.1, carcass-based purchases by all packers increased from 32.0% in 1986 to 47.5% in 1997. This carcass based pricing focuses on traits of individual cattle, and this gives true value of the cattle to the cattle feeders, beef packers, and consumers by better matching fed cattle quality and prices. One carcass based pricing method is grid pricing, which is based on grade and yield of the fed cattle.

Objectives

The overall objective of the research reported in this study was to examine the short-term variability in grid prices. Short-term refers to the variability that can arise on any given day from pricing fed cattle with a formula or negotiated base price and premium-discount grids. Expected variability may arise from alternative base prices, alternative premium-discount grids, packing plant where cattle are slaughtered, and cattle quality characteristics. Results suggest implications both for buyers and sellers.

Literature Review

One of the studies relevant to price discovery is component pricing, i.e., that "a commodity can be divided into component parts, and 'component prices' can be derived for these parts" (Perrin). Perrin's study was focused on soybeans and milk to find the potential social gains when component pricing was applied. He found that the potential social gain was small.

Brorsen et al. suggested for the conditions to succeed with component pricing of hogs that "the components must be easily measurable, the proportion of the components must vary across carcasses, and the prices of the components must differ". They used three component and six component models to "(a) determine the appropriate components, (b) develop a method to determine the prices for the components, and (c) measure the accuracy of the component pricing systems". They obtained conclusions that "component pricing models are clearly more accurate than live weight pricing", and "adding more components improves the accuracy of the component model".

In other studies of component pricing, Lenz, Mittelhammer, and Hillers compared component pricing and hedonic pricing for raw milk, and Updaw's research showed the benefits from component pricing of soybeans in the United States. Jacobson and Walker found that multiple component pricing increased the value of nonfat dry milk.

On the other hand, Parcell, Schroeder, and Hiner used a hedonic model to estimate price differentials associated with cow-calf pair characteristics. They obtained conclusions that "physical characteristics are important in determining cow-calf pair value". A study by Dhuyvetter et al also used a hedonic model to determine the price differentials of purebred beef bulls. They found that "bull prices are determined by generic, physical, and expected performance characteristics of the bull and by marketing technique".

A few studies explained factors affecting transaction prices. Jones et al. focused on quality factors of fed steers and heifers in southern Kansas. Their study showed "transaction prices were significantly affected by average weight, the percentage of cattle expected to grade choice, the Select-to-Choice carcass price spread, finish uniformity, breed, the number of head purchased from the feedyard by a single buyer during the day, the packer, the feedyard, the day of the week the cattle were sold, and the number of bids".

Grid pricing is also focused on quality factors of individual fed cattle. According to Schroeder and Graff, grid pricing has "more than twice the variability in price received per cwt. across carcasses compared to live pricing and dressed-weight pricing". And, this means that producers obtain better pricing signals from grid pricing. They also suggested that producers would "find most benefit from managing cattle quality grade, carcass weights, and monitoring the Choice-to-Select price spread using grid pricing".

If cattle are priced individually by grid pricing, it sends correct market signals to producers and consumers. However, producers receive different market signals because of the different price grids. Then, is there any specific price grid that gives correct signal to producers and consumers? A study of Feuz evaluated three grid pricing systems over six marketing dates to answer the question. His results couldn't answer the question. However, his study explained "magnitudes of price signals vary over time and across grids".

Fausti and Qasmi modeled a value-based pricing system for slaughter cattle. They developed a three-stage recursive model to investigate the determinants of the price differential between grid pricing and average pricing. Their results provided evidence that there is "variability in the price differential between grid pricing and average pricing", and they thought the changes in the Choice/Select discount were the reason for the variability.

Feuz, Fausti, and Wagner examined the efficiency of four marketing methods, i.e., live weight, carcass weight, dressed weight and grade, and a value based marketing approach proposed by Excel Muscle Score (EMS) for slaughter cattle. They found that profits per head were significantly different between the four methods. As carcass information was increased, greater price discrimination occurred, namely, the range in profit increased from live-weight to dressed-weight to grade and yield to the EMS method.

From this previous research we have important information to understand price discovery and price variability for fed cattle. However, there is no study to compare short-term price variability between different packer grids and live weight and dressed weight pricing in fed cattle.

Data Sources and Procedure

This study took a cross-section approach, examining grid prices at a given point in time. Thus, carcass data for a single point in time were needed, as well as reported prices that could be used as base prices and premium-discount grids in use at a single point in time. Data were provided from several industry sources.

Carcass data were obtained on 140 sale lots of cattle of at least 25,000 pounds (i.e., about 20 head or more) slaughtered on the same day in four plants from Nebraska to Texas. Number of head totaled 19,426. Plants are referred to as Northern Plains 1 and 2 and Southern Plains 1 and 2. Not all packers keep records in the same manner. Therefore, some assumptions were necessary regarding the categories of carcass information kept by packers for the sake of data consistency. These assumptions affected selected results. Premium-discount grids were collected for one week and were believed to closely represent premium-discount grids that were reported to the Agricultural Marketing Service (AMS), U.S. Department of Agriculture (USDA) and reported in the National Carcass Premiums and Discounts for Slaughter Steers and Heifers. For the week chosen in this study, the week of November 17, 1997, selected sections of the premium-discount summary reported by AMS are shown in Table 2.2.

Base prices for the analysis were selected by considering reported live weight and dressed weight prices from AMS for the week ending November 15, 1997. Mean dressed weight prices across quality groups in the five-state weighted-average report (*Livestock, Meat and Wool Weekly Summary and Statistics*) ranged from \$105.67 to \$107.33/cwt (Table 2.3). In addition, an estimate was made of fed cattle prices based on the process followed by packers to estimate fed cattle prices and using summary data for the four plants (Ward, Schroeder, and Feuz; 1998a). The estimated break-even dressed weight price was \$107.05/cwt. From the above reported prices and estimates, selected base prices chosen were: low, \$106.00; medium, \$107.00; and high, \$108.00/cwt. In addition, a plant-average price was estimated following the example in Ward, Schroeder, and Feuz (1998b). Available carcass data from each plant were used along with the medium dressed weight base price.

Several alternative prices were estimated for each of the 140 sale lots of carcass data. Prices assigned to each lot included a live weight and dressed weight price based on the quality category and reported prices in Table 2.3. In addition, 21 grid prices were estimated using three base prices (Table 2.4) and seven premium-discount grids (Table 2.5). Each base price was assumed to be for Choice, Yield Grade 3 carcasses.

Prices were summarized across alternative base prices and premium-discount grids, both across sale lots and plants. These summaries show the variation within a given day across sale lots of cattle. Prices also were summarized across premium-discount grids within each sale lot. These summaries show how much prices may vary for the same cattle using alternative premium-discount grids.

Seven grid prices were estimated for each of the 140 lots using a common base price. Therefore, to aid in summarizing the effects of carcass attributes on prices and price variability across premium-discount grids, three regression models were estimated. The three models were intended to identify the relative importance of carcass attributes that receive premiums and those that are discounted on prices and price variability. Models of the following form were estimated by OLS.

(1) Std Dev of Mean Price = f(%Prime, %Select, %Standard, %YG1, %YG2, %YG4-5, %Light, %Heavy, %Outs)

(2) Mean Price = f(%Premium attributes, %Discount attributes), and

(3) Std Dev of Mean Price = f(%Premium attributes, %Discount attributes).

Variables are defined as follows. Std Dev of Mean Price is the standard deviation of prices across seven grids for the same sale lot of cattle. Each % variable is the percentage of the sale lot which consisted of those attributes, i.e., Prime, Select, Standard quality grades, Yield Grades 1, 2, and 4-5, carcasses less than 550 lbs or over 900 lbs, and "out" or non-specification carcasses such as dark cutters, heiferettes, hard bones, dairy breeds, etc. Mean Price is the average of prices across seven grids, assuming a common base price, for each sale lot of cattle. % Premium attributes is the sum of carcass attributes in the sale lot which receive premiums in most grids, i.e., %Prime, %YG1, and %YG2. % Discount attributes is the sum of carcass attributes in the sale lot which receive discounts in most grids, i.e., %Select, %Standard, %YG4-5, %Light, %Heavy, and %Outs.

Carcass Data Summary

Table 2.6 summarizes the carcass data collected from the four packing plants. It is important to keep in mind these data were for one day's slaughter. Variation attributable to seasonality and other factors is not reflected in these data. Feeder cattle were purchased under similar market conditions, fed under similar weather conditions, and marketed as finished cattle in response to similar market conditions. Therefore, this analysis illustrates the variation that existed within and between sale lots and within and between packing plants on the same day.

Average lot size varied across packing plants though the range within each plant was similar. Average dressed and live weights were similar for three plants and significantly lower for one plant (Southern Plains 2). Average dressing percentage was relatively consistent across plants even though weights were not.

The percentage of carcasses grading prime was estimated from the percentage of Choice or above in each sale lot. The mean %Prime carcasses from three independent data sets of cattle were used to estimate the %Prime carcasses consistently across all plants for this set of carcass data (Table 2.7). Thus, as %Choice increased, so did %Prime. Note that the percentage of %Choice carcasses differed significantly between the two Northern Plains plants and two Southern Plains plants. Some cattle feeders assert that Northern Plains cattle are higher quality than Southern Plains cattle and that a higher percentage are marketed on a carcasses weight or grid basis (Schroeder et al). As expected, results for %Select were the reverse for the four plants, i.e., lower for the Northern plains and higher for the Southern Plains plants. The percentage of %Standard carcasses varied widely, in part due to the way in which data were provided and interpreted. Included in %Standard carcasses were no roll or ungraded Select carcasses as well as Standard carcasses. Thus, the range of %Standard in the 140 lots was wide, and wider than would be expected if only carcasses grading Standard were included.

The percentage of %YG1, %YG2, and %YG3 carcasses varied somewhat among plants. Carcasses in the two Southern Plains plants were somewhat leaner than those in the Northern Plains plants, which would be expected given the differences in quality grades across plants. The percentage of %YG4-5 carcasses tended to be correlated with a higher percentage of carcasses grading Choice and Prime.

Carcass weights have trended higher in recent years, resulting in more heavier carcasses than lighter carcasses. Heavier carcasses were assumed to be greater than 900 lbs and lighter carcasses were those less than 550 lb. The percentage of "out" carcasses, those not meeting desired carcasses specifications of packers, included dark cutters, heiferettes, condemned carcasses, and dairy breeds. Thus, the range of %Out carcasses in this set of carcass data was wider than would be expected if dairy carcasses had been excluded.

One point can be concluded clearly from the summary of carcass data. Cattle feeders bring a widely varying set of cattle to packers daily. Packers are then expected to sort and process those carcasses, and market a broad array of product types, sizes, and qualities to a wide set of target markets. Quality inconsistency has been identified as a problem for the beef industry and these carcass data, for a single day, confirm the concern based solely on generic quality attributes. Attributes such as tenderness, flavorfulness, and juiciness which are critically important to consumers were not even considered but would likely further increase the variability of cattle brought to packers.

Price Variation Summary

Base Prices

The focus of this project was on the variation across premium-discount grids. However, it should be noted that significant variation occurs in the base price as well. Plant average base prices were calculated from the one-day slaughter data. The estimated plant average base price for Choice, Yield Grade 3 cattle ranged from $112.91 to $110.74/dressed cwt, a variation of $2.17/cwt or over $16/head. Thus, cattle feeders may experience a significant difference in the base price when the base price is tied to a plant average cost of cattle. The plant average base depends on the quality of a given pen of cattle relative to the quality slaughtered in that plant for the period in which the plant average is calculated, usually the preceding week or a three to four week moving average.

When the base price is tied to a reported market price, the base price may also vary significantly. For the week chosen for this study, the base price varied over $2/cwt or over $15/head. These variations in the base price occur before considering any variation from the premium-discount grids and variation in cattle quality.

Prices and Price Grids

Table 2.8 shows mean prices and price variation associated with each grid and a single base price for the 140 pens of cattle across the four plants. Also shown are mean prices and price variation for live weight and dressed weight prices. It should be noted that mean live weight and dressed weight prices are not comparable with mean grid prices. Reported prices have already been adjusted for the estimated cattle quality composition within sale lots during the price discovery process between packers and feeders. Thus, using base prices representing the range of reported prices, then adjusting them for cattle quality and premium-discount grids, is essentially a double adjustment for cattle quality variation.

What is important in Table 2.8 between live and dressed prices and grid prices is the variation, expressed as the standard deviation (std. dev.) across sale lots and pricing alternatives. "Average" pricing on a live weight or dressed weight basis results in little price variation within and between plants and among sale lots. This finding supports previous work by Feuz, Fausti, and Wagner. This small amount of variation is one attraction to using "average" pricing, both by packers and feeders. Price variation with all grids exceeds the price variation with "average" pricing.

Mean grid prices varied across grids by $2.38, $2.35, $2.92, and $2.61/cwt (or $18 to $22/head) for the four plants (Northern Plains 1 to Southern Plains 2, respectively). Thus, the variation from different grids exceeded the variation from the base price. However, together, the variation could exceed $5/cwt on a dressed weight basis or over $38/head.

The variation in mean prices across plants within a single grid also varied, ranging from $2.94/dressed cwt for grid 7 to $5.76/cwt for grid 2 or $22 to $45/head. Quality of the cattle slaughtered varies from plant to plant which, when combined with alternative premium-discount grids, results in substantial variation.

Thus far, the discussion has been on mean prices, not the full range of estimated prices (maximum less minimum price). Much less variation can be expected in mean prices than prices for individual sale lots, yet the variation in mean prices across grids and plants is considerable. Recall, also, this is for a single day's slaughter. Additional variation would occur had data been collected for several slaughter days.

Quality variation and the variation in grid prices can be shown in Tables 2.9-2.12. For those tables, sale lots were sorted into similar groups based on the percentage of Choice carcasses in the sale lot. Then, prices were summarized within like groups of cattle for each grid and each plant. Number of observations in some quality groups was small, especially in the lowest and highest quality groups for each plant. In general and as expected, mean prices increased with higher quality groups of cattle (i.e., sale lots with a higher percentage of Choice carcasses) within all grids. In general, the standard deviation or variation in prices also increased with higher quality groups of cattle within all grids.

In some cases within a quality group and grid for each plant, relatively little variation in the range of prices for individual sale lots was found. For example, there were six sale lots in the Northern Plains 1 plant that had 20-39 percent Choice carcasses in the sale lots. The range in price across the six lots ranged from $1.37 for grid 4 to $2.74/cwt for grid 7. While that variation is important, over $10/head, it is small compared with most other quality groups. In the adjacent quality group (40-59 percent Choice), among the 17 sale lots, prices ranged from $9.91 to $18.23/cwt for grids 4 and 2, respectively, a different exceeding $65/head.

Examining the minimum and maximum prices within quality groups, grids, and plants reveals large ranges, especially low minimum prices relative to the mean. For example, in the 40-59 percent Choice group for the Southern Plains 2 plant, prices ranged widely. Recall that we had to make some assumptions about carcass characteristics for the sake of data consistency. It is possible that sale lots that have very low prices had dairy cattle which were categorized as "out" carcasses for grid pricing purposes. As a result, those sale lots were severely price discounted. However, this phenomenon occurred relatively infrequently. In most cases, within similar quality groups, grids, and plants, price differences still ranged from $4 to $10/cwt or $30 to $77/head.

Variation within Sale Lots

Marketing fed cattle with a premium-discount grid involves two strategies, one long-run and one short-run. True value-based marketing means changing cattle to meet consumer preferences for beef products from those animals. This takes time, genetic improvement, feeding to correct end points, etc. In the short-run, a given set of cattle with given attributes can be priced with one of several alternative grids.

This section discusses how much variation there is for the same cattle on the same day with alternative grid prices. This does not consider the significant variation arising from alternative base prices as discussed earlier which must be added to the variation discussion below to fully recognize and appreciate the true amount of variation with grid pricing.

Recall each sale lot was priced with seven alternative grids for each base price. The following assumes a constant base price. Therefore, variation is attributable for each sale lot to alternative grids and to cattle attributes. Table 2.13 shows a frequency distribution of the range in prices across the seven grids within each plant for all sale lots. The price range for over half the sale lots (55.7 %) ranged from $2.00 to $3.99/dressed cwt or $15 to $31/head. Those sale lots which ranged in excess of $8.00/cwt may have included dairy animals or had other carcass characteristics that were discounted severely.

Sale lots in the $4.00 to $7.99/cwt range (or $31 to $62/head) are not likely data anomalies. These lots, 17.9 percent of the total, contained sufficient numbers of carcasses that were discounted in grids to widen the range in mean prices across grids. Thus, marketing a given sale lot of cattle on any given day can result in wide differences in prices due to the premium-discount grid used and cattle quality.

Regression results emphasize the importance of cattle quality on mean prices and price variation across premium-discount grids. Note for this analysis, the base price was associated with Choice YG3 carcasses. Average premiums and discounts were shown in

Table 2.2 but are worth repeating here (in round number/dressed cwt). Premiums were associated with %Prime ($0.06), %YG1 ($0.02), and %YG2 ($0.01) carcasses. Thus, premiums were relatively small. Discounts were more important. Discounts were associated with %Select ($0.10), %Standard ($0.20), %YG4-5 ($0.19), %Light ($0.20), %Heavy ($0.20), and %Out ($0.32) carcasses. Discounts clearly exceeded premiums. The message is that mean price variation across grids was strongly affected by those cattle characteristics that are discounted severely.

Results in Table 2.14 are for the regression model in which carcass characteristics were included to explain the variation in standard deviation of prices for each sale lot across the seven grids. Overall, the model explained 94 percent of the variation in the standard deviation of grid prices for each sale lot across seven grids. All carcass characteristics except %Light carcasses significantly added variability to grid prices. Since there were relatively few %Light carcasses, these results are not surprising. Characteristics contributing the most to variability were %Prime and %Out carcasses. As the percentage of those characteristics increase in a sale lot, more variability can be expected across grids. Thus, the two most extreme carcasses characteristics (%Prime and %Out) contributed most to the variability of grid prices for a given sale lot across the seven grids.

The other two models estimated attempted to group all carcass characteristics that typically receive premiums and all characteristics that are discounted. Results in Table 2.15 show that all carcass characteristics typically receiving premiums contribute far less to variation in the price level and to variability (standard deviation) across grids than do all the carcass characteristics which are discounted.

The contribution to mean price from positive carcass characteristics was $0.02/dressed cwt, while the negative contribution from carcass characteristics that are discounted was $0.19/cwt. Discounted characteristics also contributed significantly to variability, while characteristics that receive premiums did not.

Summary

Grid prices vary considerably more than the variation in live weight or dressed weight prices. However, such variation is essential in a value-based marketing system. All carcasses should not receive the same price because they are not of the same value to packers, retailers, and consumers. To achieve pricing accuracy and send clearer signals to producers, better quality cattle should be rewarded and poorer quality cattle should be discounted. Combined, that means increased price variation. Thus, price variation of this type is positive and essential to industry progress, not a negative result of grid pricing. However, cattlemen must be aware that greater variation exists with grid pricing.

With grid pricing, cattlemen must be aware of the variation in base price, whether from using plant average or reported prices. From both base price sources on the same day, prices may vary $2/dressed cwt or more, or about $15/head. Considerable variation also exists across premium-discount grids. For the same cattle, on the same day, with the same base price, the variation was $2 to $4/cwt ($15 to $30/head) over half the time in the sale lots studied here. For sale lots with a high percentage of cattle whose carcass characteristics were severely discounted (Standard, YG4-5, Heavy, and Out carcasses), the variation was considerably more that $4/cwt. These lower quality carcass characteristics need to be avoided if producers want to experience higher overall prices with grid pricing compared with live weight or dressed weight pricing. From an industry standpoint, these lower quality groups of cattle need to be eliminated from the market mix, through genetic selection, feeding practices, improved handling, or other methods.

Conclusions

This research was intended to examine the variability in grid pricing that can occur within a given day or week for a given set of cattle. Data for one day's slaughter from four plants revealed considerable variation in cattle brought to slaughter by cattle feeders. Within-day, within-plant and between-plant variation is likely not appreciated fully by cattle producers. The variability is only one element of the broader problem the industry faces regarding quality and consistency of final products for consumers.

Examining live weight and dressed weight pricing reveals one reason both feeders and packers continue to use them. Price variability is low and poorer quality cattle bring almost as much as better quality cattle, even across sale lots.

Several sources of variation exist in grid pricing. Base prices can vary $2/dressed cwt, or $15/head, whether using plant average or formulas tied to reported cash-market prices. Prices across grids can add another $2-4/cwt of variation, another $15 to $30/head. In addition, variation in carcass characteristics also adds to variability in prices, such as for Select and Standard carcasses, Yield grade 4-5 carcasses, light and heavy carcasses, and non-conforming or "out" carcasses. A relatively large number of carcasses with discounted characteristics alone can double the amount of variation arising from grid pricing.

Grid pricing is a step towards value-based pricing when used correctly. Cattlemen can learn much about the cattle they market with grid pricing and can then use the information to make genetic and management improvements. However, simply trying to match a given sale lot of cattle to the best grid, while potentially beneficial from a short-run price, revenue, and profit perspective, is not moving the industry to value-based marketing. Only when genetic and management changes result from grid pricing information can long-term value-based marketing be achieved.

Table 2.1. Carcass-Basis Purchases by Firm Size during 1986-97 Years

Year	Carcass-basis purchases	Share of total	Total purchases
	Thousand (Head)	Percent	Thousand (Head)
4 largest firm			
1986	5,415	34.3	15,767
1987	7,478	34.8	18,631
1988	8,573	44.9	19,090
1989	8,481	45.5	18,640
1990	8,875	47.1	18,849
1991	7,455	38.9	19,147
1992	7,983	40.1	19,927
1993	D [1]	D	$21,994
1994	D	D	$23,180
1995	D	D	$23,967
1996	11,714	47.3	24,775
1997	11,605	47.6	24,371
8 largest firm			
1986	6,496	34.7	18,718
1987	6,960	32.3	21,534
1988	9,074	40.8	22,253
1989	8,859	40.0	22,151
1990	9,326	41.7	22,386
1991	7,985	36.3	21,771
1992	8,721	38.4	22,715
1993	9,362	40.6	23,072
1994	10,811	45.8	23,586
1995	11,850	48.1	24,632
1996	D	D	26,237
1997	D	D	D
All packers			
1986	11,053	32.0	34,494
1987	10,480	30.5	34,338
1988	12,131	35.9	33,792
1989	11,764	36.5	32,199
1990	12,175	38.2	31,892
1991	10,783	34.3	31,448
1992	11,508	36.9	31,200
1993	12,544	39.6	31,665
1994	14,456	44.6	32,413
1995	15,751	46.5	33,837
1996	16,907	47.3	35,744
1997	16,628	47.5	35,041

Source: Grain Inspection, Packers and Stockyards Administration. *Packers and Stockyards Statistical Report: 1997 Reporting Year*. U.S. Department of Agriculture, Washington DC, June 1999.
Note: D denotes entry was withheld to avoid disclosing data for individual companies.

Table 2.2. Premium-Discount Grids Reported by Agricultural Marketing Service (AMS) – U.S. Department of Agriculture for November 17, 1997

	Low ($/cwt)	Average ($/cwt)	High ($/cwt)
Prime	3.00	5.71	10.00
Choice	0.00	0.00	0.00
Select	-9.00	-9.85	-11.00
Standard	-9.00	-19.70	-30.00
Bullocks, hard bones			
Dark cutters	-21.00	-32.30	-44.35
YG1	0.00	1.70	3.00
YG2	0.00	0.90	2.00
YG3	0.00	-0.20	-1.00
YG4	-10.00	-16.30	-22.00
YG5	-15.00	-21.30	-27.00
Weight (dressed)			
<550	-13.00	-19.65	-27.50
550-900	0.00	0.00	0.00
>900	-10.00	-19.65	-27.50

Source: *National Carcass Premiums and Discounts for Slaughter Steer and Heifers.* AMS-USDA.

Table 2.3. Reported Five-State Fed Cattle Prices, Week Ended November 15, 1997

Cattle Category		Dressed Weight	Live Weight Converted to Dressed Weight[a]
		($/cwt dressed weight)	
Steers	80-100% Choice	107.58	106.78
	65- 80% Choice	107.22	106.21
	35- 65% Choice	107.12	107.33
	20- 35% Choice	106.00	105.67

Source: *Livestock, Meat and Wool Weekly Summary and Statistics.* AMS-USDA.
Note : [a] Converted from live weight price to dressed weight price by a fixed 63.3 dressing percentage.

Table 2.4. Base Prices by Plants ($/dressed cwt)

Plant	Plant average	Low	Average	High
Northern Plains 1	111.73	106	107	108
Northern Plains 2	112.22	106	107	108
Southern Plains 1	110.74	106	107	108
Southern Plains 2	112.91	106	107	108

Table 2.5. 7 Premium-Discount Grids ($/dressed cwt)

Grid 1

Quality Grade	Yield Grade 1	2	3	4
Prime			4	
Choice	1	0	0	-20.5
Select			-9	
Standard			-19	
Dark cut	-25.33			
Light carcass	-27.5			
Heavy carcass	-17.5			

Grid 2

Quality Grade	Yield Grade 1	2	3	4
Prime			6	
Choice	2	2	0	-12.5
Select			-10	
Standard			-30	
Dark cut	-41			
Light carcass	-20			
Heavy carcass	-20			

Grid 3

Quality Grade	Yield Grade 1	2	3	4
Prime			3	
Choice	0	0	0	-22.5
Select			-11	
Standard			-22	
Dark cut	-27.33			
Light carcass	-20			
Heavy carcass	-27.5			

Grid 4

Quality Grade	Yield Grade 1	2	3	4
Prime			8	
Choice	2	1	0	-14.5
Select			-10	
Standard			-20	
Dark cut	-21			
Light carcass	-15			
Heavy carcass	-10			

Grid 5

Quality Grade	Yield Grade 1	2	3	4
Prime			6	
Choice	3	1.25	0	-22.5
Select			-10	
Standard			-20	
Dark cut	-36.67			
Light carcass	-20			
Heavy carcass	-20			

Grid 6

Quality Grade	Yield Grade 1	2	3	4
Prime			3	
Choice	2	1	0	-14.5
Select			-10	
Standard			-18	
Dark cut	-31.67			
Light carcass	-13			
Heavy carcass	-20.5			

Grid 7

Quality Grade	Yield Grade 1	2	3	4
Prime			10	
Choice	2	1	0	-24.5
Select			-9	
Standard			-9	
Dark cut	-38.33			
Light carcass	-22			
Heavy carcass	-22			

Table 2.6. Carcass Data Summary Statistics, by Plants and Total

Variable	Statistics	Plant				
		Nothern Plains 1	Nothern Plains 2	Southern Plains1	Southern Plains 2	Total
Lot Size (head)	N	52	22	25	41	140
	Mean	92	196	199	131	139
	Std Dev	95.9	147.1	107.7	92.4	1,14.4
	Min	23	32	41	30	23
	Max	570	524	423	392	570
Average Dressed Weight (lb)	Mean	788	791	776	729	769
	Std Dev	65.0	65.8	58.3	61.6	67.7
	Min	665	649	639	632	632
	Max	891	870	878	887	891
Average Live Weight (lb)	Mean	1,242	1,252	1,225	1,155	1,215
	Std Dev	96.1	98.3	98.2	101.1	105.0
	Min	1,054	1,048	997	996	996
	Max	1,401	1,389	1,388	1,419	1,419
Average Dressing Percentage (%)	Mean	63.5	63.1	63.4	63.2	63.3
	Std Dev	2.0	1.2	1.2	2.5	1.9
	Min	59.4	59.5	60.3	48.9	48.9
	Max	71.5	65.0	64.8	64.8	71.5
% Prime	Mean	2.3	1.7	0.8	0.8	1.5
	Std Dev	2.1	1.3	1.3	1.1	1.7
	Min	0.0	0.0	0.0	0.0	0.0
	Max	7.3	4.4	4.5	4.2	7.3
% Choice	Mean	59.6	58.7	45.1	45.0	52.6
	Std Dev	17.4	11.2	15.4	15.7	17.1
	Min	17.1	32.9	14.6	17.8	14.6
	Max	87.4	76.1	76.6	75.4	87.4
% Select	Mean	30.7	37.9	40.6	45.0	37.8
	Std Dev	17.7	12.3	13.0	13.9	16.0
	Min	2.7	20.0	11.5	17.8	2.7
	Max	71.4	67.1	58.7	71.1	71.4
% Standard	Mean	7.4	1.7	13.6	9.2	8.2
	Std Dev	7.7	2.3	10.6	8.4	8.6
	Min	0.0	0.0	0.0	0.0	0.0
	Max	34.8	8.2	51.0	38.5	51.0

Table 2.6. Carcass Data Summary Statistics, by Plants and Total (continued)

Variable	Statistics	Plant				
		Nothern Plains 1	Nothern Plains 2	Southern Plains1	Southern Plains 2	Total
% YG1	Mean	11.9	12.0	24.1	14.8	14.9
	Std Dev	10.3	8.8	15.7	10.8	12.1
	Min	0.0	0.0	5.6	0.0	0.0
	Max	44.4	34.4	83.8	37.5	83.8
% YG2	Mean	42.9	49.0	46.9	51.4	47.1
	Std Dev	14.6	11.7	10.2	12.2	13.1
	Min	8.8	18.1	16.2	32.2	8.8
	Max	79.5	62.9	65.9	84.0	84.0
% YG3	Mean	41.1	36.2	27.1	30.8	34.7
	Std Dev	16.3	15.1	11.2	14.4	15.6
	Min	6.9	8.6	0.0	4.0	0.0
	Max	70.2	63.4	54.7	58.5	70.2
% YG4/5	Mean	4.2	2.8	1.8	3.2	3.3
	Std Dev	5.1	4.9	2.6	3.9	4.4
	Min	0.0	0.0	0.0	0.0	0.0
	Max	21.0	21.0	10.9	18.6	21.0
% Light Carcasses (<550lb)	Mean	0.1	1.1	0.4	1.0	0.6
	Std Dev	0.4	3.9	1.0	1.3	1.8
	Min	0.0	0.0	0.0	0.0	0.0
	Max	2.0	18.4	4.3	5.3	18.4
% Heavy Carcasses (>900lb)	Mean	3.3	4.5	3.2	2.2	3.2
	Std Dev	5.0	4.8	5.6	5.1	5.1
	Min	0.0	0.0	0.0	0.0	0.0
	Max	21.5	13.4	22.0	25.7	25.7
% "Out" Carcasses	Mean	3.5	0.9	7.1	3.6	3.8
	Std Dev	7.2	2.0	16.8	15.1	11.7
	Min	0.0	0.0	0.0	0.0	0.0
	Max	37.8	9.1	78.1	96.0	96.0

Table 2.7. Percentage of Prime Carcasses in Three Sets of Cattle[a]

	Percent Prime			
Percent Choice	Set 1	Set 2	Set 3	Average
0-10	0.00	0.00	0.00	0.00
10-19	0.00	0.07	0.00	0.02
20-29	0.39	0.31	0.00	0.23
30-39	0.35	0.54	0.00	0.30
40-49	0.42	0.59	0.24	0.42
50-59	0.93	0.85	0.08	0.62
60-69	1.33	1.73	0.94	1.33
70-79	2.65	2.51	2.74	2.63
80-89	6.78	5.12	5.66	5.85
90-100	11.39	7.52	3.95	7.62

Note: [a] Sets 1 - 3 were carcass data from different sources which was used for the analysis in Sections A and B of this research report.

Table 2.8. Summary Statistics for Alternative Prices: Live Weight, Dressed Weight, Seven Grids with Medium Base Price, by Plants and Total (in $/dressed cwt)[a]

Price	Statistics	Plant				
		Nothern Plains 1	Nothern Plains 2	Southern Plains1	Southern Plains 2	Total
Live Weight[b]	N	52	22	25	41	140
	Mean	106.65	107.00	106.69	106.60	106.70
	Std Dev	0.62	0.56	0.76	0.78	0.69
	Min	105.67	105.67	105.67	105.67	105.67
	Max	107.33	107.33	107.33	107.33	107.33
Dresses Weight	Mean	107.07	107.09	106.82	106.75	106.94
	Std Dev	0.41	0.25	0.52	0.55	0.48
	Min	106.00	106.00	106.00	106.00	106.00
	Max	107.58	107.22	107.22	107.22	107.58
Grid One	Mean	100.68	101.56	98.16	99.14	99.92
	Std Dev	2.97	2.08	4.26	4.54	3.79
	Min	91.69	95.51	81.55	76.20	76.20
	Max	105.62	105.44	103.99	104.39	105.62
Grid Two	Mean	100.29	102.19	96.43	98.57	99.40
	Std Dev	4.54	2.12	7.04	7.15	5.90
	Min	84.91	96.70	69.02	60.75	60.75
	Max	106.40	106.18	105.14	105.36	106.40
Grid Three	Mean	99.22	100.18	96.22	97.52	98.34
	Std Dev	3.56	2.22	5.06	5.16	4.39
	Min	89.34	95.82	76.76	72.93	72.93
	Max	105.22	104.98	103.31	103.70	105.22
Grid Four	Mean	101.60	102.53	99.08	99.93	100.81
	Std Dev	2.78	1.70	3.32	3.89	3.32
	Min	93.22	98.39	86.90	81.54	81.54
	Max	106.22	105.85	104.92	105.17	106.22
Grid Five	Mean	100.56	101.87	97.80	99.10	99.85
	Std Dev	3.68	2.18	5.91	6.05	4.90
	Min	89.20	96.55	73.88	66.30	66.30
	Max	105.94	105.89	105.12	105.01	105.94

Table 2.8. Summary Statistics for Alternative Prices: Live Weight, Dressed Weight, Seven Grids with Medium Base Price, by Plants and Total (in $/dressed cwt)[a] (con't)

Price	Statistics	Plant				
		Nothern Plains 1	Nothern Plains 2	Southern Plains1	Southern Plains 2	Total
Grid Six	Mean	100.92	101.93	98.21	99.48	100.17
	Std Dev	3.30	1.76	5.27	5.33	4.36
	Min	91.12	98.62	76.91	71.22	71.22
	Max	105.75	105.63	104.84	105.01	105.75
Grid Seven	Mean	101.34	102.08	99.14	100.13	100.71
	Std Dev	3.32	2.17	6.34	5.92	4.77
	Min	91.18	97.03	72.56	66.60	66.60
	Max	106.22	106.13	105.16	105.33	106.22

Note: a: See text for discussion of non-comparability of mean prices for live and dressed weight versus price grids
b: Live weight prices were converted to dressed cwt by an average 63.3 dressing percentage.

Table 2.9. Summary Statistics, Seven Grids, Medium Base Price, by Quality Group and Plant (in $/dressed cwt)

Plant – Northern Plains 1

		Quality Group (% Choice)				
Price	Statistics	0-19	20-39	40-59	60-79	80-100
Grid One	N	1	6	17	23	5
	Mean	96.87	99.15	99.78	101.75	101.38
	Std Dev	-	0.56	2.79	2.94	3.95
	Min	96.87	98.40	91.69	93.18	94.95
	Max	96.87	99.86	103.05	105.62	105.22
Grid Two	Mean	96.01	98.39	98.82	101.80	101.48
	Std Dev	-	0.79	4.66	4.10	7.01
	Min	96.01	97.56	84.91	88.89	89.21
	Max	96.01	99.58	103.14	106.40	106.29
Grid Three	Mean	94.41	97.27	98.07	100.53	100.46
	Std Dev	-	0.66	3.30	3.54	4.39
	Min	94.41	96.62	89.34	90.45	93.54
	Max	94.41	98.13	102.11	105.22	104.81
Grid Four	Mean	97.18	99.39	100.48	102.86	103.16
	Std Dev	-	0.53	2.42	2.46	3.39
	Min	97.18	98.78	93.22	95.83	97.46
	Max	97.18	100.15	103.14	105.97	106.22
Grid Five	Mean	96.56	99.27	99.71	101.66	100.71
	Std Dev	-	0.80	3.46	3.74	5.51
	Min	96.56	98.23	89.20	90.20	91.48
	Max	96.56	100.35	103.27	105.94	105.54
Grid Six	Mean	96.81	99.23	99.97	102.05	101.78
	Std Dev	-	0.75	3.02	3.20	4.94
	Min	96.81	98.35	91.12	92.17	93.36
	Max	96.81	101.31	103.14	105.75	105.75
Grid Seven	Mean	98.18	100.58	100.94	102.11	100.74
	Std Dev	-	1.11	2.90	3.54	5.33
	Min	98.18	99.37	92.27	91.18	91.96
	Max	98.18	102.11	104.19	106.23	105.61

Table 2.10. Summary Statistics, Seven Grids, Medium Base Price, by Quality Group and Plant (in $/dressed cwt)

Plant – Northern Plains 2

		Quality Group (% Choice)				
Price	Statistics	0-19	20-39	40-59	60-79	80-100
Grid One	N	0	2	8	5	0
	Mean	-	100.47	100.30	102.59	-
	Std Dev	-	0.02	2.11	1.71	-
	Min	-	100.45	95.51	98.16	-
	Max	-	100.45	102.12	105.44	-
Grid Two	Mean	-	101.00	100.74	103.35	-
	Std Dev	-	0.20	2.03	1.63	-
	Min	-	100.86	96.70	99.55	-
	Max	-	101.14	102.72	106.18	-
Grid Three	Mean	-	98.85	98.92	101.24	-
	Std Dev	-	0.16	1.69	2.21	-
	Min	-	98.73	95.82	96.00	-
	Max	-	98.97	100.78	104.98	-
Grid Four	Mean	-	100.84	101.34	103.61	-
	Std Dev	-	0.08	1.31	1.26	-
	Min	-	100.78	98.39	100.42	-
	Max	-	100.89	102.62	105.85	-
Grid Five	Mean	-	100.98	100.52	102.92	-
	Std Dev	-	0.19	1.88	2.05	-
	Min	-	100.85	96.55	97.37	-
	Max	-	101.12	102.36	105.89	-
Grid Six	Mean	-	100.84	100.79	102.88	-
	Std Dev	-	0.25	1.27	1.65	-
	Min	-	100.66	98.62	98.90	-
	Max	-	101.02	102.20	105.63	-
Grid Seven	Mean	-	101.51	100.83	103.01	-
	Std Dev	-	0.45	1.78	2.19	-
	Min	-	101.19	97.17	97.03	-
	Max	-	101.83	102.62	106.13	-

Table 2.11. Summary Statistics, Seven Grids, Medium Base Price, by Quality Group and Plant (in $/dressed cwt)

Plant – Southern Plains 1

Price	Statistics	Quality Group (% Choice)				
		0-19	20-39	40-59	60-79	80-100
Grid One	N	1	11	8	5	0
	Mean	94.48	99.03	99.59	94.70	-
	Std Dev	-	1.18	2.00	8.58	-
	Min	94.48	97.77	95.37	81.55	-
	Max	94.48	101.27	101.52	103.99	-
Grid Two	Mean	89.72	97.97	99.06	90.19	-
	Std Dev	-	1.98	2.93	13.86	-
	Min	89.72	95.99	92.86	69.02	-
	Max	89.72	101.81	101.56	105.14	-
Grid Three	Mean	91.73	97.13	98.03	92.18	-
	Std Dev	-	1.48	2.09	10.30	-
	Min	91.73	95.35	94.03	76.77	-
	Max	91.73	99.82	100.16	103.31	-
Grid Four	Mean	94.52	99.37	100.28	97.44	-
	Std Dev	-	1.08	1.56	6.89	-
	Min	94.52	98.06	97.00	86.90	-
	Max	94.52	101.53	101.81	104.92	-
Grid Five	Mean	94.98	99.36	99.55	92.15	-
	Std Dev	-	1.33	2.49	11.82	-
	Min	94.98	97.67	94.24	73.88	-
	Max	94.98	101.84	101.93	105.12	-
Grid Six	Mean	95.48	99.41	99.96	93.32	-
	Std Dev	-	1.20	2.02	10.67	-
	Min	95.48	97.87	95.69	76.91	-
	Max	95.48	101.59	101.86	104.85	-
Grid Seven	Mean	100.36	101.18	100.57	92.13	-
	Std Dev	-	0.96	2.40	12.31	-
	Min	100.36	99.20	95.43	72.56	-
	Max	100.36	102.33	102.81	105.16	-

Table 2.12. Summary Statistics, Seven Grids, Medium Base Price, by Quality Group and Plant (in $/dressed cwt)

Plant – Southern Plains 2

		Quality Group (% Choice)				
Price	Statistics	0-19	20-39	40-59	60-79	80-100
Grid One	N	1	17	13	10	0
	Mean	97.84	98.05	97.96	102.65	-
	Std Dev	-	2.27	6.90	0.95	-
	Min	97.84	91.90	76.20	101.00	-
	Max	97.84	101.30	102.63	104.39	-
Grid Two	Mean	97.53	97.03	96.88	103.51	-
	Std Dev	-	3.64	11.55	1.03	-
	Min	97.53	86.75	60.75	101.60	-
	Max	97.53	102.20	103.70	105.37	-
Grid Three	Mean	95.51	96.02	96.31	101.87	-
	Std Dev	-	2.70	7.57	1.05	-
	Min	95.51	89.37	72.93	99.95	-
	Max	95.51	99.67	101.65	103.71	-
Grid Four	Mean	98.29	98.58	99.12	103.44	-
	Std Dev	-	1.96	5.56	0.86	-
	Min	98.29	93.48	81.54	101.94	-
	Max	98.29	101.57	103.04	105.17	-
Grid Five	Mean	98.18	98.21	97.20	103.15	-
	Std Dev	-	2.73	9.61	1.14	-
	Min	98.18	90.29	66.30	100.93	-
	Max	98.18	102.03	103.04	105.01	-
Grid Six	Mean	98.04	98.43	97.95	103.38	-
	Std Dev	-	2.40	8.33	0.87	-
	Min	98.04	91.65	71.22	101.73	-
	Max	98.04	101.57	102.99	105.01	-
Grid Seven	Mean	99.69	99.88	97.84	103.55	-
	Std Dev	-	2.16	9.70	1.14	-
	Min	99.69	92.95	66.60	101.28	-
	Max	99.69	102.23	103.27	105.33	-

Table 2.13. Frequency Distribution of the Range in Prices Across Seven Grids within Each Plant

Price Range ($/dressed cwt)	Northern Plains 1	Northern Plains 2	Southern Plains 1	Southern Plains 2	Total
		(Number of Sale Lots)			
Less than 2.00	12	7	1	11	31
2.00-3.99	31	14	14	19	78
4.00-5.99	4	1	6	7	18
6.00-7.99	3	0	1	3	7
8.00 or More	2	0	3	1	6
Total	52	22	25	41	140

Table 2.14 . Regression Results on Standard Deviation of Grid Prices from Carcass Characteristics and Alternative Grids

Dependent Variable : Standard Deviation of Mean Price	
Independent Variable	Coefficient ($/dressed cwt)
Intercept	0.031 (0.19)
%Prime	0.086* (3.77)
%Choice	Base
%Select	0.01* (4.25)
%Standard	0.033* (12.73)
%YG1	0.005* (3.14)
%YG2	0.004* (2.64)
%YG3	Base
%YG4-5	0.018* (3.60)
%Light	0.007 (0.78)
%Heavy	0.026* (8.48)
%Out	0.047* (30.99)
n	140
R^2	0.94

Note: Absolute value of calculated t statistics are given in parentheses.
* indicates 0.01 significance level.

Table 2.15 . Regression Results on Mean Grid Prices and Standard Deviation of Grid Prices from Groups of Carcass Characteristics and Alternative Grids

Dependent Variable			
Mean Price		Standard Deviation of Mean Price	
Independent Variable	Coefficient[a] ($/dressed cwt)	Independent Variable	Coefficient ($/dressed cwt)
Intercept	109.31* (137.34)	Intercept	-0.054 (0.30)
%Premiums	0.025 (2.02)	%Premiums	0.002 (0.92)
%Discounts	-0.194* (18.32)	%Discounts	0.023* (9.46)
n	140	n	140
R^2	0.72	R^2	0.45

Note : [a] Absolute value of calculated t statistics are given in parentheses.
* indicates 0.01 significance level.

CHAPTER III

Meatpacking Firm Mergers: Empirical Impacts in an Experimental Fed Cattle Market

Mergers are considered a method of improving operational efficiency. The efficiency gains depend on the nature of exchange and coordination mechanisms, the structure of markets, the behavior of participants, and the social rules and institutions (Connor and Geithman). As the result of mergers, "large food manufactures grew rapidly over the 1976 to 1982 both by increasing their share of food manufacturing and by expanding into services" (MacDonald).

There are several reasons for mergers that are believed to have positive social outcomes, among them increased efficiency and productivity, ability to capitalize on economies of size and scope, synergism of operations, and improved management. However, there may be negative social outcomes, among them exploitation of short-term gains at the expense of long-term losses and increased market power leading to higher-than-competitive consumer prices or lower-than-competitive input prices.

Each meatpacking firm pursues profit maximization. Thus, meatpacking firms must consider two cases when they merge. Meatpacking firms will merge when the expected positive effects are larger than negative effects. However, they will not merge when expected negative effects are larger than positive effects. Of course, each firm may not correctly predict the results of a merger.

Two firms (A and B) will be considered to assess the merger effects in this study. Firm A is the merger of two smaller firms, and firm B is the merger of two larger firms.

Each firm will pursue profit maximization through the merger. This study is focused on fed cattle prices, because fed cattle are a main input of meat packing firms. Thus, the objective of this analysis is to see the effects of mergers; market price effects, changes in market behavior among merged and non-merged firms, and profitability prior to the merger, during the merger, and after dissolving the merger. If the effects of mergers are known, they will be used in forming marketing strategies.

Literature Review

In recent years, the food industry has undergone substantial restructuring for increased efficiency through mergers. Then, what is the motive of mergers, and how can the efficiency be measured? Connor and Geithman's study explained these motives and measurement. They used the neoclassical economics viewpoint to explain the motives and measurement. Neoclassical economics assumes that producers (firms) always pursue profit maximization. From this assumption, meatpacking firms merge their firms if they expect the profit during the post-merger period to be higher than when the firms are not merged. Connor and Geithman explained that "the higher profits are explained by efficiency and technology: economies of scale and synergy or the replacement of incompetent management of the acquired firm by superior managers in the acquiring firm."

They explained another motive to merge, when there exists market risk under the neoclassical assumption. According to their explanation, "a more diversified firm will display lower variance of profit. If investors are risk averse, then the post-merger company may be more highly valued by the stock market. A related explanation is that diversification allows a more efficient deployment of corporate assets within the firm than would have occurred between separate firms."

Whereas Williamson explained the motive to merge as some nontrivial degree of decision-making discretion that firms possess. His viewpoint is from non-neocalssical economics. His explanation didn't assume the deterministic pursuit of profits by firms.

As seen before, the effects of mergers can be both positive and negative. If the effects are considered from the viewpoint of the firms, what are the effects of the mergers? Connor and Geithman asserted that the effects are on the size and growth of firms. According to them, managers in the food industry want to merge for growth and maintenance of leading market position. However, the market for corporate control of major firms is an important example of a market failure, because there are few buyers and sellers in such markets, and they can control quantity and price.

Another effect is a firm's diversification level (Connor and Geithman; Mueller). Conglomerate firms can pursue an oligopolistic conduct not available to single-line firms (Mueller). "As a result of the formation of conglomerate firms, investors and potential entrants will lose significant information" (Federal Trade Commission). One more effect is that "mergers have significant adverse effects on national productivity growth" (Ravenscraft and Scherer; Connor and Geithman).

Empirical evidence on merger impacts has addressed post-merger efficiency or productivity of merged firms, profitability of the acquiring firm, and various financial effects on stock prices and earnings. No significant improvement in post-merger profitability was found using line of business profits for the 1960s and 1970s (Ravenscraft and Scherer; Scherer). However, other research revealed significant improvements in productivity of individual plants resulting from mergers (Lichtenberg and Siegel).

Merger activity was not believed to contribute significantly to increased concentration in manufacturing or the overall economy (Carlton and Perloff). Increased merger activity included the food industries (Connor and Geithman; MacDonald). There, mergers contributed to concentration in food retailing (Caswell) and meatpacking (Marion and Kim).

The four-firm concentration ratio (CR-4) in the meat packing industry increased sharply from the late 1970s (Marion and Kim). The CR-4 of beef packing increased from 25 in 1977 to 44 in 1982 (Marion and Kim), and the CR-4 of steer and heifer slaughtering increased from 29.1 in 1977 to 45.0 in 1982 (Marion).

In 1966, earlier than Marion and Kim's argument of the sharply increasing CR-4, Williams explained that there was change of structure in meat industry as follows. "Medium-volume, independently owned, commercial packers, and meat distributors have grown rapidly in number and size", and "the larger national packers have established new, modern plants at a number of locations and have placed considerable emphasis upon product innovation and development".

The change has been continuing into the 1990s. However, the drive to operate larger, more efficient meatpacking plants, capitalizing on economies of size (Ward 1993), does not explain by itself the increase in firm size. Internal growth as well as mergers and acquisitions have both played a significant role in increased beef packing concentration (Marion and Kim).

Packers want to possess market power through mergers. Thus, many studies have tried to measure market power in meat packing. Most studies have concluded that market power may exist (Schroeder; Koontz, Garcia, and Hudson; Schroeder and Azzam; Azzam and Schroeder), but "most have resulted in findings of no or very limited ability of packers to exploit feeders and consumers" (Hunnicutt and Weninger). In order to measure market power, the conjectural variations approach (Hunnicutt and Weninger; Schroeder and Azzam) was used.

Azzam and Schroeder estimated the tradeoff between regional oligopsony power and cost efficiency resulting from consolidation in the beef packing industry. They used a simple tradeoff model "to calculate the cost reductions necessary to offset the anticompetitive effects of market power and to compare them to actual cost savings achieved through plant scale or multiplant operating economies". They found that Willimason's finding was held; "a merger which yields nontrivial real economies must produce substantial market power and result in relatively large price increases for net allocative effects to be negative". Their estimation of "cost savings necessary to neutralize the anticompetitive effects of consolidation" was "about half the actual cost savings from the scale economies". They also concluded that "the structural changes in beef packing in recent years have been welfare enhancing on balance".

As reviewed so far, many analyses have focused on market efficiency. However, no studies have examined market effects from meatpacking firm mergers. And no research has estimated how large a firm must be (i.e. how many plants are needed) to achieve most economics of scope or multi-plant economies and yet not have excessive, potential market power. This is believed to be the first study to explicitly examine potential impacts of meatpacking firm mergers.

Fed Cattle Market Simulator Structure

The FCMS creates a market for fed cattle in which participants role play as feedlot marketing managers and meatpacking procurement managers (Ward et al.). Eight participating feedlot teams and four participating meatpacking teams trade cattle in seven-minute trading sessions. Feedlot teams market fed cattle from their feedlot when cattle reach acceptable finish weights. Meatpacking teams purchase fed cattle for processing into boxed beef.

The time reference and trading periods in the simulated market are weeks. During each trading period or week, feedlot and packer teams negotiate prices and transactions. About 35-50 transactions occur per trading period on average. Participants role playing as meatpacking procurement managers approach feedlots to purchase cattle from the visible array of paper pens of cattle. Each sheet of paper represents a pen of 100 fed steers available for sale. All pens on the visible array represent that week's show list. Prices are negotiated and sales occur for the range of available weights of show-list cattle, from 1100 to 1200 pounds in 25-pound increments. Cattle in the simulated market grow 25 pounds per week and must be processed into boxed beef in the five-week marketing window, but can be sold anytime during the five-week period. Cattle sold in the current week for delivery in the current or following week are treated as cash market transactions. Cattle to be delivered two or more weeks in the future are recorded as contract transactions, i.e., following the reporting rules among Agricultural Marketing Service (AMS), U.S. Department of Agriculture (USDA) market reporters.

Continuous market information is provided during the trading period on two digital display bars, one which scrolls cash market information (trading volume and high-low price range) and the other which scrolls futures market information (trading volume and current prices for three active futures contracts). Current market information parallels within-week or within-day market information available to fed cattle buyers and sellers from AMS-USDA and the Chicago Mercantile Exchange (CME).

Cattle placements in feedlots include periods of larger and smaller suppliers, as occur in a cattle inventory cycle. Fed cattle market conditions and resulting prices are driven largely by how effectively participants market and purchase fed cattle. *Cattle on Feed* reports, much like those reported by the National Agricultural Statistics Service (NASS), USDA are issued every four trading weeks and indicate feeder cattle placements, fed cattle marketings, and cattle on feed, in total and by weight groups.

Teams receive a profit and loss statement following each week of trading. The statement details that week's sales/purchases and provides profit/loss information for each transaction and on average for the period.

Experimental design and Data

Economists have examined impacts from structural and behavioral changes in meatpacking using transaction-level data (Ward, Koontz, and Schroeder) as well as with aggregated data such as annual averages (Azzam and Schroeder). Frequently, data to directly examine transaction-level impacts from various structural and behavioral changes are not available. The *Fed Cattle Market Simulator (FCMS)* was developed in part to capture the necessary data to study such market phenomena. This study is focused on an analysis of transaction-level data from the experimental market in which meatpacking firms were merged. The analysis involved assessing market price effects. Changes in market behavior among merged and non-merged firms were observed as well as profitability prior to the merger, during the merger, and after dissolving the merger.

Experimental simulation with the *FCMS* represents an integration of business simulation and experimental economics (Ward et al. 1996). Within a specified market structure and set institutional structure, subjects or participants of experimental simulation studies make repetitive decisions that affects performance of their particular firm and the entire market. The distinction between experimental simulation and experimental economics resolves around the amount of physical control researchers impart on subjects of the experiment. In experimental economics, the experimenter purposefully and directly controls specific variables of the system, thus allowing the experimenter to monitor and focus on selected variables in order to draw conclusions about how those selected variables affect economic behavior and performance (Friedman and Sunder). The purpose of experimental simulation is to evaluate dynamic relationships between many economic variables of a specified market when major components of that market are affected by realistic market change. With experimental simulation, researchers control relatively few variables in the market, thus allowing economic variables to interact more with one another much like real-world markets. Participants of the simulated market experience consequences of interrelated decisions that they must make regularly. Properly designed experimental economics experiments can make use of relatively basic statistical methods, while experimental simulation or less-controlled experiments, such as with the *FCMS*, require more elaborate econometric estimation.

Data for this study were collected from two one-day-and-a-half-day workshops with large agribusiness firms. Firm A is one of the largest meatpacking firms in the U.S., while Firm B is one of the largest cattle feeding firms. The predetermined experimental design was identical, with one exception, for the two workshops. Data were generated from 30 trading weeks of the *FCMS* in each workshop. Each workshop consisted of a start-up or learning period in which data were not collected (weeks 38-40), a pre-merger period of 10 weeks (weeks 41-50) in which a merger of two packers was imposed upon the experimental market (weeks 51-60), a post-merger period of 10 weeks (weeks 61-70), and an ending period for which data were not collected (weeks 71-76). The only difference in the two experimental designs was the packers involved in the mergers. For Firm A, the two smallest firms in the *FCMS* (packers 1 and 2) were merged, whereas for Firm B, the two largest firms (packers 3 and 4) were merged.

Given there are four firms in the *FCMS*, the four-firm concentration ratio (CR4) is 1.00 before the merger, during the merger, and after the merger was dissolved. The Herfindahl-Hirschman index (HHI) was 2,562 prior to the merger (based on the minimum-cost volume of each packer) and after each merger was dissolved. In the workshop for Firm A, when the two smaller packers were merged, the *ex ante* HHI increased to 3,462. For Firm B, when the two larger packers were merged, the *ex ante* HHI increased to 4,212. Based on the 1968 merger guidelines of the Department of

Justice, this level of concentration and changes about competition would be challenged (Carlton and Perloff). Similarly, mergers which increase concentration this magnitude in a market as concentrated as the *FCMS*, would even face a Department of Justice challenge according to the more lenient merger guidelines of 1992.

The merger in each workshop was announced to workshop participants in the form of a press release. A brief meeting with the merging packers was held. Merger participants were instructed to operate their merged firm as a multi-plant firm. They were to share profit/loss statements and other pertinent information, such as pre-purchased cattle by forward contracts, etc. the merged packers then jointly developed and implemented a procurement and pricing policy.

Data collected for this study consisted of transaction prices with associated information for 30 weeks of trading, or 1,062 pens of fed cattle for firm A and 1,083 pens for firm B. Each data record consisted of one transaction between one feedlot firm and one meatpacking firm. Data for each transaction included: week traded, meatpacker purchasing the cattle, feedlot selling the cattle, weight of cattle traded, transaction price, and type of transaction (cash or forward contract). Other data recorded for each trading week included: break even prices for 1,150 pound cattle for each feedlot and the largest meatpacker, boxed beef price, number of pens marketed, number of pens of cattle on the show list at the beginning of each trading week, and profits for each feedlot and packer. Figure 3.1 shows the total cattle totaled each week and average prices paid each week.

Models Specified

Previous transaction price models using *FCMS* data provided the basis for the models specified (Ward et al. 1996; Anderson et al.; Ward et al. 1999). Those models were based on previous price discovery research analyzing fed cattle transaction prices using industry data (Ward 1992; Schroeder et al. 1993; Ward, Koontz, and Schroeder 1998).

Transaction Price Model

Two transaction price models were specified to estimate how meatpacking firm mergers affected the level of transaction prices. The second was a slight modification of the first. Transaction prices were modeled as a function of lagged boxed beef prices (*BBP*) and lagged fed cattle marketings (*TM*). Transaction prices were assumed dependent also on the current total inventory of cattle on the show list (*TSL*) and potential profit/loss to be shared by packers and feeders (*PPL*) during the week transactions occurred. Also included were binary dummy variables for the weight of cattle traded (*WT*), type of transaction (*TYP*), feedlot selling cattle (*FDLT*) and packer buying cattle (*PKR*). Additional binary variables were included to measure price differences among pre-merger, merger, and post-merger periods (*MERGR*). Thus, the models specified and estimated respectively were

(3-1) $$TPFC_{it} = \beta_0 + \beta_1 BBP_{t-1} + \beta_2 TM_{t-1} + \beta_3 TSL_t + \beta_4 PPL_t + \sum_{j=1}^{5} \beta_{5j} WT_{jit} + \sum_{j=1}^{2} \beta_{6j} TYP_{jit} + \sum_{j=1}^{8} \beta_{7j} FDLT_{jit} + \sum_{j=1}^{4} \beta_{8j} PKR_{jit} + \sum_{j=1}^{3} \beta_{9j} MERGR_{jit} + v_{it}$$

(3-2) $$TPFC_{it} = \beta_0 + \beta_1 BBP_{t-1} + \beta_2 TM_{t-1} + \beta_3 TSL_t + \beta_4 PPL_t + \sum_{j=1}^{5} \beta_{5j} WT_{jit} + \sum_{j=1}^{2} \beta_{6j} TYP_{jit} + \sum_{j=1}^{8} \beta_{7j} FDLT_{jit} + \sum_{j=1}^{4} \beta_{8j} PKR_{jit} + \beta_9 HHI_t + v_{it}$$

where: t = time in simulated weeks which is 41, 42, … , 70 and i = transaction observations within each week =1, 2, 3, …, n. There are potentially a different number of transactions each week. Complete variable definitions and expected signs are presented in Table 3-1. One variable from each binary group was omitted and is referred to as the "base" in subsequent tables and figures. Model 2 was identical to equation (3-1) with one exception. A variable for the weekly Herfindahl index (HHI_t), based on actual market shares by packers, replaced the binary variable for premerger, merger, and dissolution periods ($MERGR_{jit}$).

Many traditional economic variables found in transaction price models using industry data are accounted for or held constant by the *FCMS* (Ward et al. 1996; Anderson et al.; Ward et al. 1999). Reasons for including selected variables in transaction price models for fed cattle are developed in previous research cited above.

Boxed beef price was included in the model because demand for fed cattle is derived from the demand for beef. The boxed beef price (BBP_{t-1}) was lagged one week because decisions under uncertainty tend to be made based on market information reported most recently. Two supply variables were included. One was the total number of pens marketed the previous week (TM_{t-1}), similar to previous research (Schroeder et al. 1993). The second is unique to using *FCMS* data. Number of cattle on the show list (TSL_t) represents cattle that can be marketed in the current week at one of five weights, 1,100 to 1,200 pounds in 25-pound increments. Previous research found information on market-ready inventories was important in forecasting fed cattle prices (Bacon, Trapp, and Koontz).

Buyers and sellers negotiate transaction prices on their respective break-even prices and market conditions. The difference between the largest meatpacker's break-even price for the 1,150-pound cattle and the feedlot break-even price for the same weight cattle represents potential profits or losses (PPL_t) available to share in week *t*. Available profits or losses were used as a measure of the bargaining range or the distribution of profits or losses between buyers and sellers (Ward et al. 1996). Significant price differences were observed among simulated firms due to individual negotiation skills that are unique to each simulated feedlot and meatpacking firm. Separate variables were included to account for price differences among the eight feedlots and four meatpacking firms ($FDLT_{jit}$, PKR_{jit} , respectively).

Since the primary purpose of this specification was to determine whether or not transaction prices differed before the merger period, during the merger period, and after the merger was dissolved ($MERGR_t$). The binary variable was intended to measure the potential shift in transaction price level as a result of the specific market structure of packers. As noted above, the mergers significantly increased the HHI (Figure 3.2). Thus, in an alternative specification, a continuous market structure variable for each trading period, HHI_t replaced the binary variable for premerger, merger, and dissolution periods ($MERGR_{jit}$).

FCMS data have cross-sectional heteroscedesticity due to the nature of the experiment (Anderson; Choi). In order to test for the problem, the Breusch-Pagan test was performed using SAS program following codes of Hill. According to the results of the Breusch-Pagan tests, the null hypotheses of homoscedasticity were rejected for the models. Due to heteroscedasticity, t-tests and F-tests may yield errors in inferences.

Judge et al. explained the pooling of time-series and cross-sectional data using error components. Equations 3-1 and 3-2 can be expressed as follows.

(3-3) $$TPFC_{it} = \beta_{1i} + \sum_{j=1}^{J} \beta_j x_{jit} + e_{it}$$

where, β_{1i} = fixed coefficients for transaction observations within each week, β_k is parameters, x_{kit} is variables, and e_{it} is error terms. β_{1i} can be rewritten:

(3-4) $$\beta_{1i} = \vec{\beta}_1 + \mu_i$$

where $E[\mu]=0$, $E[\mu_i^2]=\sigma_\mu^2$, $E[\mu_i \mu_j]=0$ for $i \neq j$, and $E[\mu_i e_{jt}]=0$. Equation 3-3 becomes:

(3-5) $$TPFC_{it} = \beta_{1i} + \sum_{j=1}^{J} \beta_j x_{jit} + \mu_i + e_{it}$$

Thus, the error term in the equations 3-1 and 3-2 can be rewritten as:

(3-6) $$v_{it} = \mu_i + e_{it}$$

In the *FCMS*, numerous transactions occurred each week, and some variables have the same value for every transaction in a week. Thus, the models are hierarchical models.

"Goldstein points out that if modeling does not take into account the hierarchical nature of data, coefficient estimates may be inefficient; and standard errors, confidence intervals, and significance tests may be incorrect" (Anderson).

The data have several problems as discussed. In order to correct the problems, "the models are specified as weighted random effects models (WREM) for unbalanced panel data" (Anderson). For estimating the models, base dummy variables are excluded in each model to avoid perfect collinearity. Thus, feedlot 5, weight 1150, each transactions 1, and weeks between week 51 through week 60 were excluded in model 1. And feedlot 5, weight 1150, and each transactions were excluded in model 2. Both models are estimated by PROC MIXED model of SAS program.

Results and Discussion

Several types of results are presented, some to address behavioral changes and some to address price and profit performance changes before, during, and after the merger/dissolution for Firm A and B.

Behavioral Changes

Table 3.2 provides summary statistics for selected variables from Firm A and Firm B workshops by experimental simulation periods. The prices increased sharply during and after the merger period due to sharply reduced supplies of fed cattle in both workshops.

Summary statistics are presented for each packer during each of the three periods. However, during the merger period, packers 1 and 2 were a single firm for Firm A and packers 3 and 4 were a single firm for Firm B. Thus, for Firm A, the market shares for packers 1 and 2 increased from 22.2 and 24.1%, respectively, to 51.3% for the merged firm; and for Firm B, the market shares for packers 3 and 4 increased from 28.3 and 30.6%, respectively, to 66.1% for the merged firm. However, for the firms not involved in the mergers, market shares declined during the merger period. There appeared to be some synergistic or efficiency gains experienced by the merged firms, enabling them to jointly increase market shares beyond the additive shares of the merging firms during the pre-merger period.

Trading patterns among packers and feeders were examined and compared among premerger, merger, and dissolution periods. However, no clear pattern is evident from Table 3.3. Most packers purchased cattle from two or three primary suppliers in each period, and though the primary suppliers changed for most packers during the three experimental periods (premerger, merger, dissolution) no consistent pattern was evident. The extent of contracting also varied between Firms A and B and among experimental periods with no clear pattern emerging.

Observation of the participants during the workshops yielded some insight into management differences. With Firm A, one strong individual emerged as the leader of merged packer 1 and 2. This individual quickly directed buyers to purchase cattle from specified feedlots and not compete directly with each other for cattle. Purchases were reported to this individual and he directed deliveries to specific plants to achieve the minimum-cost volume for each plant. After the merger of packers 3 and 4 with Firm B, no such leadership emerged among the merged teams. If buyers were directed to purchase from specific feedlots to avoid competing among themselves, it was not apparent. Nor was it apparent purchases or deliveries were coordinated between the two plants to ensure maximum plant efficiency at both plants. Thus, management differences undoubtedly contributed somewhat to capitalizing (or not capitalizing) on the synergies associated with merged packers.

Transaction Price Model Results

As discussed before, models were estimated by an iterative MLE (maximum likelihood estimator) procedure using Proc Mixed models of SAS software (SAS Institute 1995). For the results of Breusch-Pagan test for heteroscedasticity, test statistics are 356.780 and 328.108 in Firm A and Firm B, respectively, and p-values are 0 for both Firms. Thus, the null hypotheses of homoscedasticity could not be accepted. The model used pooled cross-section, time-series data and was corrected for heteroscedasticity. Table 3.4 provides parameter estimates for both transaction price models.

Similar to previous transaction-level studies, the price and quantity variables significantly affected fed cattle transaction prices. Boxed beef price (BBP_{t-1}), number of cattle marketed (TM_{t-1}), and number of pens of cattle on the show list (TSL_t) all impacted transaction prices in the anticipated direction. Number of cattle marketed was not significant in Model 1 for Firm B. In most previous work, the coefficient on the potential profit/loss variable (PPL_t) was negative and significant, but in this study it was negative and significant only in Model 2 for Firm B.

Price differences for weights of cattle marketed were expected relative to previous work. Largest price discounts were received when cattle were marketed beyond 1,150 pounds. One weight of lighter cattle received a premium price in each workshop, i.e., 1,100-pound cattle for Firm A and 1,125-pound cattle for Firm B. Forward contract prices were significantly lower than cash transactions for Firm B, consistent with economic theory (Carlton 1979). In Model 2 for Firm A contract prices were significantly higher than cash transactions. Differences in managerial and negotiation skills also existed among participants of the *FCMS*, leading to average transaction price differences among several feedlot firms ($DFDLT_{jit}$) and meatpacking firms ($DPKR_{jit}$), similar to previous *FCMS* research.

Significant price differences were found between the experimental periods, for both Firm A and B. In both cases, prices during the merger period ($MERGE_{jit}$) were significantly higher than prior to the merger ($PREPD_{jit}$), i.e., $4.07/cwt higher for Firm A and $3.18/cwt higher for firm B. Following dissolution of the merger ($POSTPD_{jit}$), prices declined for Firm A and were significantly lower during the dissolution period than during the merger period ($1.04/cwt lower). Prices were not significantly different during the dissolution period for Firm B compared with the merger period.

Results were similar in the alternative specification. Market share data are shown in Table 3.2 . Sizeable differences can be noted among the experimental periods. With Firm A, market shares during the merger period were: merged Packers 1-2, 51.3%; Packer 3, 25.5%; and Packer 4, 23.3%. With Firm B, market shares during the merger period were: merged Packers 3-4, 66.1%; Packer 1, 16.8%; and Packer 2, 17.1%. The *HHI* increased significantly during the two mergers, from 2,555 to 4,008 with Firm A and from 2,738 to 5,224 with Firm B. Despite the sharp increase in *HHI* during the mergers, a higher *HHI* was associated with a higher transaction price rather than a lower price for Firm B, i.e., $5.57/cwt. The coefficient on the Herfindahl variable was not significant for Firm A.

Model results tended not to support the economic theory linking higher concentration with poor market performance. During the merger period, market prices were significantly higher than prior to the merger in both cases and higher than after dissolution in one case. Despite the significant size disparity during the merger period between largest and smallest firms, the merged firms failed to use their presumed market power to depress prices for fed cattle. On the contrary, they appeared to pass along realized economies of scope efficiencies, i.e., multiplant economies, in the form of higher prices for fed cattle. This finding is consistent with research using industry data indicating that larger firms, most of which are multiplant firms, paid higher prices for fed cattle compared with smaller firms (Slaughter Cattle Procurement and Pricing Team 1996). Results suggest the merged firms achieved some managerial efficiencies or synergies from multiplant operations. However, it should be noted that the merger did not affect economies of plant size, as plant cost functions remained unchanged during the experiment.

Profitability Comparisons

Profitability of packers for premerger, merger, and dissolution periods are shown in Table 3.5. Both for Firms A and B, the merged firms were more profitable than their single-plant rivals. In the case of Firm A, Packers 1 and 2 were the least profitable packers prior to the merger. However, during the merger, merged Packer 1 and 2 was most profitable packer. Packer 2 remained most profitable after the merger was dissolved.

Packers 3 and 4 were the most profitable packers before the merger in the Firm B case, and together, they represented the most profitable packer during the merger period, i.e., losing the least of all packers. Following dissolution of the merger, Packers 3 and 4 remained the most profitable packers though the ranking after the merger reversed between the two packers compared with prior to the merger.

It appeared the management of the merged firms capitalized on their multi-plant organization during the merger relative to their competitors. In the case of Firm A, the merged firm (Packer 1-2) remained profitable despite also sharing some of its efficiency gains with feedlots via higher fed cattle prices. For Firm B, the merged firm (Packer 3-4) was not more profitable but was less unprofitable compared with its rivals. Market prices likewise were higher during the merger period but to the detriment of packer's profits in this instance. In both cases, the merged packers did not use their significant increase in market share to depress market prices for fed cattle, yet used their larger size to increase profitability either in an absolute or relative sense.

Summary and Conclusion

The *Fed Cattle Market Simulator (FCMS)* was developed to provide a realistic market framework and institutional structure in which market participants make repeated marketing/procurement decisions. Experimental simulation was used in this study to estimate fed cattle transaction price impacts from two packer mergers, one involving the two smallest packers in the *FCMS* and one involving the two largest packers. Data were collected for 30 trading weeks from *FCMS* workshops with two, large agribusiness firms, amounting to 1,062 and 1,083 transactions, respectively.

Transaction price model results for most variables were found to be generally consistent with previous research using industry data as well as previous *FCMS* studies. These variables include lagged boxed beef prices, lagged marketings, total show list, and dummy variables for individual feedlot firms and individual meatpacking firms. Other variables differed somewhat from prior studies with *FCMS* data. Among them were the potential profit/loss each week, and dummy variables for weight of cattle sold and type of transaction.

The central focus of this study was on impacts that resulted from the merger of two of the four meatpacking firms; the two smaller firms in one case (Firm A) and the two larger firms in another (Firm B). Some behavioral differences were noted during the mergers compared with preceding and following periods, however no clear changes were observed. During the merger period for both firms, market prices were significantly higher than prior to the merger and significantly higher compared with the post-merger period for one firm. For both merger periods, profits of the merged firm exceeded profits of their rival firms. Some behavioral differences were noted between the two merger experiments that contributed to the findings.

Unexpectedly, even though the merged firms had a sharp increase in market share relative to market shares prior to the merger, there was no evidence the merged firm used its larger size to depress prices paid for fed cattle. Instead, they appeared to achieve some economics of scope and passed along some of the efficiency gains in the form of higher prices for fed cattle.

This research was the first to measure impacts from mergers and acquisitions in an experimental market. A limiting factor with the merger experiment is likely the length of the experimental periods. Perhaps more than ten weeks is required for the merged firms to recognize their potential market power and use it to adversely affect transaction prices. Yet, the ten-week period was sufficiently long for the merged firms to achieve a degree of multiplant synergy or efficiency and positively affect their profits relative to rival firms. Potentially, efficiency gains precede market power effects. One could hypothesize such performance outcome in the real meatpacking industry. Significant efficiency gains were achieved during the 1980s and concentration also increased sharply. At some point, efficiency gains may be exhausted and high levels of concentration could result in adverse effects for cattle feeders.

Results suggest that mergers may have positive, short-run impacts on market prices, but as always, care must be exercised in transferring results *per se* from this experimental simulation to the real world fed cattle market. The experimental market does not allow estimating any spatial market impacts that are likely important in reality. Also, more information is needed on the extent of scope economies in meatpacking. Mergers may result in behavioral changes among the merged and non-merged firms but not necessarily to the detriment of the overall market, at least for some short-run period. Lastly, it appears management of the merged firm affects how effectively a merged packer operates, thus affecting its behavior and performance.

Table 3.1. Definitions of Variables and their Expected Signs for Transaction Price Models

Variables	Variable definition	Expected Sign
Dependent Variable		
$TPFC_{it}$	ith transaction price ($/cwt) for one pen of fed cattle in week t	N/A
Independent Variables		
BBP_{t-1}	Boxed beef price ($/cwt) for Choice, YG 1-3 550-700 lb carcasses, lagged one week	Positive
TM_{t-1}	Total number of pens of cattle (100 hd/pen) marketed, lagged one week	Negative
TSL_t	Total number of pens of cattle (100 hd/pen) on the market ready show list in week t	Negative
PPL_t	Potential profit or loss ($/cwt) in week t, i.e., largest meatpacker's break-even price for 1150 lb cattle less the feedlot break-even price for 1150 lb cattle	Negative
WT_{jit}	Binary dummy variables for weight of cattle traded (lbs), j=1-5, 1=1100, 2=1125, 3=1150 (Base), 4=1175, and 5=1200	Positive/ Negative
TYP_{jit}	Binary dummy variables for type of transaction, j=1-2, 1=cash (Base) and 2=Forward Contract	Negative
$FDLT_{jit}$	Binary dummy variables identifying feedlot firms, j=1-8, 1=FDLT1, 2=FDLT2, 3=FDLT3, 4=FDLT4, 5=FDLT5 (Base), 6=FDLT6, 7=FDLT7, and 8=FDLT8	Positive/ Negative
PKR_{jit}	Binary dummy variables identifying meatpacking firms, j=1-4, 1=PKR1, 2=PKR2, 3=PKR3, and 4=PKR4 (Base)	Positive/ Negative
$MERGR_{jit}$	Binary dummy variables for merger, non-merger periods, j=1-2, 1=Premerger, 2=Merger (Base), 3=Postmerger	Positive
HHI_t	Weekly Herfindahl index	Negative

Table 3.2. Summary Statistics of *Fed Cattle Market Simulator (FCMS)* Data for Two Firms by Experimental Period

Variable		Firm A			Firm B	
	Premerger	Merger	Postmerger	Premerger	Merger	Postmerger
Transactions (n)	415	341	306	399	363	321
Price ($/cwt)						
Mean	72.94	80.51	84.96	73.04	81.80	82.98
Std. Dev.	3.04	1.74	1.75	2.47	1.74	2.46
Marketings (Pens)						
Mean	41.8	35.3	29.9	40.2	36.2	31.5
Std. Dev.	2.2	8.0	7.0	5.4	6.4	4.1
Boxed Beef Price ($/cwt)						
Mean	114.37	125.67	130.27	115.26	125.87	131.22
Std. Dev.	1.30	4.95	4.44	2.70	3.70	4.51
Total Show List (Pens)						
Mean	129.3	113.6	91.0	132.8	118.3	100.2
Std. Dev.	17.2	14.2	9.7	12.7	7.0	8.9
Potential Profit/Loss ($/cwt)						
Mean	-1.51	0.02	0.37	-0.86	0.08	1.34
Std. Dev.	3.78	3.30	4.68	3.52	2.46	5.01
HHI	2,555	4,008	3,013	2,738	5,224	2,898
		(% of Period Transaction)				
Packer 1	22.2	24.9	26.5	19.5	16.8	20.9
2	24.1	26.4	20.9	21.6	17.1	18.4
3	26.0	25.5	24.5	28.3	35.5	27.1
4	27.7	23.2	28.1	30.6	30.6	33.6
Feedlot 1	13.0	11.4	12.4	12.5	11.3	12.4
2	13.0	9.7	12.4	13.5	12.4	14.3
3	14.4	11.4	10.4	12.3	11.6	10.0
4	10.6	11.7	13.4	10.8	12.4	11.8
5	12.0	14.1	14.7	11.8	14.0	14.3
6	12.8	14.7	12.4	13.3	13.5	12.1
7	11.5	14.4	10.4	12.3	13.5	11.2
8	12.5	12.6	13.7	13.5	11.3	13.7
Weight 1100	1.4	1.2	2.9	0.8	0.0	0.3
1125	2.6	15.8	20.3	1.2	7.7	7.8
1150	65.3	60.7	66.0	57.9	57.6	74.8
1175	25.5	19.1	9.5	35.3	30.3	15.3
1200	5.1	3.2	1.3	4.8	4.4	1.9
Type Cash	90.1	84.4	85.6	93.0	93.4	81.0
Contract	9.9	15.5	14.4	7.0	6.6	19.0

Table 3.3. Purchases by Packers Prior to and during the Merger, and after Dissolving the Merger

Packer	Period	Feedlot (% of Packer Purchases)							
		Firm A : Merger of Packer 1 and 2 during the Merger							
		1	2	3	4	5	6	7	8
1	Premerger	8.7	23.9	0.0	26.1	12.0	21.7	0.0	7.6
	Merger	8.2	2.4	12.9	18.8	25.9	11.8	9.4	10.6
	Postmerger	6.2	1.2	17.3	1.2	37.0	21.0	16.0	0.0
2	Premerger	21.0	5.0	25.0	0.0	2.0	13.0	0.0	34.0
	Merger	7.8	3.3	15.6	17.8	20.0	12.2	15.6	7.8
	Postmerger	4.7	17.2	14.1	25.0	3.1	0.0	17.2	18.8
3	Premerger	12.0	25.0	29.6	12.0	1.8	10.2	0.0	9.3
	Merger	17.2	0.0	16.1	9.2	4.6	12.6	10.3	29.9
	Postmerger	32.0	22.7	8.0	1.3	8.0	21.3	4.0	2.7
4	Premerger	10.4	0.0	2.6	6.1	30.4	7.8	41.7	0.9
	Merger	12.7	35.4	0.0	0.0	5.1	22.8	22.8	1.3
	Postmerger	7.0	10.5	3.5	26.7	8.1	5.8	5.8	32.5
		Firm B : Merger of Packer 3 and 4 during the Merger							
		1	2	3	4	5	6	7	8
1	Premerger	34.6	0.0	16.7	6.4	14.1	14.1	5.1	9.0
	Merger	0.0	21.3	6.6	13.1	1.6	19.7	16.4	21.3
	Postmerger	0.0	55.2	0.0	1.5	3.0	29.8	0.0	10.4
2	Premerger	4.6	12.8	4.6	9.3	11.6	24.2	8.1	24.4
	Merger	24.2	12.9	12.9	0.0	14.5	30.6	0.0	4.8
	Postmerger	0.0	13.6	54.2	0.0	8.5	13.6	10.2	0.0
3	Premerger	4.4	13.3	23.0	15.0	17.7	7.1	14.2	5.3
	Merger	10.8	7.8	14.7	19.4	10.1	5.4	12.4	19.4
	Postmerger	46.0	1.2	0.0	3.4	3.4	9.2	6.9	29.9
4	Premerger	11.5	23.0	4.9	10.7	4.9	10.7	18.0	16.4
	Merger	10.8	12.6	9.9	10.8	25.2	9.9	20.7	0.0
	Postmerger	0.0	0.0	0.0	31.5	33.3	2.8	22.2	10.2

Table 3.4. Parameter Estimates ($/cwt) for the Transaction Price Models

Variable	Firm A Model 1	Firm A Model 2	Firm B Model 1	Firm B Model 2
Intercept	80.30*** (15.25)	69.94*** (8.50)	50.30*** (3.75)	24.02* (1.97)
BBP_{t-1}	0.15*** (4.40)	0.29*** (5.85)	0.31*** (4.11)	0.49*** (6.81)
TM_{t-1}	-0.14*** (8.93)	-0.18*** (7.76)	-0.02 (0.61)	-0.07*** (2.93)
TSL_t	-0.11*** (8.56)	-0.13*** (8.45)	-0.07* (2.06)	-0.05* (1.95)
PPL_t	-0.03 (0.46)	-0.07 (0.80)	-0.17 (1.39)	-0.29** (2.66)
WT1	1.38*** (4.67)	1.21** (2.34)	2.35 (1.05)	2.72 (1.34)
WT2	0.12 (1.03)	-0.01 (0.08)	0.53*** (3.12)	0.61** (2.49)
WT3	Base	Base	Base	Base
WT4	-0.78*** (7.63)	-0.62 (4.87)	-0.15* (1.83)	-0.24*** (2.79)
WT5	-1.72*** (7.56)	-1.21*** (4.84)	-0.64** (2.43)	-0.93*** (3.50)
TYP1	Base	Base	Base	Base
TYP2	0.23 (0.93)	0.44** (2.41)	-0.71*** (5.71)	-1.15*** (5.27)
PKR1	0.15 (1.32)	0.14 (1.07)	0.61*** (6.51)	0.77*** (8.03)
PKR2	0.23*** (2.02)	0.15 (1.21)	0.39*** (4.63)	0.30*** (3.26)
PKR3	0.17* (1.78)	0.14 (1.18)	0.39*** (4.35)	0.37*** (3.96)
PKR4	Base	Base	Base	Base

Table 3.4. Parameter Estimates ($/cwt) for the Transaction Price Models (continued)

Variable	Firm A Model 1	Firm A Model 2	Firm B Model 1	Firm B Model 2
FDLT1	-0.09 (0.60)	-0.12 (0.71)	0.83*** (5.89)	0.85*** (4.99)
FDLT2	-0.62*** (3.17)	-0.43** (2.53)	1.16 (9.98)	1.27*** (9.57)
FDLT3	-0.44*** (2.93)	-0.64*** (4.05)	0.85*** (3.85)	0.88*** (5.21)
FDLT4	-0.47*** (2.90)	-0.58*** (3.15)	0.31* (1.75)	0.67*** (4.83)
FDLT5	Base	Base	Base	Base
FDLT6	-0.75*** (5.61)	-0.71*** (4.85)	0.68*** (5.18)	0.69*** (5.70)
FDLT7	-0.68*** (3.14)	-0.78*** (4.59)	0.94*** (7.65)	1.21*** (9.82)
FDLT8	-0.65*** (3.99)	-1.13*** (6.20)	0.94*** (8.30)	1.14*** (10.48)
PREPD	-4.07*** (8.29)	NA	-3.18*** (5.31)	NA
MERGE	Base	NA	Base	NA
POSTPD	-1.04** (2.74)	NA	0.36 (0.53)	NA
HHI	NA	-2.43	NA	5.57***

Note: [a] Figures in parenthesis are absolute values of t-statistics.
[b] Significance levels are denoted as follows: ***=0.01, **=0.05, and *=0.10.

Table 3.5. Packer Profitability Prior to and during the Merger and after Dissolving the Merger

Packer	Premerger	Merger	Dissolution
		($/Head)	
		Firm A	
Packer 1	9.37	--	-13.83
Packer 2	0.49	--	-7.40
Merged Packer 1 and 2	--	7.48	--
Packer 3	10.92	-3.92	-12.04
Packer 4	11.80	-6.19	-17.58
		Firm B	
Packer 1	2.54	-19.71	-5.74
Packer 2	-7.79	-30.73	-7.68
Packer 3	30.90	--	5.36
Packer 4	18.08	--	35.90
Merged Packer 3 and 4	--	-10.36	--

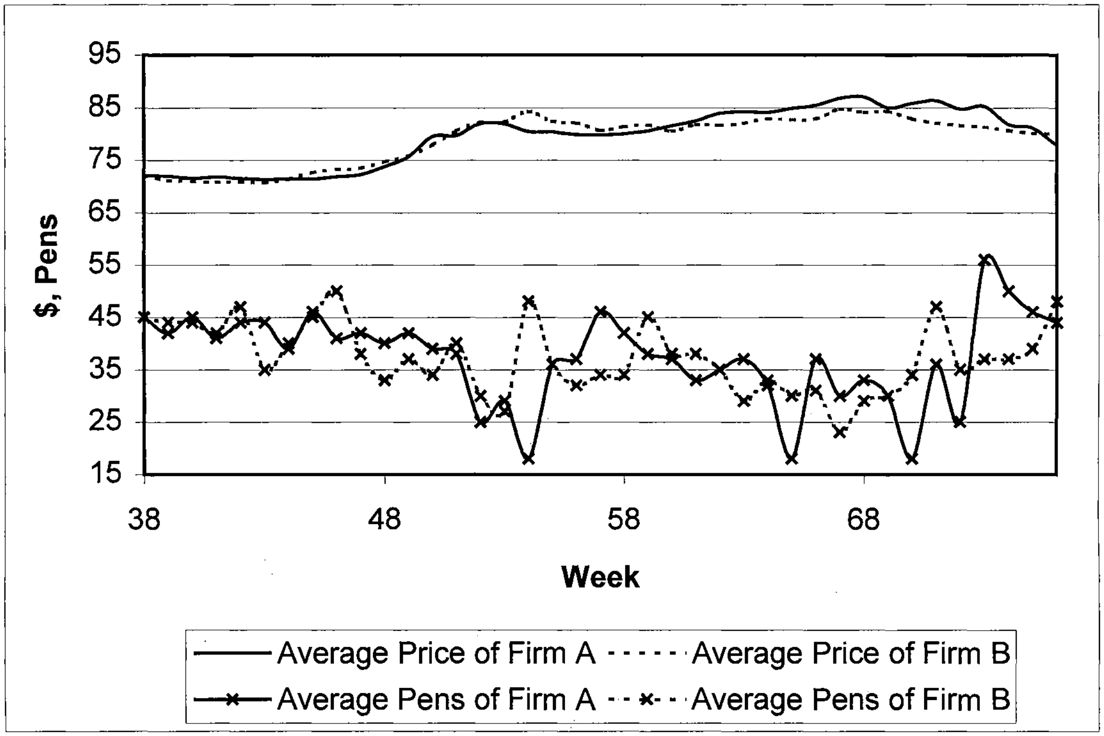

Figure 3.1. Trend of the Total Cattle Marketed Number of Pens and Average Prices ($/cwt.)

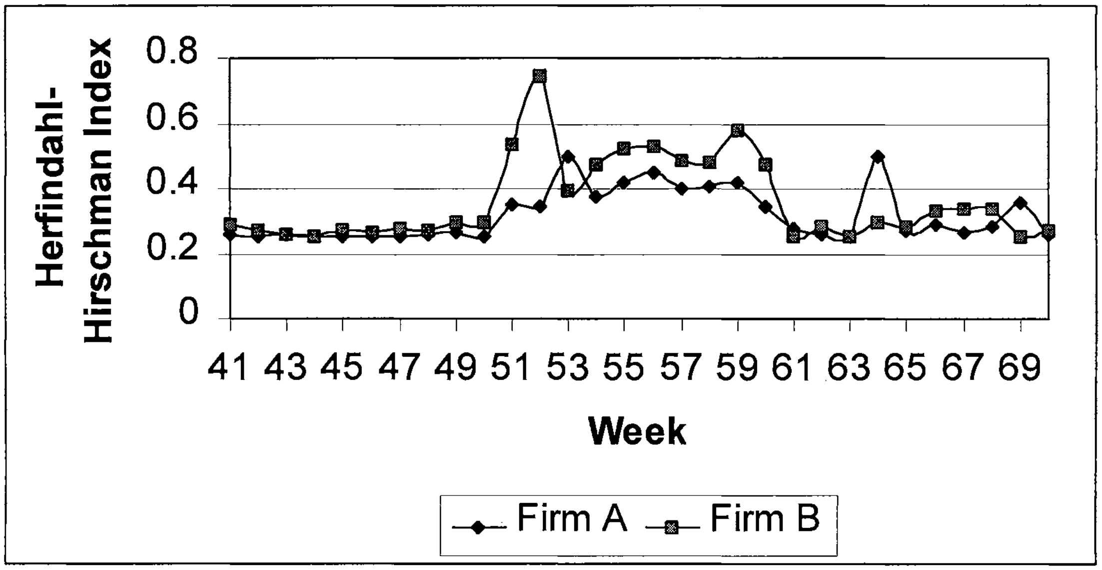

Figure 3.2. Herfindahl-Hirschman Indexes for the two firms during merger periods

CHAPTER IV

Advertising Impacts on Beef Consumption using VAR Models

Per capita meat consumption has changed dramatically significantly since 1960 in the U.S. Per capita consumption of beef increased from 68.4 lbs in 1960 to 97.7 lbs in 1976, however, it has since decreased to 65.7 lbs in 1997. These statistics indicate that the per capita beef consumption has decreased since 1976, the peak of its consumption. This trend is similar for the per capita consumption of pork. Per capita pork consumption decreased from 60.8 lbs in 1960 to 47.8 lbs in 1997. However, per capita consumption of poultry has increased from 34.1 lbs in 1960 to 94.2 lbs in 1997. Table 4.1. shows per capita consumption of these meats for the years between 1960-1997.

The reasons for the trends are considered to be; "changes in relative prices for beef, pork, chicken and turkey" (Wu; Dahlgran), "changes in the structure of meat demand" for example, more convenience in cooking, taste preferences, or health concerns (Moschini and Meilke; Larkin), problems on the supply side (Ikerd), and consumption habits (Chen and Veeman).

As beef consumption has declined, the U.S. beef industry has been trying to increase beef consumption. One of the efforts is beef promotion that is based on the 'U.S. Beef Promotion and Research Act of 1985'. The Act "authorized the U.S. beef industry to develop and implement various programs for enhancing consumer demand for beef" (Ward and Lambert). These programs are "funded by a mandatory assessment of $1-per-head collected each time cattle are sold" (Agricultural Marketing Service, USDA).

Total amount of the assessments is about $80 million annually (Agricultural Marketing Service, USDA), and 61.8% of the total assessments from the first quarter in 1987 to the second quarter in 1995 was spent for promotion (Ward).

The efforts to increase meat consumption are not confined to the beef industry. The pork and poultry industries have been trying to increase the consumption of their meats, too. They are using advertising as a tool to appeal their products to consumers. Associations use generic advertising for their products, and individual firms use branded advertising for its products. This study will examine the effects of advertising expenditures for beef, and will compare which factors have more effects on beef consumption using data on advertising expenditures, meat prices, and meat consumption. The effects will be analyzed with a Vector Autoregressions (VAR) model of the RATS (Regression Analysis for Time Series) program.

Literature Review

Advertising Effects on Meats

The aim of brand and generic advertising in the meat industry is undoubtedly "to increase the consumption of meat products" (Brester and Schroeder). Thus, advertising has "been a profitable undertaking from the industry viewpoint; that is, not only did advertising increase demand, it increased demand enough to more than cover the costs of the advertising expenditure" (Ward and Lambert). "Brand advertising is directed at shifting the market shares of individual firms and not necessarily at enlarging the size of the total market". The chief aim of "generic advertising, by contrast, is market expansion" (Kinnucan et al.).

Brester and Schroeder defined advertising as "a shifter of demand"; some other different viewpoints are a "taste shifter" (Theil 1980), or "an input in the household production function" (Stigler and Becker).

Rhodes and Abou-Bakr studied if "advertising expenditure would affect meat retailing". They used survey data for retail food prices and advertising for beef, pork, and poultry in Columbia, MO. "Advertised prices of meats were obtained from weekly newspaper advertising for all 14 of the supermarkets in the area for 16 consecutive weekends". From the analysis, they obtained two patterns of merchandising conduct. One is "the advertised price cut was very much in evidence in some affiliate supermarkets". The other is "the advertising of some chain supermarkets in the same market area contained few price cuts".

Piggott, Piggott, and Wright tested whether "advertising expenditure is worthwhile in the sense of increasing net profits for producers" using Australian data. Their study was focused to "address various questions relating to the farm-level returns from incremental advertising expenditure when multiple commodities and markets are involved".

As a result of their study, "the impacts of incremental advertising expenditure when commodities are related in demand and/or supply, and are sold in multiple markets that cannot be separated, depend on many parameters. Obtaining a statistically-significant regression coefficient associated with advertising in a demand function falls well short of the information". They also found that "advertising one meat has direct impacts on the demand for other meats".

The impact of brand and generic advertising on meat demand was studied by Brester and Schroeder. The focus of the study was "to determine the impact of meat advertising expenditure on the demand for beef, pork, and poultry". In particular, "a demand system is used to allow for cross-commodity advertising effects on competing product demand".

A nonlinear Rotterdam model was used to estimate the effects of meat advertising expenditures. They found that "branded beef, pork, and poultry advertising elasticities are each significantly different from zero, and generic beef and pork advertising elasticities are significantly different from zero. Branded beef and poultry advertising has increased total meat consumption". And they also found that "generic advertising of beef and pork has a negative effect on poultry consumption, but no effect on the demand for beef or pork".

Piggott et al. studied demand response to advertising in the Australian meat industry. The meats group consisted of beef, lamb, pork and chicken. Quarterly data on nominal average retail prices, and quarterly per capita consumption were used for 1978:3 to 1988:4.

They considered "the implications of specification choices for findings concerning the statistical and economic significance of demand response to advertising by two producer groups in Australia: pork producers (Australian Pork Corporation, APC) and beef and lamb producers (Australian Meat and Livestock Corporation, AMLC)". They also investigated "whether the results from tests for advertising effects are sensitive to the choices of functional form for demand equations and whether single equation models or a complete system approach is used".

The result was that "the estimated advertising effects were not very sensitive to functional forms". "The AMLC advertising was statistically significant in the equations for beef and chicken in every model, and AMLC advertising had no effect on demand for lamb while increasing the demand for beef. A negative effect of AMLC advertising on chicken consistent with the objectives of the beef and lamb industry, and the effect could be economically important. APC pork advertising was usually found not to have any statistically significant effects".

Kinnucan et al. studied the effects of health information and generic advertising on U.S. meat demand. Their study was focused on whether "generic advertising and health information have detectable effects on U.S. meat demand". Variables of beef, pork, poultry, fish, and Brown and Schrader's cholesterol information index were used for the study.

They found that "the own-price effect for fish is significant, and fish is a net substitute for pork. Total meat expenditure is a significant determinant of the demand for beef, pork, and fish, but not for poultry". About the health information, "poultry appears to have benefited from the dissemination of cholesterol-related health information largely at the expense of beef. However, pork and fish appear to have been unaffected by health information". On the side of advertising, "beef advertising has a positive effect on pork and fish demand, but no effect on beef or poultry demand".

Ward and Lambert's study was focused on the impact of the US beef checkoff. The program was designed to increase the total demand of US beef. Promotion expenditure was about $2 million per quarter before the program was begun, but the promotion expenditure increased to the range of $8 to $13 million per quarter. They developed a model using a double-log model to measure the economic impact and promotion efforts.

The results of the checkoff model verified that there were impacts on beef price, revenue, and live-weight return. To summarize their findings, the impact was "at the producer level". Namely, "Beef price increased by 2.24 % in response to the checkoff efforts thus yielding the gain in revenue." And "the model showed $2.56 billion gain in revenue through 1991:2. On average the checkoff programs yielded a live-weight return of 5.71 net dollars for each $1 of assessments for the 18 quarters since 1987:1."

In order to estimate meat demand or advertising effects on meat, researchers have adopted several models. The Rotterdam model is based on consumer demand theory (Theil). The Rotterdam model is selected because of some reasons that "the model has the ability to model the whole substitution matrix" (Mountain), and the model is "consistent with demand theory" (Barten; Theil). Brester and Schroeder also used this model to analyze the Impacts of Brand and Generic Advertising on Meat Demand. Besides, the AIDS model (Piggott et al.) and SUR procedure (Kinnucan et al.) were used to study meat advertising effects. Table 4.2. shows summaries of selected papers for advertising effects in agricultural products.

VAR and Theoretical Background of VAR

An unrestricted VAR model, "treating all variables as endogeneous" (Sims), was suggested by Sims for short-term forecasting (Lee). DeBenedictis explained this VAR model as "an example of a dynamic seemingly unrelated regression equations (SUR) model. The model is characterized by lagged endogeneous variables and disturbances which may be contemporaneously correlated across the equations".

Sims thought some exogeneous variables, that are categorized as exogeneous variables by previous studies, as "if the list of exogeneous variables were carefully reconsidered and tested in cases where exogeneity is doubtful, the identification of these models might well, by Hatanaka's criterion, fail, and would at best be weak". "It used to be that when expected future values of a variable were thought to be important in a behavioral equation, they were replaced by a distributed lag on that same variable" (Sims). He explained that "this practice had the advantage of producing uncomplicted effects on identification".

Thus, the VAR model is "an alternative to large simultaneous equations models for studying the relationship among the important aggregates". When Sims developed the model it was "not well–suited for use in forecasting", but "Litterman developed a Bayesian procedure for estimating the VAR which greatly improved forecasting performance" (Doan). Namely, "the VAR can be estimated easily with OLS, and it is an excellent model for forecasting". Forecasting is done using the estimator after the estimation, and it's a kind of chain rule of forecasting (Lee).

In a different way with this forecasting, an impulse response function is used to see the relationships between variables, or to see the spillover of a policy. This function gives a shock to a specific variable, and sees responses of other variables in a model. But this result gives only sensitivity analysis, not dynamic relationships of the whole model (Lee).

Sims mentioned a problem of the VAR. "If every variable is allowed to influence every other variable with a distributed lag of reasonable length, without restriction, the number of parameters grows with the square of the number of variables and quickly exhausts degrees of freedom" (Sims). For example, if there are 100 observations in the data set, it is a 4-variable VAR, and lag length is 3, then the degrees of freedom are 52[1].

Hsiao argued another problem that "the distribution theory on which tests are based is asymptotic". It "makes interpretation of the tests difficult for a number of reasons". First, "the tests are non-robust". Second, "different but apparently reasonable and asymptotically equivalent formulars for the test statistic may give very different apparent significance levels for the same data". Third, "the distribution of a test statistic is sensitive to the order of lags fitted to the first stage model".

Even though there are a few of problems, Sims' procedure still has good recommendations for constructing empirical models (Hsiao). Hsiao also explained the reasons as follow: "(1) under fairly general conditions a stationary time series admits an autoregressive representation and the economic theory is used only to the extent of choosing relevant variables, (2) the estimation method is simple and consistent, (3) the first few autoregressive coefficient estimates are reasonably stable with respect to the varying order of lags fitted".

A general form of the VAR model is

(4-1) $$y_t = A_0 + A_1 y_{t-1} + A_2 y_{t-2} + \dots\dots + A_p y_{t-p} + \varepsilon_t$$

where: $y_t = (n \times 1)$ vector containing n variables, $A_0 = (n \times 1)$ vector of intercepts or a matrix, $A_l = (n \times n)$ matrix of coefficient parameters for l=1,2,3,.....,p, p is a common lag

---

[1] $d.f. = number \quad of \quad observation \quad - \{(number \quad of \quad variable)^2 \times lag \quad length)\}$.

length, $\varepsilon_t = (n \times 1)$ vector of error terms (Kim). Equation (4-1) can be rewritten as follow (Jeon):

$$(4\text{-}2) \qquad Y_t = A_0 + \sum_{k=1}^{p} A_l Y_{t-k} + \varepsilon_t$$

DeBenedictis applied the VAR model to forecasting the British Columbia macro economy in Canada. He compared forecast results of VAR compared with the results of univariate ARIMA, and concluded that the VAR model is a forecasting tool, because the VAR is more accurate than ARIMA.

The impulse responses were focused on cointegrated variables (Lütkepohl and Reimers) and "interpreting finite order vector autoregressive models in the stationary as well as the nonstationary cointegrated case" (Lütkepohl and Saikkonen). The results of the studies "showed that a direct interpretation of the cointegration relations may be difficult or misleading", and "the assumption that the order of the approximating process increases with the sample size conforms with common practice in applied works".

Leeper and Gorden studied "whether the characterization of the liquidity effect is sensitive to i) changes in sample period, ii) conditioning the correlations on past information, iii) assuming money growth is exogeneous, and iv) treating monetary changes as anticipated or unanticipated". In order to investigate these effects, they used traditional distributed lag regression, traditional distributed lags with endogeneous money growth, vector autoregressions, and correlation between anticipated variables. However, they "concluded that the traditional analysis and modern models can not explain the observed correlations".

Santos used a VAR model to "determine the major forces, channels of influence and dynamics characterizing the savings and loan industry". The number of firms, real advertising, and real gross income variables were involved for the VAR model. He found that "the market structure emerges as an important factor affecting profitability. However, there are indicators that suggest a weak relationship existing between market structure and profitability".

Kang's study explained the optimal lag selection. He insisted that "the conventional selection of lag lengths through the final prediction error criterion is shown to be inadequate in the test of Granger causality". For this problem, he used "modification of Granger-Sims tests with the optimal and parsimonious use of lag structures", and he obtained a result that the "optimal model corrects for the inadequate uses of arbitrary lag lengths or lag terms".

Brandt and Bessler forecasted hog prices using quarterly data from 1976 to 1982. They estimated the forecasting model using VAR and univariate ARIMA processes. It is believed that "the forecasting performance of the vector autoregression approach would have been superior to the individually simpler univariate ARIMA process", but they found that there was "no improvement in forecasting ability by the more complex VAR procedure based on several measures of performance".

Ward et al. used a VAR model to "analyze geographic market boundaries and factors affecting market boundaries including", especially to examine the relationships of spatial fed-cattle transaction prices between plants. Their focus was "if prices at one plant statistically explain prices at another plant, then prices at the first plant affect prices at the second plant". They estimated 756 paired estimations for 28 plants.

In order to see the price relationships between plants, they assumed as follows. "If the paired price effects are bidirectional, then price information flows in both directions, suggesting plants are competing with each other and are in the same geographic market. If the paired price effects are unidirectional, then one plant simply responds to price changes at the other plant and the leading plant may be able to operate independently". The study had three types of VAR models: "using price level, using first-differenced prices, and using error-correction models with first-differenced price data".

They found that "prices at 11 plants in 8 States significantly affected prices at 90 percent or more of the other 27 plants. Two plants affected prices at less than 30 percent of the other 27 plants. And regionally, 80 percent of the paired comparisons for plants in Nebraska, Colorado, Kansas, and Texas were strongly related". From the results, they concluded that "most prices were significantly affected by other plants' prices".

The advertising effects and VAR approaches are considered so far. However, there is no research for advertising effects using a VAR model. Among several procedures of VAR, impulse response functions were considered for the study.

Purpose of the Study

The purposes of this study are to: i) analyze the effects of advertising between meats, ii) compare the effects of generic and branded advertising in beef, and iii) suggest better methods and other suggestions for the beef industry to increase beef consumption.

Data

As meat consumption patterns have been changing, many researchers have tried to identify and measure structural changes in meats consumption. A few researchers show that there are structural changes in meat demand since the late 1970s or early 1980s (Choi and Kim; Ikerd; Braschler; Chavas; Thurman). Due to the structural change, quarterly data were collected during the first quarter in 1980 through the third quarter in 1996.

The data set consisted of meat consumption, meat prices, and advertising expenditures. Meat consumption included variables for beef consumption (BC), pork consumption (PKC), and poultry consumption (PLC). For the meat prices data, beef price (BP), pork price (PKP), and chicken price (PLC) at retail are considered. Generic advertising expenditure for beef (GB), generic advertising expenditure for pork (GPK), branded advertising expenditure for beef (BB), branded advertising expenditure for pork (BPK), and branded advertising expenditure for poultry (BPL) are the variables for the advertising expenditures for meats.

Data for advertising expenditure are provided by Dr. Schroeder[2], and other data are collected from *Livestock, Dairy, and Poultry Situation and Outlook* of USDA. All time-series data are adjusted for seasonality using PROC X-11 model of the SAS program, and then, all data are deflated by the consumer price index (CPI) for all urban consumers for all items. Natural log is adopted for all adjusted series. RATS (Regression Analysis for Time Series) program and Vector Autoregressions (VAR) model were used for the main analysis.

Advertising Expenditure and Consumption for Each Meat

[2] Professor at Department of Agricultural Economics, Kansas State University. The author appreciates Dr. Schroeder for providing the data.

Advertising expenditures for branded pork and branded poultry had constantly increased since 1970. The advertising expenditures peaked around 1985, and then advertising expenditures were reduced for a while. Since 1992 and 1994, the advertising expenditures for branded pork and branded poultry has increased again. However, advertising expenditures for generic beef, generic pork, and branded beef were very small until around 1987. After that, advertising expenditure for generic pork has increased rapidly. However, advertising expenditures for generic and branded beef are worthy of notice, because whereas advertising expenditure for generic beef has increased suddenly, advertising expenditure for branded beef has decreased again (Figure 4.1.).

Let's consider meat consumption again. As it was considered before, poultry consumption has increased constantly, but beef consumption has decreased since 1976 (Figure 4.2.). Although beef consumption has decreased since 1976, there were no significant changes in advertising expenditure for each meat until 1987. Since then, advertising expenditure has changed. Correctly speaking, advertising expenditure for branded pork and branded poultry has decreased since 1986. But advertising expenditure for generic beef has increased suddenly. It can be considered a result of the 'Beef Promotion and Research Act of 1985'.

Figures 4.3 through 4.7 explain the relationship between meat consumption, and advertising expenditures for generic and branded meats. Each figure shows the changes in each quarter. Thus, 19702 on the x axis means the changes of advertising expenditure and meat consumption between the second and first quarter in 1970. Axis x means time, left axis y means changes in advertising expenditure, and right axis y means changes in meat consumption in each figure.

In Figure 4.3 the changes in beef consumption do not have any significant trend. The generic advertising expenditure for beef was not changed significantly until the early 1980s. The changes increased a little bit during 1982 to 1986, after that the changes increased drastically. The direction of changes of generic advertising expenditure and beef consumption seems not to coincide. For almost all periods, the changes moved in opposite directions. Namely, the generic advertising expenditure increased when beef consumption decreased from the previous quarter, and the expenditure decreased as beef consumption increased from the previous quarter. This pattern may be repeated. Say, reduced beef consumption increased the expenditure, or increased beef consumption reduced the expenditure. The "time lag" of Brester and Schroeder between advertising expenditure and consumption of meat was also found here.

This trend can be compared with the case of brand advertising expenditure for beef and beef consumption (Figure 4.4). The trends of the two changes in 1980s are noticeable. It is found that the two changes moved in almost same way.

In the case of pork consumption, the direction of generic and brand advertising expenditure for pork and pork consumption moved in opposite directions until the mid 1980s, after that the directions are coincident. However, the trends of generic advertising expenditure for pork and pork consumption have a time lag. One of them affects the other, but brand advertising expenditure and pork consumption have almost same trend (Figure 4.5 and Figure 4.6). However, the case of brand advertising expenditure and poultry consumption explains another result. The trends are almost coincident since 1970 (Figure 4.7).

The results suggest a few thoughts. First, brand advertising may have a greater effect than generic advertising. Second, the advertisers of generic advertising seem to not have long term plans compared to the advertisers of brand advertising. Third, the advertisers of brand advertising may have a more effective marketing strategy than the advertisers of generic advertising. Comparing the trends of Figure 4.1 and Figure 4.2 may well explain these thoughts. Of course, these are just results of graphical analyses.

Empirical Models

From the equation of (4-1), typical *p*-order *n*-variables VAR models are considered.

(4-1) $$y_t = A_0 + A_1 y_{t-1} + A_2 y_{t-2} + \ldots\ldots + A_p y_{t-p} + \varepsilon_t$$

where $y_t = [X_t]'$. Let X_t be the matrix of the following variables.

Model 1: $X_t = (dlogBC_t,\ dlogGB_t,\ dlogBB_t)$

Model 2: $X_t = (dlogBC_t,\ dlogGB_t,\ dlogGPK_t)$

Model 3: $X_t = (dlogBC_t,\ dlogBB_t,\ dlogBPK_t,\ dlogBPL_t)$

Model 4: $X_t = (dlogBC_t,\ dlogBP_t,\ dlogPKP_t,\ dlogPLP_t)$

Model 5: $X_t = (dlogBC_t,\ dlogBP_t,\ dlogGB_t,\ dlogBB_t)$

Model 6: $X_t = (dlogBC_t,\ dlogPKC_t,\ dlogPLC_t)$

Estimation and Empirical Results

Nonstationarity Test

As time series analysis requires stationarity, a VAR model needs a test to see if the time series has a unit root. Dickey and Fuller explained stationarity in the autoregressive model.

(4-3) "$Y_t = \rho Y_{t-1} + e_t$, $t = 1, 2, \ldots$,

where: $Y_0 = 0$, ρ is a real number, and $\{ e_t \}$ is a sequence of independent normal random variables with mean zero and variance σ^2. The time series Y_t converges (as $t \to \infty$) to a time series if $|\rho| < 1$." If $|\rho| = 1$, or $|\rho| > 1$, then the time series is not stationary. "Properties of the regression estimator of ρ are obtained under the assumption that $\rho = \pm 1$. The estimator of ρ and the regression t test furnish methods of testing the hypothesis that $\rho = 1$".

This study followed the (augmented) Dickey-Fuller (ADF) test as they suggested above. The results of the tests for raw data series in this study were not statistically significant (Table 4.3). However, after taking one difference the results of tests were all statistically significant (Table 4.4). They mean first differences for all time-series data were stationary.

Determination of Lag-Length

In an autoregression (AR) model, past observations affect present observations. In the case of beef consumption, let's assume that a consumer's purchasing behavior of beef is affected by his/her previous purchasing behavior. If he/she purchases beef with his/her memory from 3 terms (or 3 times purchasing experiences) ago, then his/her present purchasing behavior is affected by those three previous purchasing behaviors. Namely, the p value will be 3 in equation (4-1), and it will optimize the forecasting of y_t.

Lag-length, called the AR order, has a trait that all equations in a VAR model have identical lag length. The choice of lag-length affects very sensitively the test results of Granger causality (Kang; Guilker and Salemi).

The testing procedure of lag-length to use is the Likelihood Ratio (Sims). The test statistic is:

(4-4) $$LR = (T - c)(\ln|\Sigma_r| - \ln|\Sigma_u|) \quad \sim \quad \chi_k^2$$

where: T = the number of effective observations, c = the Sims' small sample correlation which is equal to the number of parameters estimated in one equation of the unrestricted system, $|\Sigma|$ = the determinant of the variance-covariance matirx of error terms, *r* = restricted system, *u* = unrestricted system, and *k* = degree of freedom which is the number of parameters restricted. "The test is for the restricted model against the unrestricted model at a conventional significance level" (Kim). Besides the Likelihood Ratio test, Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC) were used for model selection. From the results of the tests of lag-length selection, the lag-lengths for all models were decided as 1 (Table 4.5).

Impulse Responses (IR) and Discussions

If there is a perturbation in one standard innovation in the VAR, it influences all variables in the VAR by chain reaction. This reaction is called the impulse response. This impulse response is "generated by analyzing the effects of unanticipated shocks in the vector moving average representation of the VAR system", and is "to gain a better understanding of the main channels of influences in the variable" (Santos).

The unanticipated shock is “a unit shock to a variable in the normalized system is interpreted as one-standard-deviation unanticipated movement in that variable, where the measured variance of the shocks to each variable is, in part, a function of the particular normalization chosen” (Santos). The impulse response is a “common tool for investigating the interrelationships among the variables in dynamic model variables” (Lütkepohl and Reimers).

The impulse response functions were considered for the six models in this section. The focus variable was beef consumption in each model. The effects consider how each variable affects beef consumption and, how beef consumption affects the other variables.

Null hypothesis tests are done for the expected value of the response at $\alpha = 5\%$. The null hypothesis is that the error bounds are zero in each impulse response. Each response has an expected value of the response, lower bound, and upper bound. When one of the bounds cuts the x-axis, it means that the expected value of the response has statistical significance at the range between the origin and the point of intersection.

Model 1: [BC, GB, BB]

Though the generic and brand advertising for beef were a little bit smaller than the expenditures for the other meats, the advertising continued until about 1987. After that period brand advertising for beef decreased again, but generic advertising increased rapidly due to the US beef checkoff program. As considered in a previous section the relationships between beef consumption and generic advertising for beef, and beef consumption and brand advertising for beef have several patterns. The changes in consumption and advertising are almost coincident, moving in opposite directions or moving in the same directions through time.

Figure 4.8 shows impulse responses of model 1, however all responses are not statistically significant in this model. Figure 4.9 explains the sensitivity of beef consumption to the shock in the two types of advertising. The response of beef consumption doesn't change in the first time period, but the response increased during the second time period and decreased during the third time period. The response of beef consumption to brand advertising is more sensitive to the shock in generic advertising. The responses died down to zero after period 9.

Figure 4.10 explains another case of responses of generic advertising and brand advertising when there is a shock in beef consumption. The generic advertising responses is much more sensitive than brand advertising in this case. The generic advertising increased during the first two periods, but brand advertising decreased.

These two figures may be summarized as follows. As beef consumption decreased beef advertisers increased their expenditure on beef advertising using the generic and brand methods. The checkoff program has been affording more advertising on generic beef, but the effect is less than brand advertising. To consider the difference the total amount of the generic and brand adverting, it can be said that brand advertising has much more impact that that of generic advertising. Previous research also verified that brand advertising has more effect than generic advertising (Brester and Schroeder).

Model 2: [BC, GB, GPK]

As covered in the literature review part, "advertising one meat has direct impacts on the demand for other meats" (Piggott, Piggott, and Wright). Model 2 and model 3 were designed to see the impacts on beef consumption from advertising on other meats. Armington assumed that "each country's market share is unaffected by changes in the size of the market as long as relative prices in that market remain unchanged", and generic promotion is considered as a method to increase market share (Henneberry; Kinnucan et al.).

The relationships between beef consumption and generic advertising will be considered in this model, and the relationships between beef consumption and brand advertising will be considered in model 3. Model 3 does not include data on generic advertising for poultry, because the poultry industry does not advertise for generic poultry. Thus, only three variables are included in the model.

Figure 4.11 shows all impulse responses of model 2. The impulse response of generic beef advertising to a unit shock in generic advertising of pork is statistically significant, however the others are not. Figure 4.12 explains the response of beef consumption when there are unit shocks in generic advertising of beef and generic advertising of pork. When there are shocks in both types of advertising, beef consumption decreased during the first two terms, and then it increased during the next two terms. When beef consumption is decreased during first two terms, beef consumption responded more sensitively to a shock in generic beef advertising than to a shock in generic pork advertising. However, during the next two terms, beef consumption responded more sensitively to a shock in generic beef advertising than generic pork advertising. These results can be compared with the results of Brester and

Schroeder that "generic beef and pork advertising had no effect on beef or pork demand" (Kinnucan et al.).

Figure 4.13 shows the case of an impulse response of generic advertising of beef and pork to a unit shock in beef consumption. In these responses, generic pork advertising responded more sensitively during first two terms than generic beef advertising.

These two figures say that generic advertising for the two commodities doesn't increase beef consumption, but when beef consumption is increased, generic pork advertising increased more than generic beef advertising.

Model 3: [BC, BB, BPK, BPL]

This model is designed to see the effects on beef consumption from brand advertising of meats. Brand advertising is "directed at shifting the market shares of individual firms and not necessarily at enlarging the size of the total market" (Kinnucan et al.).

Figure 4.14 shows the impulse responses of the model. Impulse responses of beef consumption to a unit shock in brand poultry advertising, brand beef advertising to brand pork advertising, and brand poultry advertising to brand pork advertising are the only statistically significant responses. Others are not significant for the model.

Figure 4.15 is the impulse responses of beef consumption to unit shocks in brand advertising of beef, pork, and poultry. As the study of Brester and Schroeder showed, "branded beef and poultry advertising have increased total meat consumption", all brand advertising increased beef consumption. All unit shocks of brand advertising increased beef consumption during the first two terms, and then the trend was repeated until the 9th or 10th term. The responses died down to zero after that. Especially beef consumption responded most sensitively to a unit shock in brand poultry advertising in this model.

Figure 4.16 explained the impulse responses of brand advertising of beef, pork, and poultry to a unit shock in beef consumption. Brand poultry advertising responded most sensitively. It decreased rapidly during the first term of the unit shock in beef consumption, However, brand pork advertising increased during the first term. Brand beef advertising also decreased, but it was not as sensitive as brand advertising for pork and poultry.

Model 4: [BC, BP, PKP, PLP]

Meat demand is influenced by price (Brester and Schroeder), and relative prices (Armington; Kinnucan et al). In fact, one of the reasons for the structural change in beef is considered to be "changes in relative prices for beef, pork, chicken and turkey" (Wu; Dahlgran). Under the assumption that relative prices will affect consumption, this model included prices of beef, pork, and poultry.

Figure 4.17 shows the impulse responses of model 4. Impulse responses of beef prices to a unit shock in beef consumption, pork prices to a shock in beef prices, poultry prices to a shock in beef prices, and poultry prices to a shock in pork prices are statistically significant.

Figure 4.18 verifies that beef and pork are substitute goods. Beef consumption decreased when beef prices increased, but it increased when pork prices increased. The unit shock of poultry prices increased beef consumption, but is not as sensitive as a unit shock in pork price.

Model 5: [BC, BP, GB, BB]

For other factors that affect meat demand, Brester and Schroeder listed non-price factors as well as price factors. Thus, this model involved beef price and generic and brand beef advertising to see the responses of beef consumption. The impulse responses of this model are in Figure 4.19, and impulse response of beef prices to a unit shock in beef consumption was the only impulse response that is statistical significant. Others are not.

When there is a unit shock in beef prices, beef consumption decreased. The response of beef consumption also decreased from a unit shock in generic beef advertising, but it increased from a unit shock in brand beef advertising. Among these three responses, beef consumption was affected most by beef prices (Figure 4.19). These results are almost similar with the results of model 1 and model 4. The difference is generic beef advertising increased beef consumption when the model included beef consumption, generic beef advertising, and brand beef advertising in model 1. However, generic beef advertising decreased beef consumption when the model included beef consumption, beef price, generic beef advertising, and brand beef advertising in model 5.

It seems to be hard to explain the reason. But Brester and Schroeder found, as discussed in model 2, that "generic beef and pork advertising had no effect on beef or pork demand" (Kinnucan et al.), which may be another explanation.

Model 6: [BC, PKC, PLC]

It is said that beef and pork are substitute goods, but beef and poultry are independent goods. Namely, beef consumption affects pork consumption, but not poultry consumption. In the context of this, beef consumption will be affected by another meat. The relationship between meats will be discussed in this model.

Figure 4.21 shows all impulse responses of this model. Impulse responses of poultry consumption to a unit shock in beef consumption and impulse responses of poultry consumption to a unit shock in pork consumption were statistically significant, but others are not. Figure 4.22 explains the response for beef. As expected, a unit shock in pork consumption decreased beef consumption, and a unit shock in poultry consumption increased beef consumption during the first term, but the responses are not very sensitive. Pork consumption affects beef consumption more than poultry consumption. An unusual case in this model is that the responses became more sensitive as the time horizon increased.

Conclusions and Suggestions

In the graphical analyses, the changes in generic and brand advertising expenditure of beef, and per capita beef consumption showed lagged effects as other researchers found (Brester and Schroeder). These are compared with the case of brand pork and poultry advertising.

The sensitivity analyses were done using the six models in this study. The main focus was to see the factors and their relationships that affect beef consumption. The results are summarized as follow. The brand beef advertising is more effective than generic beef advertising when the case of generic and brand beef advertising was considered. Generic advertising doesn't affect beef consumption. However, all brand advertising increases beef consumption, and beef consumption responses were most sensitive to poultry advertising among brand advertising. In the relationships between meat prices, beef price itself decreased its consumption, but pork price increased beef consumption. In the model that combined advertising of beef and beef prices, beef consumption decreased in response to increased in beef prices and generic beef advertising, but it increased in respond an increased in brand beef advertising. For the relationships between meat consumption, beef consumption increased in response to a pork consumption decrease and poultry consumption increase.

It may be that the beef cattle industry needs more long-term planning to increase beef consumption. Brand beef advertising is better than generic advertising, and price policy should be considered also, because beef consumption is sensitive to its price.

This analysis used quarterly data on advertising expenditures, meat prices, and meat consumption. Many researchers used different time periods for their data sets, namely, monthly, quarterly, or yearly data are used for the studies. It seems that the shorter the time period, the better the results when the relationships between prices and consumption of meats are concerned. It may be possible to get weekly or monthly data of meat prices and consumption, however it is very difficult to get even quarterly data for meat advertising expenditures. In the impulse response analysis of this study, many impulse responses are not statistically significant. Data limitations may lead to the statistical insignificance for the impulse response. This should be a future study.

Table 4.1. Per Capita Meat Consumption for Selected Years Between 1960-1997 (lb)

YEAR	Beef	Pork	Poultry	Total
1960	68.4	60.8	34.1	163.3
1965	79.0	55.1	40.8	174.9
1970	87.1	55.8	48.6	191.5
1975	91.6	42.9	47.7	182.2
1976	97.7	45.5	51.1	194.3
1980	78.1	57.3	59.0	194.5
1985	81.0	51.9	65.7	198.6
1990	68.9	49.8	79.4	198.0
1995	67.1	52.5	89.1	208.7
1996	67.6	52.9	91.3	211.8
1997	65.7	47.8	94.2	207.7

Source: USDA, ERS, Livestock, Dairy, and Poultry Situation and Outlook, various issues.

Table 4.2. A Summary of Studies on Advertising Effects in Agricultural Products

Author(s)	Data	Products	Methods	Findings
Brester and Schroeder (1995)	Quarterly 1970-1993	Beef, Pork, Poultry	Rotterdam Model	Branded pork, and poultry advertising are significant. Branded beef, poultry advertising increase overall demand for meats. Brand and generic meat product advertising cause substitution among meat commodities.
Piggott, Chalfant, Alston, and Griffith (1996)	Quarterly 1978:3-1988:4	Beef, Lamb, Pork, and Chicken	AIDS	Advertising effects are not sensitive to functional form. Cross-commodity effects of advertising may be important. Negative effects of AMLC advertising on chicken. APC pork advertising does not have statistical significant.
Kinnucan, Xiao, Hsia, and Jackson (1997)	Quarterly 1976-1993	Beef, Pork, and Fish	SUR procedure	Poultry benefits from health information at the expense of beef, but pork and fish are unaffected. Advertising affects are sensitive to sample period.
Rhodes, and Abou-Bakr (1974)	Survey data in 1971	Beef, Pork, and Poultry	Variable Price Merchandi-sing	Advertised price cut was very much in some affiliate supermarket, but few in chain supermarket.
Capps and Schmitz (1991)	Monthly 1980-1988	Fluid milk	Semi-logarithmic functional form	Generic advertising expenditure generates rightward shifts in demand for fluid milk.
Ward and Dixon (1989)	Monthly 1984-1987	Fluid milk	Econometric model and simulation	Milk advertising increases milk sales.
Chang and Kinnucan (1991)	Quarterly 1973:2-1986:3	Butter	Conditional demand function formulation	Increased consumer awareness of health decreases butter consumption.
Green, Hoy, Carman, and McManus (1991)	Annual 1957-86	Californ-ia Figs, Prunes, and Raisins	AIDS	Generic advertising effects of the three dried fruits are weak when compared to price and total expenditure effects.

Table 4.2. A Summary of Studies on Advertising Effects in Agricultural Products (continued)

Reberte, Kaiser, Lenz, and Forker (1996)	Monthly 1986-1992	Fluid Milk	Time Varying parameters	Evidence of the dynamic behavior of sales response to generic advertising. Two campaigns differed considerably in effectiveness.
Pritchtt, Liu, and Kaiser (1998)	Quarterly 1975-1993	Milk	Optimal co-ntrol	Profits would have increased if funds had been reallocated from television to radio, print, and outdoor media outlets.
Kinnucan and Fearon (1986)	Panel and Annual data 1979-1981	Cheese	Econometric model	Incremental increases in generic advertising are 2.8 times more effective than incremental increases in brand advertising at increasing sale.
Kinnucan and Belleza (1995)	Quarterly 1973:1-1988:4	Fluid Milk	Equilibrium-displacement Model	Increased advertising of fluid milk enhances the farm value of milk but has minimal effect on government costs of the dairy price-support program,
Capps and Lambregts (1991)	Scanner data	Finfish and Shellfi-sh	Demand analysis	Own-advertisement elasticities are positive but very inelastic.
Lee (1981)	Quarterly 1971:1-1978:2	Florida Grape-fruit Juice	Structural Model	Given the costs to the industry, media advertising would be more profitable than would an FOB price reduction.
Hall and Foik (1983)	Monthly 1976-1979	Yogurt	Polynomial distributed lag model	Brand advertisement is more than twice as effective as generic in increasing per capita consumption demand in yogurt
Kinnucan and Forker (1986)	Monthly 1971-1980	Fluid Milk	Double-log Model	Fluid milk advertising improves statistical significance.
Goddard and Amush (1989)	Quarterly 1973-1986	Butter, Margari-ne, shorteni-ng, and vegeta-ble oils	Two-stage Demand Model	The demand for individual fats and oils is significantly affected by lagged advertising expenditure.

Table 4.3. The Augmented Dickey-Fuller (ADF) Tests for Nonstationarity of the Time-Series (Level)

Variable	Coefficient	Std. Error	T-Stat	Signif. level
BC	-0.002071359	0.002057655	-1.00666	0.31783086
PKC	-0.001901960	0.003257747	-0.58383	0.56135747
PLC	0.0073761374	0.0024448478	3.01701	0.00364171***
BP	-0.008792333	0.002667605	-3.29597	0.00159149***
PKP	-0.003009958	0.004395059	-0.68485	0.49587315
PLP	-0.006374554	0.005686838	-1.12093	0.26644145
GB	-0.103395961	0.057474568	-1.79899	0.07666324*
GPK	-0.137167331	0.063466480	-2.16126	0.03436480**
BB	-0.096249928	0.051110725	-1.88316	0.06415368*
BPK	-0.026700340	0.025329572	-1.05412	0.29573186
BPL	-0.022112392	0.025006983	-0.88425	0.37982112

Note: Significance levels are denoted as follows: ***=0.01, **=0.05, and *=0.10.

Table 4.4. The Results of Augmented Dickey-Fuller (ADF) Tests for One Difference Data

Variable	Coefficient	Std. Error	T-Stat	Signif. level
BC	-1.256682616	0.120315895	-10.44486	0.00000000***
PKC	-1.000496966	0.124593905	-8.03006	0.00000000***
PLC	-1.124792193	0.123561226	-9.10312	0.00000000***
BP	-0.951329718	0.109725667	-8.67007	0.00000000***
PKP	-0.725607823	0.116029913	-6.25363	0.00000004***
PLP	-0.897676794	0.118299132	-7.58819	0.00000000***
GB	-1.229994813	0.121864103	-10.09317	0.00000000***
GPK	-1.656630820	0.095943776	-17.26668	0.00000000***
BB	-1.354216531	0.116503330	-11.62384	0.00000000***
BPK	-1.331555220	0.122629886	-10.85833	0.00000000***
BPL	-1.405915794	0.114029695	-12.32938	0.00000000***

Note: Significance levels are denoted as follows: ***=0.01, **=0.05, and *=0.10.

Table 4.5. Tests Results of Lag-Length (L-L) Selection

Model	VAR	AIC	SBC	LR Test	Selected L-L
1	[BC, GB, BB]	7	1	1	1
2	[BC, GB, GPK]	A	1	3	1
3	[BC, BB, BPK, BPL]	5	1	1	1
4	[BC, BP, PKP, PLP]	A	1	2	1
5	[BC, BP, GB, BB]	6	1	3	1
6	[BC, PKC, PLC]	5	1	1	1

Note: A means ambiguous.

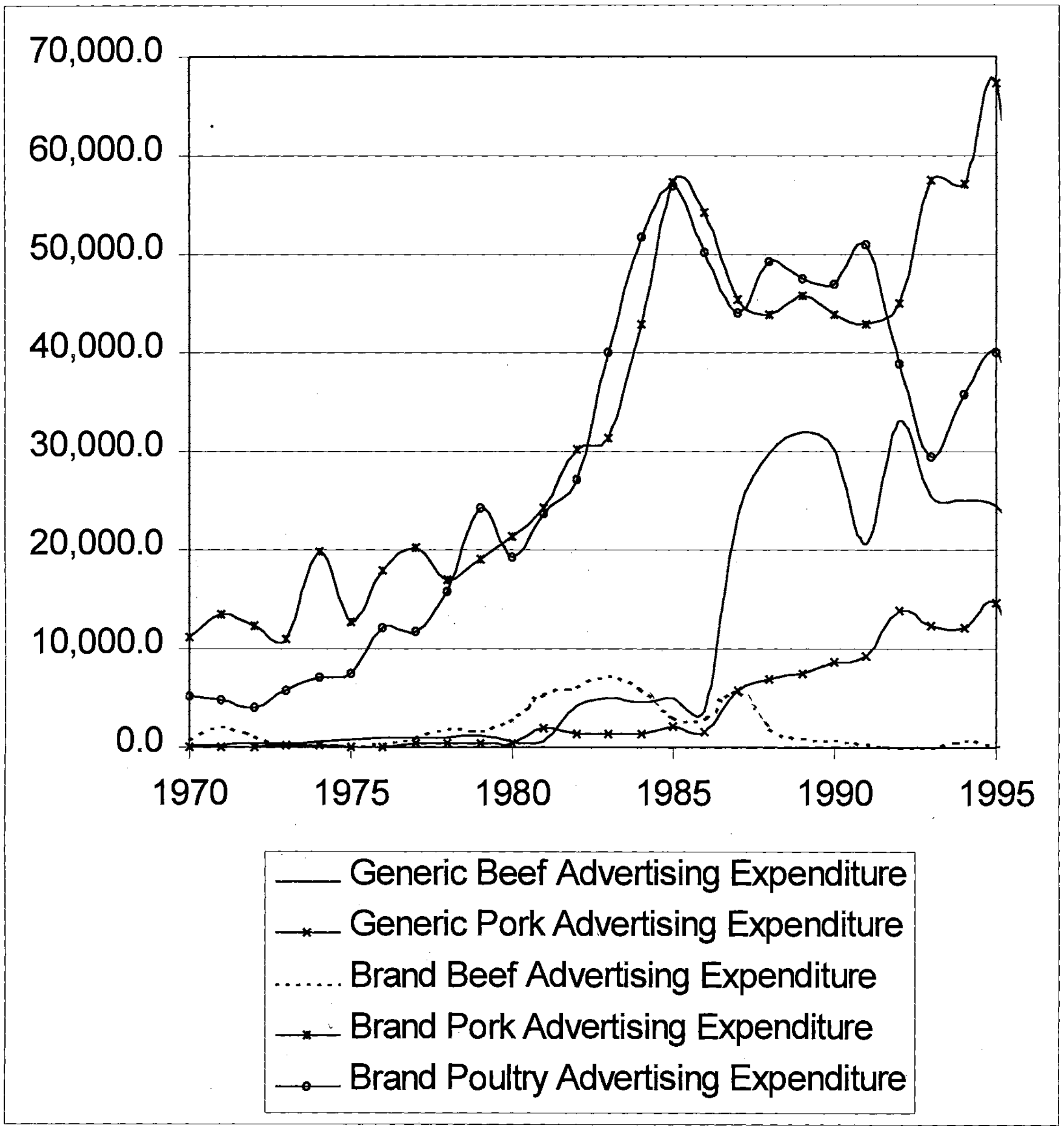

Figure 4.1. Advertising Expenditure for Each Meat between 1970-1995 (Real Data)

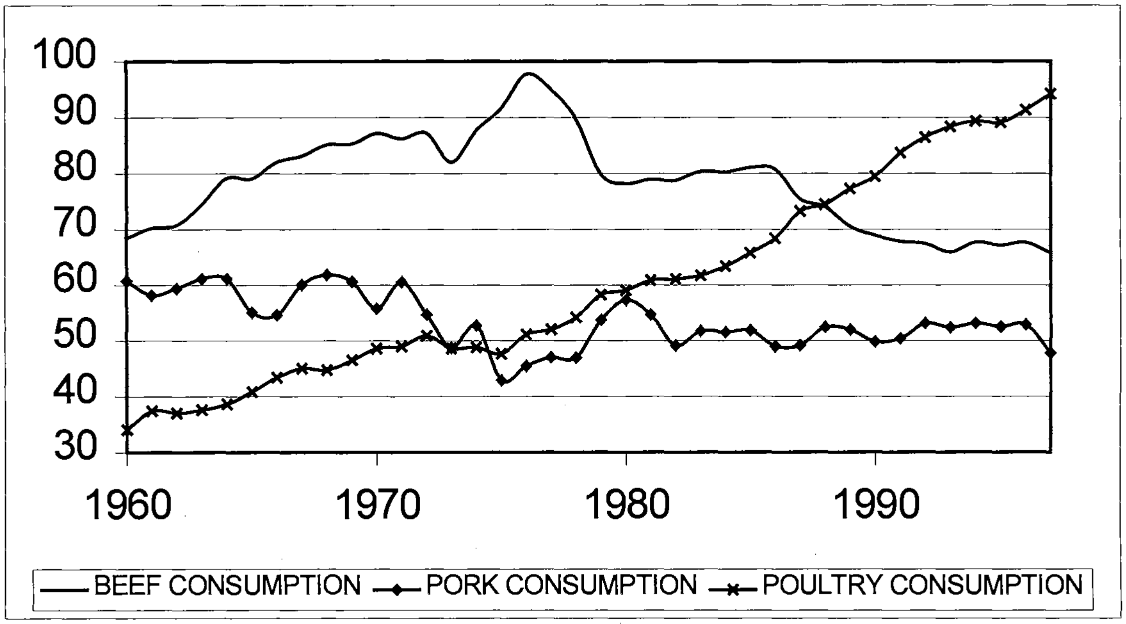

Figure 4.2. Per Capita Consumption of Meats between 1960-1997

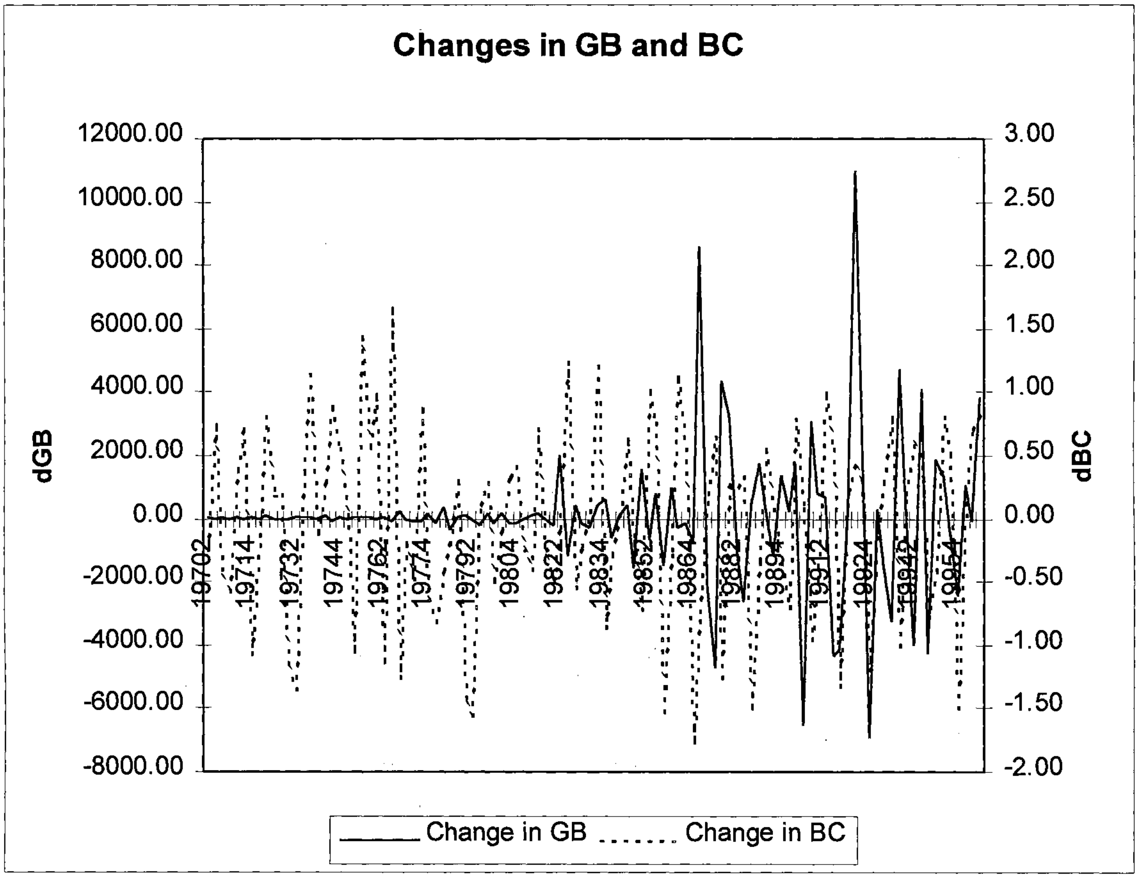

Figure 4.3. Changes in Generic Advertising Expenditure for Beef (GB) and Per Capita Beef Consumption (BC) of Real Data during 1970-1996

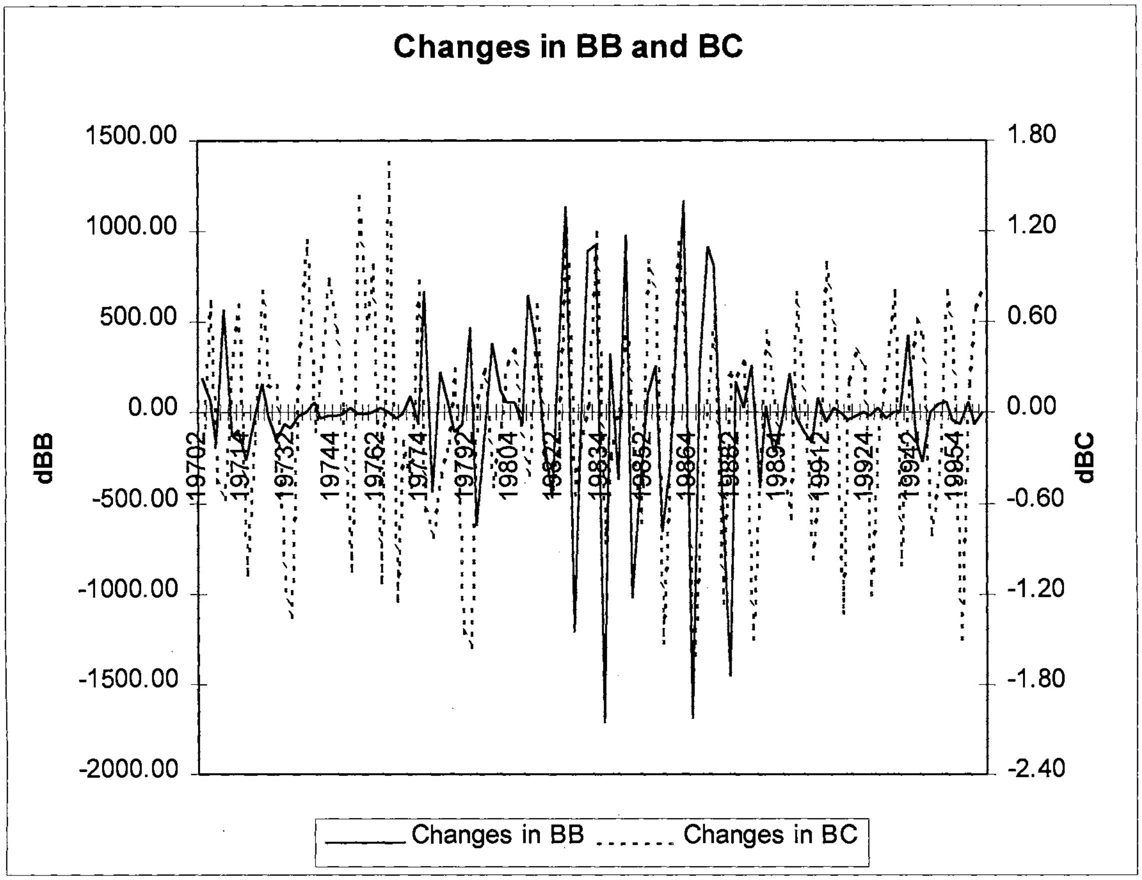

Figure 4.4. Changes in Brand Advertising Expenditure for beef (BB) and Per Capita Beef Consumption (BC) of Real Data during 1970-1996

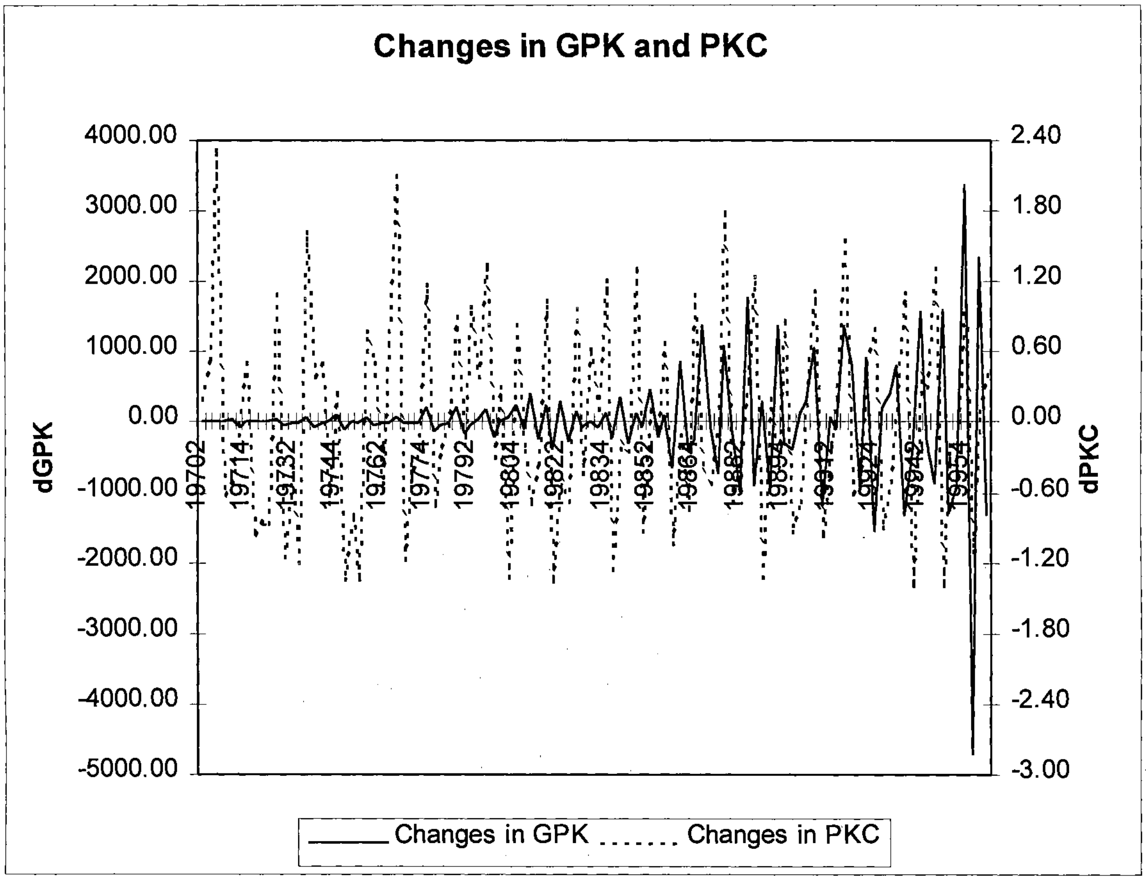

Figure 4.5. Changes in Generic Advertising Expenditure for Pork (GPK) and Per Capita Pork Consumption (GPK) of Real Data during 1970-1996

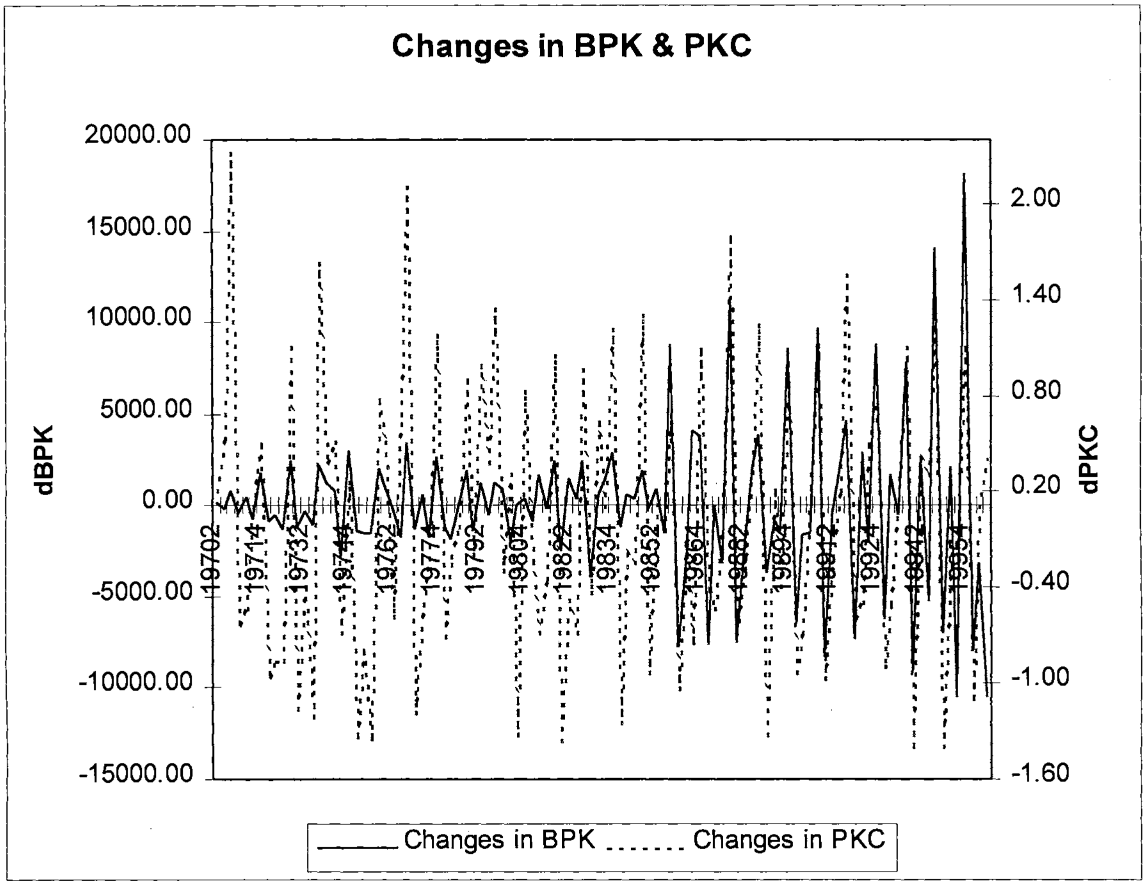

Figure 4.6. Changes in Brand Advertising Expenditure for Pork (BPK) and Per Capita Pork Consumption (PKC) of Real Data during 1970-1996

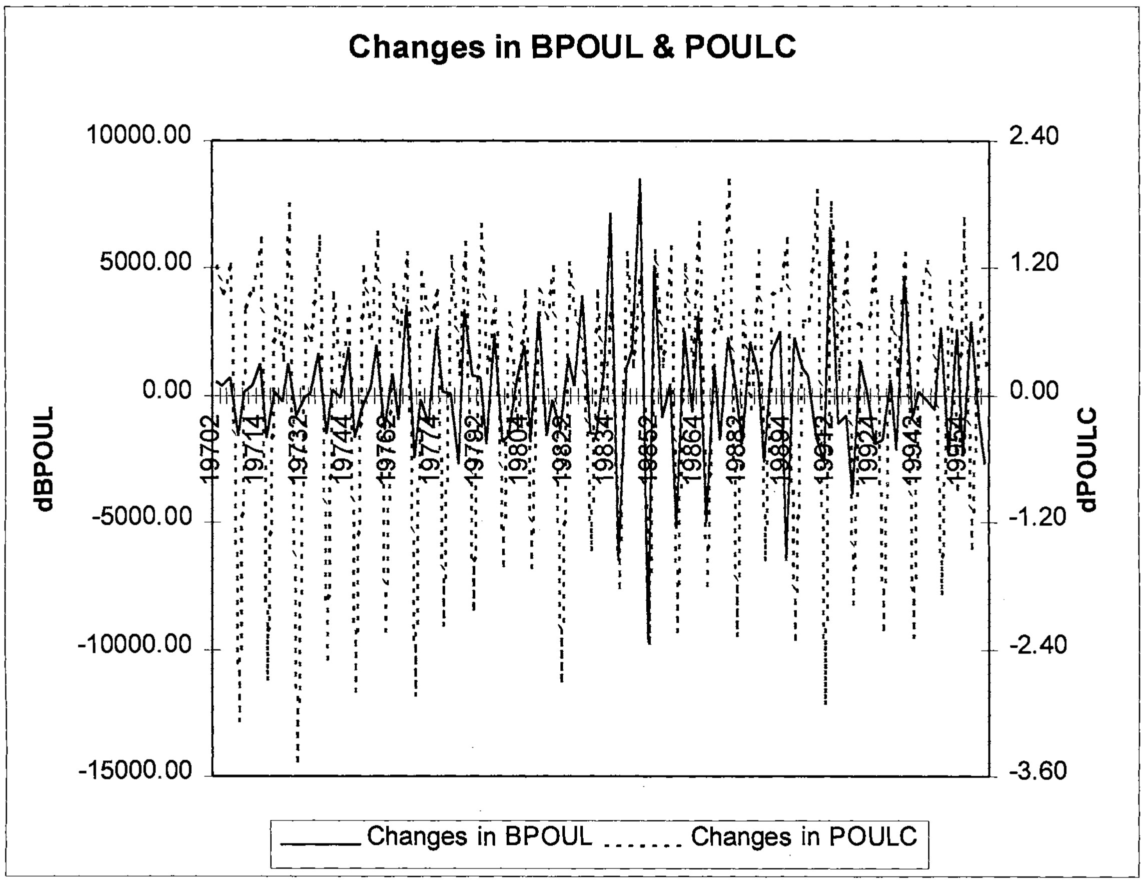

Figure 4.7. Changes in Brand Advertising Expenditure for Poultry (BPOUL) and Per Capita Poultry Consumption (POULC) of Real Data during 1970-1996

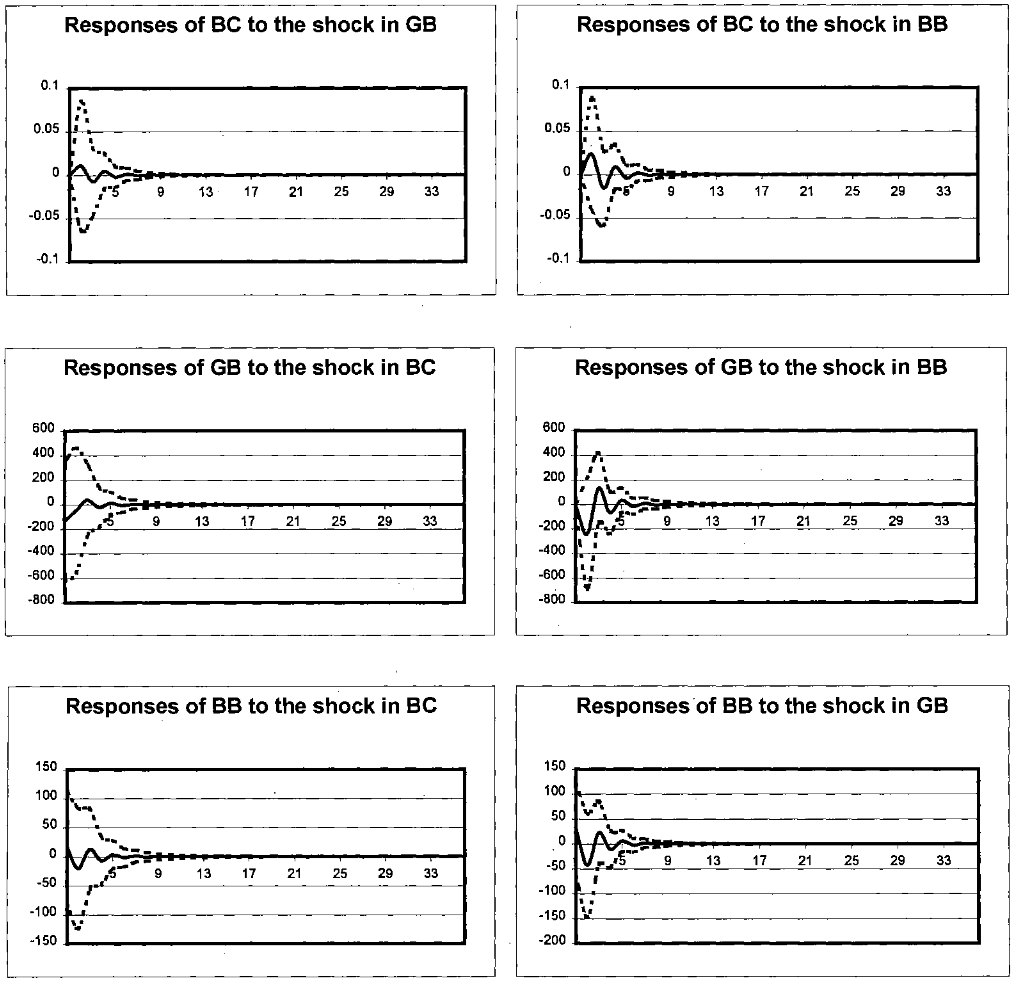

Figure 4.8. Impulse Responses of Model 1

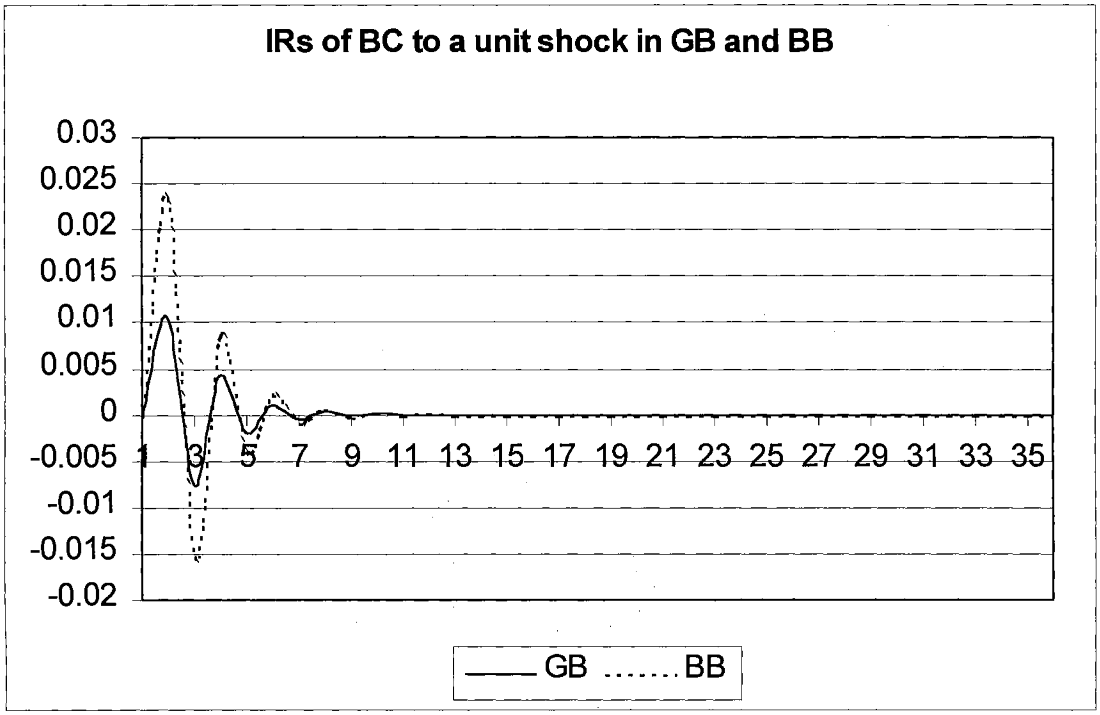

Figure 4.9. Impulse Responses of Beef Consumption (BC) to Unit Shocks in Generic Beef Advertising (GB) and Brand Beef Advertising (BB)

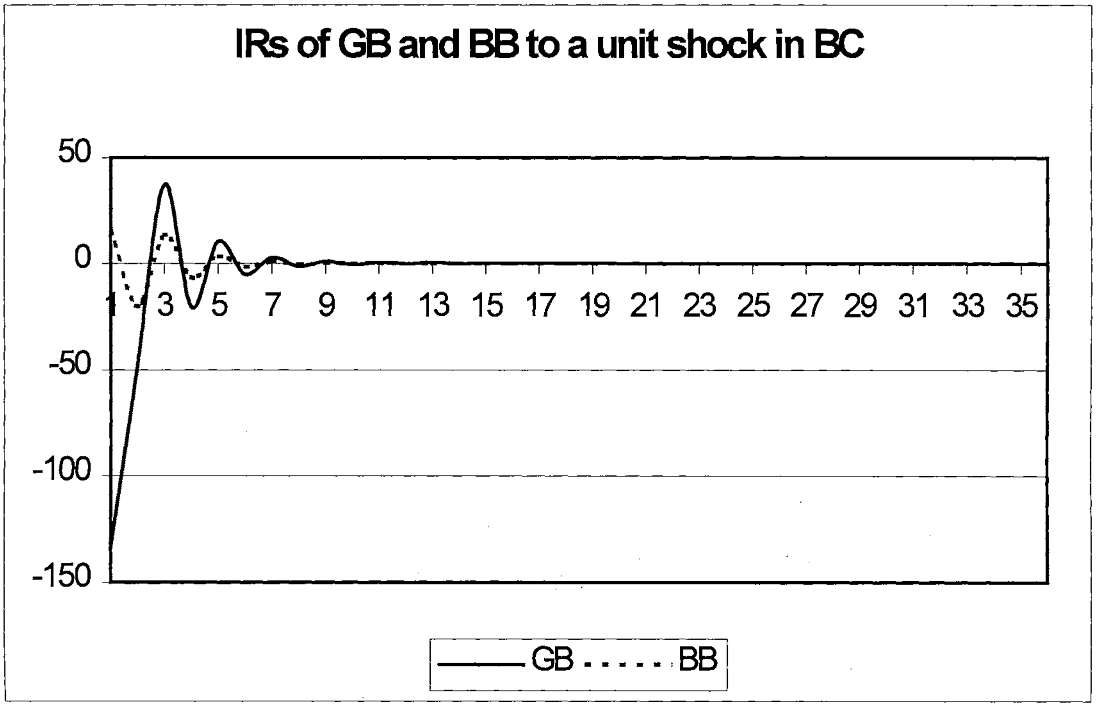

Figure 4.10. Impulse Responses of Generic Beef advertising (GB) and Brand Beef Advertising (BB) to a Unit Shock in Beef Consumption (BC)

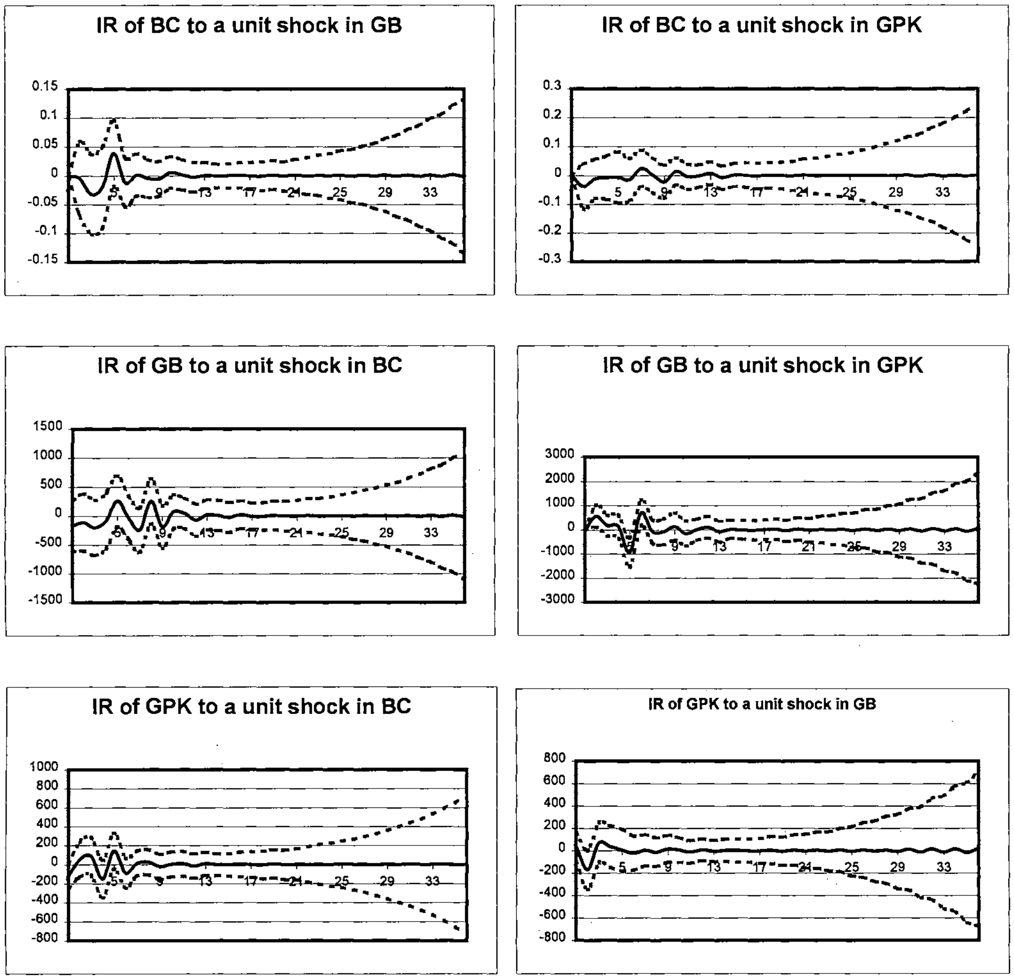

Figure 4.11. Impulse Responses of Model 2

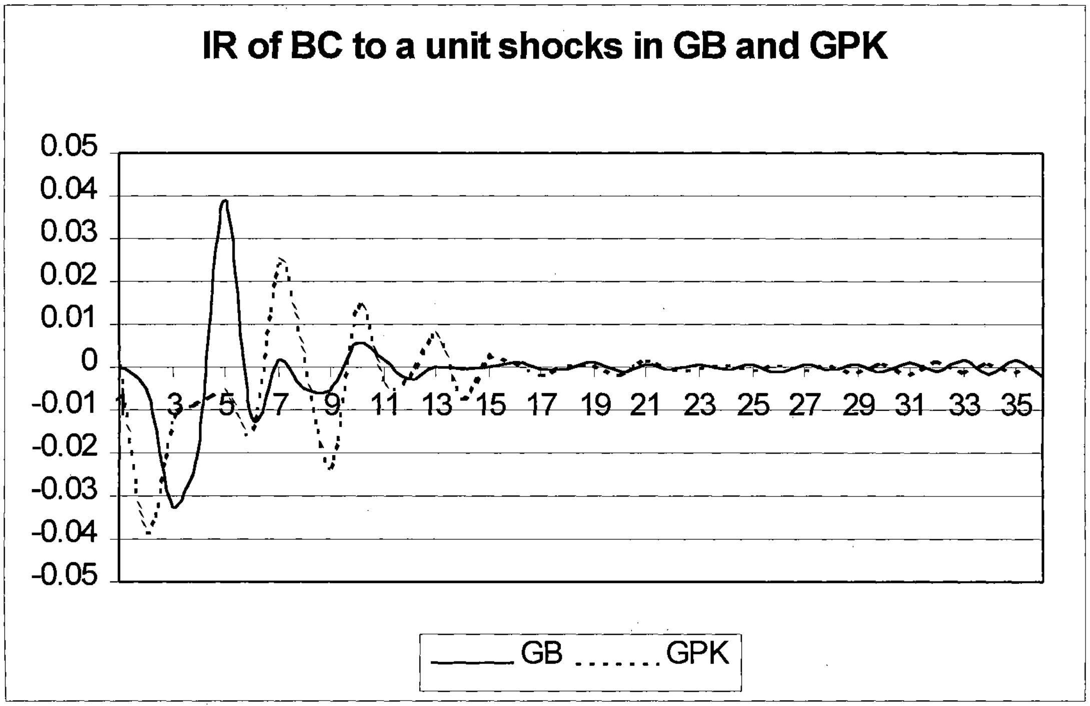

Figure 4.12. Impulse Responses of Beef Consumption (BC) to a Unit Shocks in Generic Beef Advertising (GB) and Generic Pork Advertising (GPK)

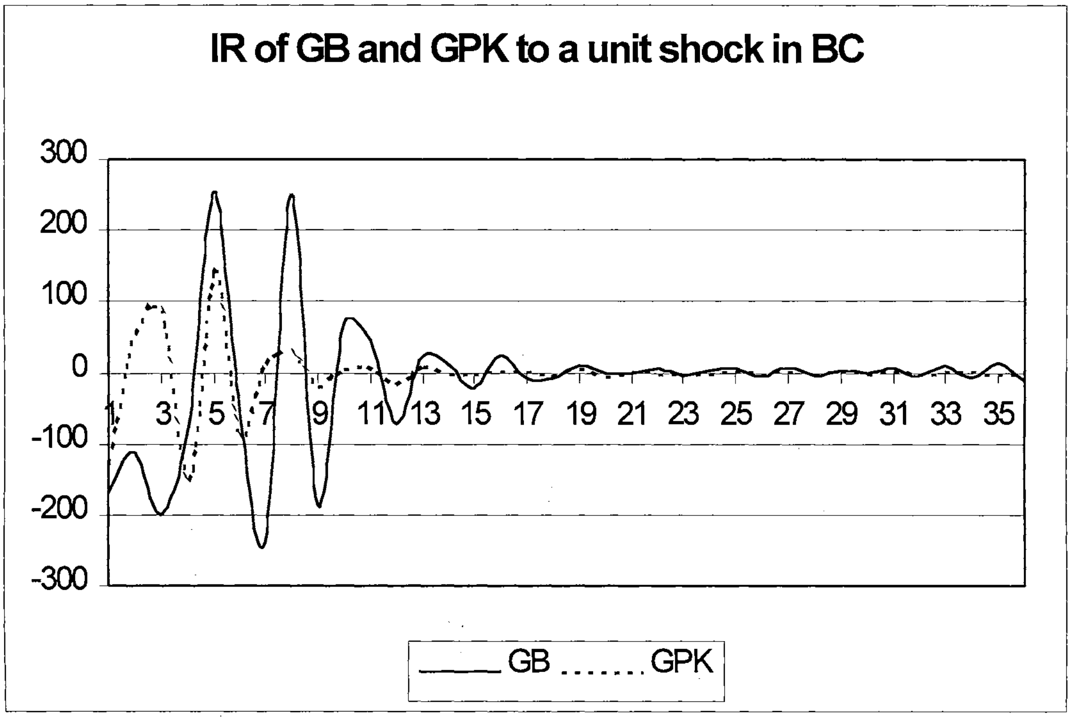

Figure 4.13. Impulse Responses of Generic Beef Advertising (GB) and Generic Pork Advertising (GPK) to a Unit Shock in Beef Consumption (BC)

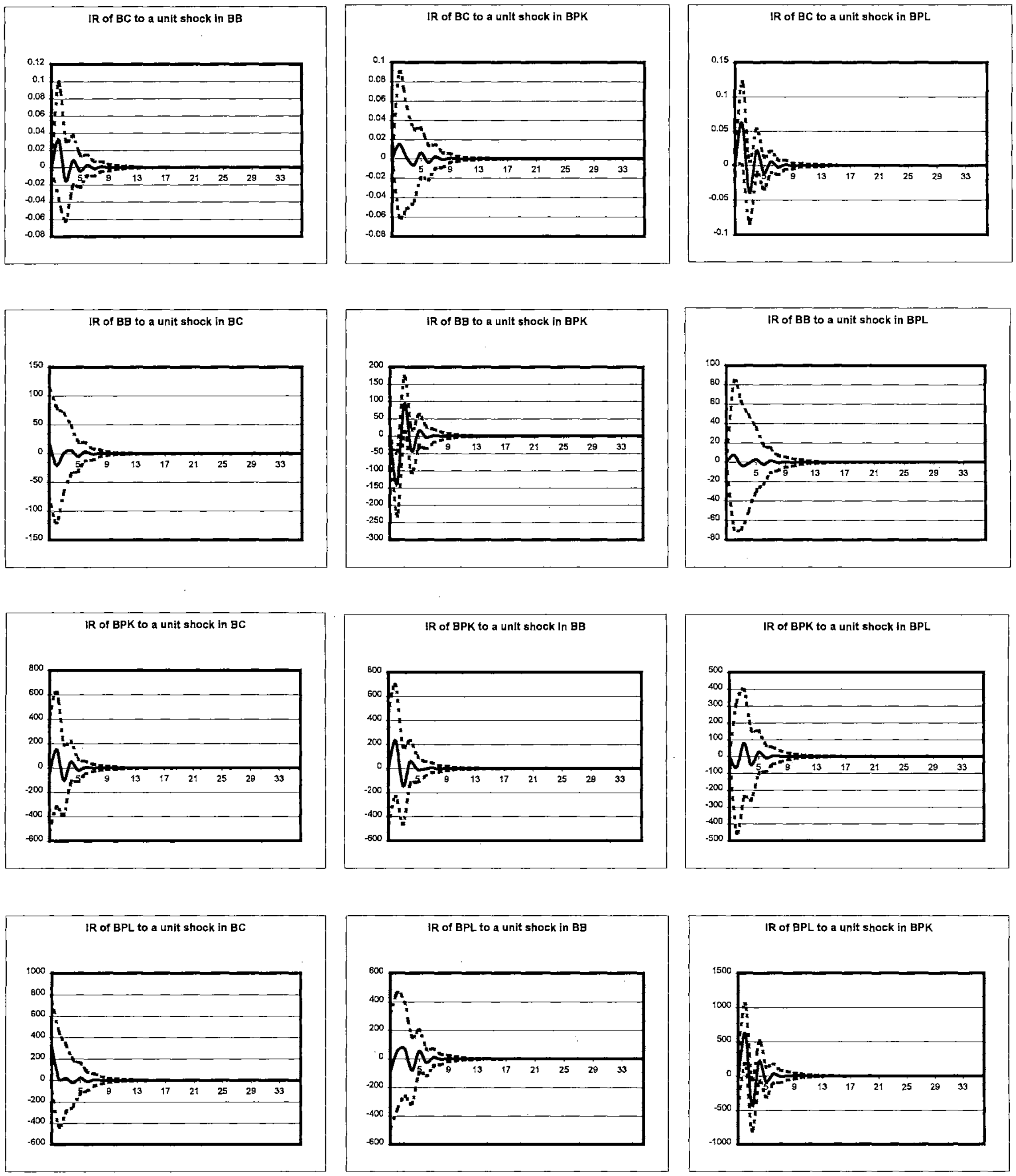

Figure 4.14. Impulse Responses of Model 3

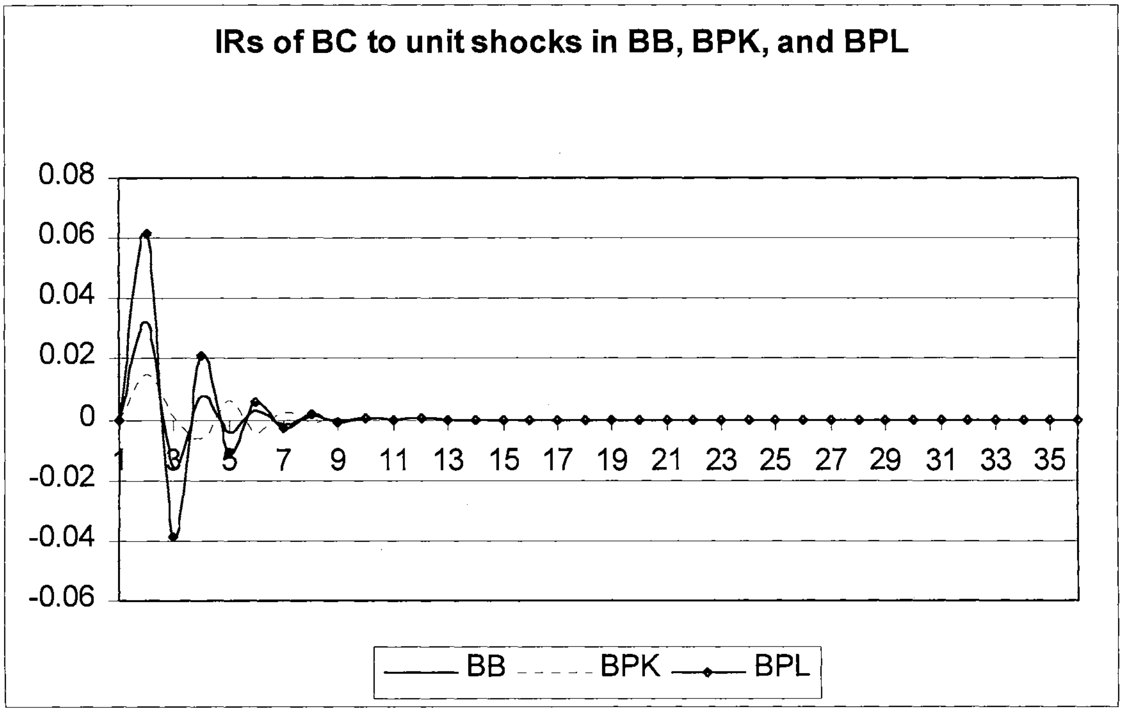

Figure 4.15. Impulse Responses of Beef Consumption (BC) to Unit Shocks in Brand Beef Advertising (BB), Brand Pork Advertising (BPK), and Brand Poultry Advertising (BPL)

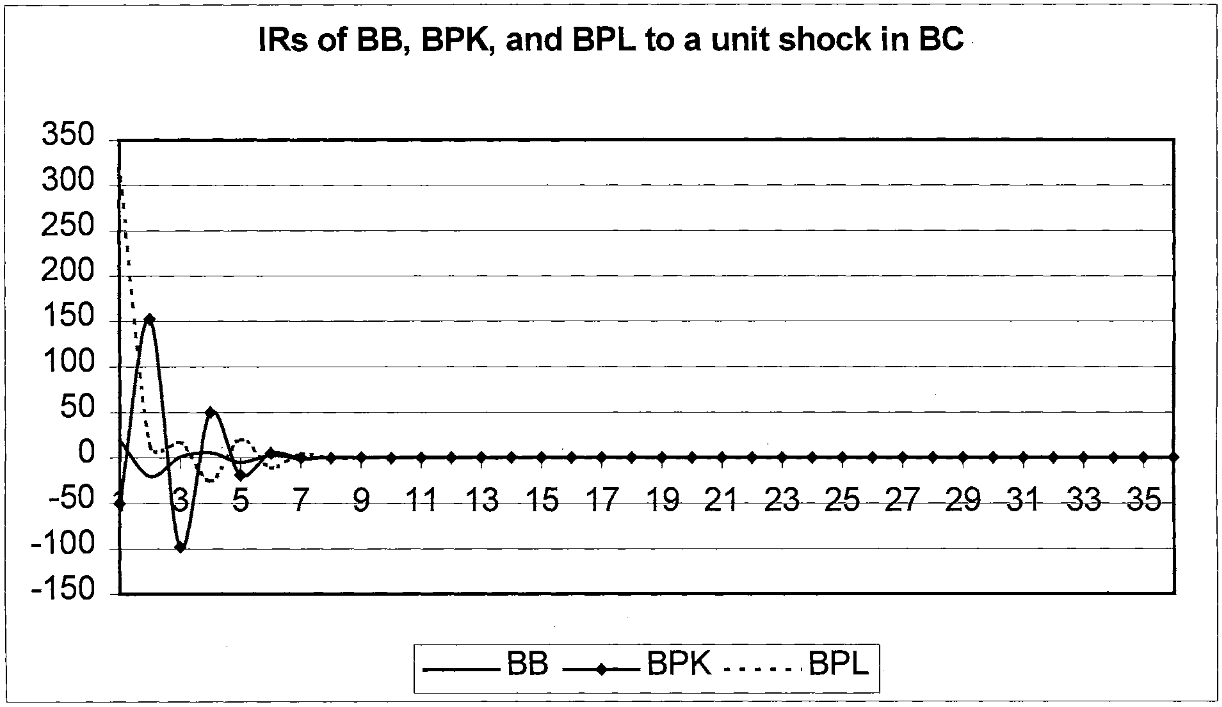

Figure 4.16. Impulse Responses of Brand Beef Advertising (BB), Brand Pork Advertising (BPK), and Brand Poultry Advertising (BPL) to a Unit Shock in Beef Consumption (BC)

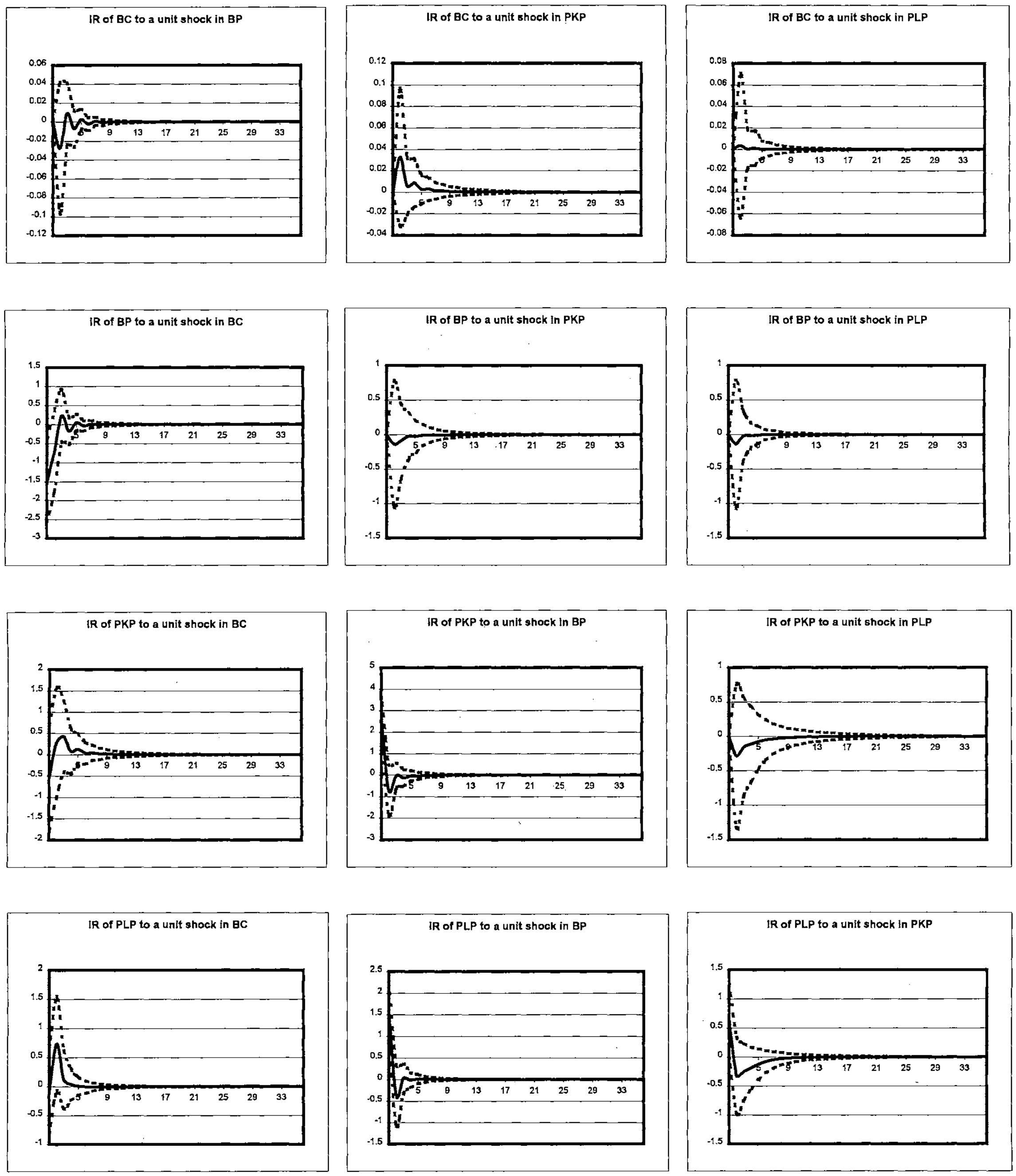

Figure 4.17. Impulse Responses of Model 4

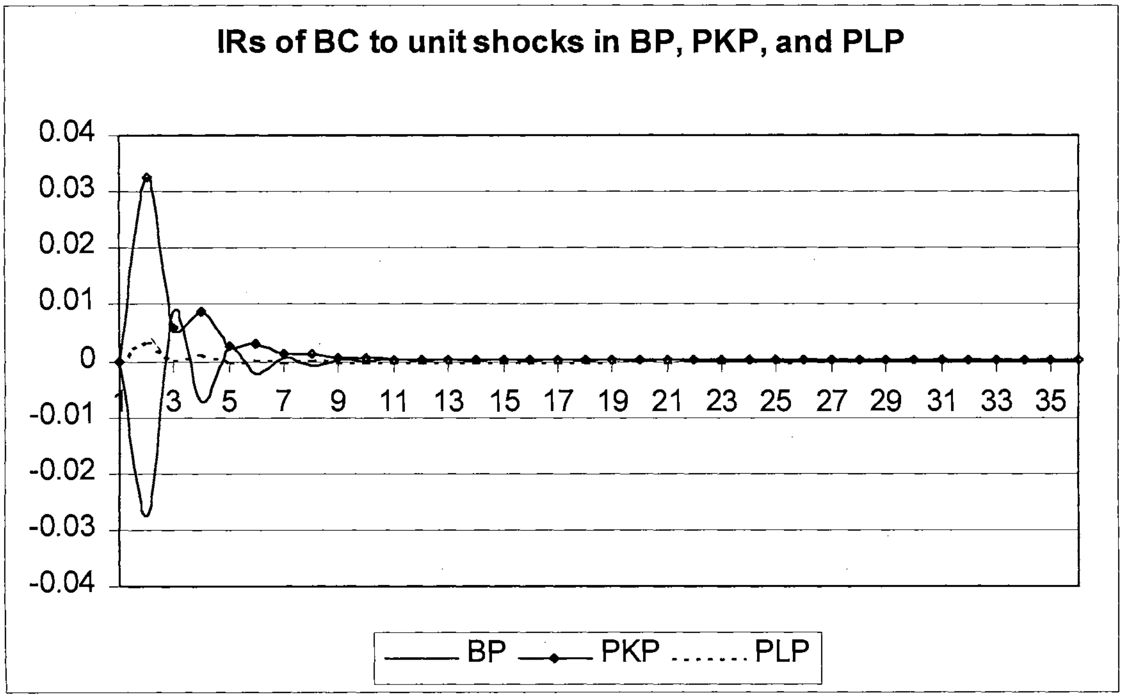

Figure 4.18. Impulse Responses of Beef Consumption (BC) to a Unit Shock in Beef Price (BP), Pork Price (PKP), and Poultry Price (PLP)

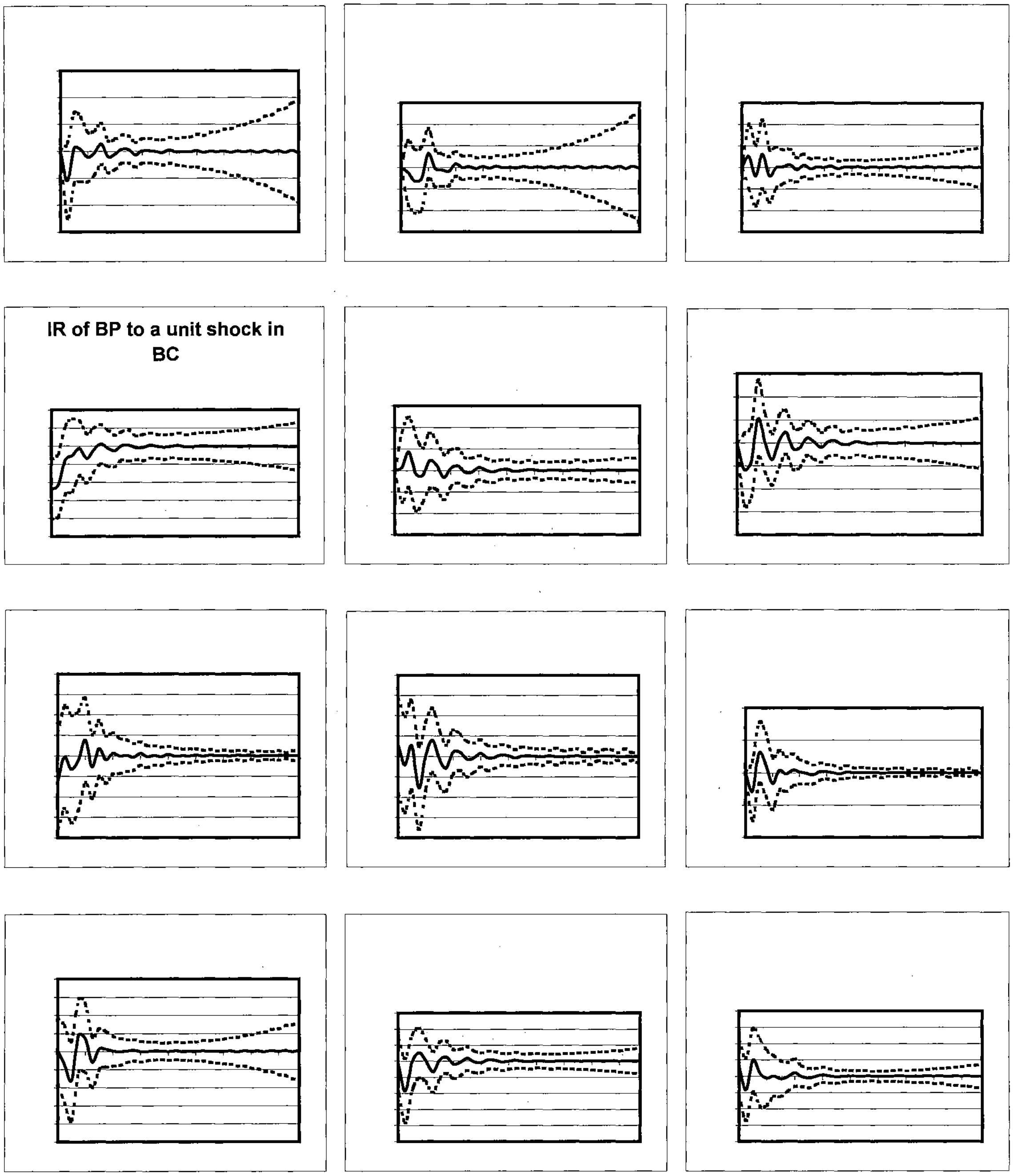

Figure 4.19. Impulse Responses of Model 5

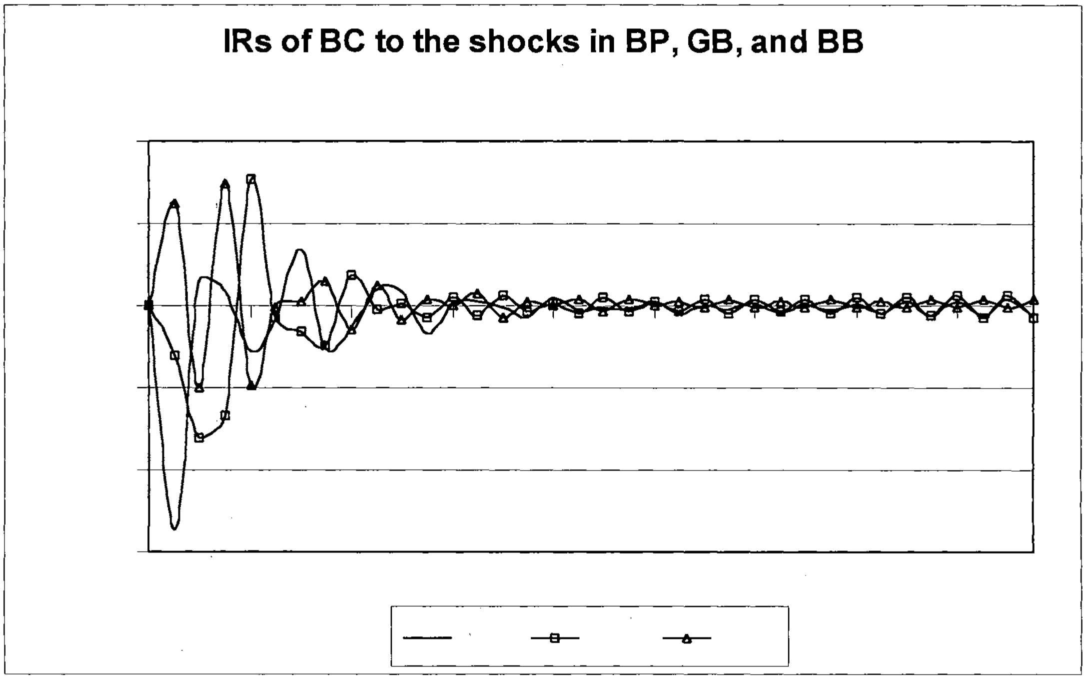

Figure 4.20. Impulse Responses of Beef Consumption (BC) to Unit Shocks in Beef Price (BP), Generic Beef Advertising (GB), and Brand Beef Advertising (BB)

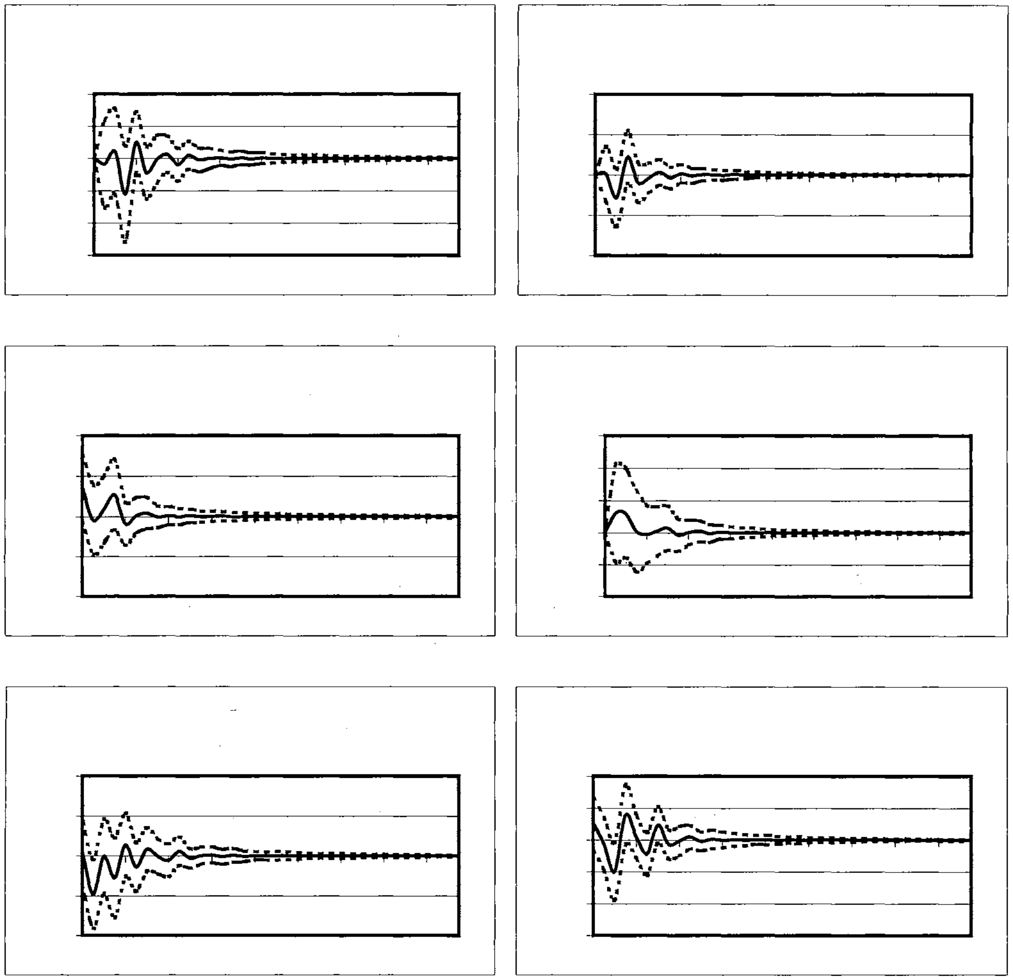

Figure 4.21. Impulse Responses of Model 6

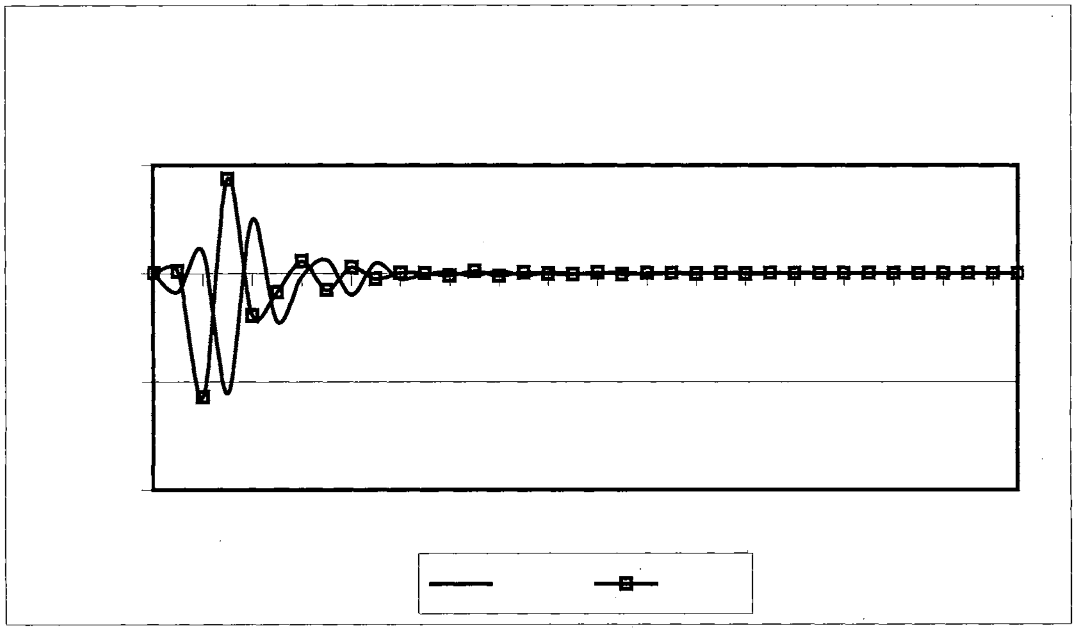

Figure 4.22. Impulse Responses of Beef Consumption (BC) to Unit Shocks in Pork Consumption (PKC) and Poultry Consumption (PLC)

CHAPTER V

Conclusions

Grid pricing, merger effects, and advertising effects in the beef and cattle industry were covered in this paper. Grid pricing examined the variability of cattle prices, merger effects measured the impacts from mergers and acquisitions in an experimental market, and advertising effects compared the effects between advertising methods, prices, and meat consumption.

Chapter two was intended to examine the variability in grid pricing that can occur within a given day or week for a given set of cattle. Data for one day's slaughter from four plants revealed considerable variation in cattle brought to slaughter by cattle feeders. The variability is only one element of the broader problem the industry faces regarding quality and consistency of final products for consumers.

Several sources of variation exist in grid pricing. Base prices can vary $2/dressed cwt, or $15/head, whether using plant average or formulas tied to reported cash-market prices. Prices across grids can add another $2-4/cwt of variation, another $15 to $30/head. In addition, variation is found in carcass characteristics such as Select and Standard carcasses, Yield grade 4-5 carcasses, light and heavy carcasses, and non-conforming or "out" carcasses.

Grid pricing is a step towards value-based pricing when used correctly. Cattlemen can learn much about the cattle they market with grid pricing and can then use the information to make genetic and management improvements.

The central focus of chapter three was on impacts that resulted from the merger of two of the four meatpacking firms; the two smaller firms in one case (Firm A) and the two larger firms in another (Firm B). Some behavioral differences were noted during the mergers compared with preceding and following periods, however no clear changes were observed. During the merger period for both firms, market prices were significantly higher than prior to the merger and significantly higher compared with the post-merger period for one firm. For both merger periods, profits of the merged firm exceeded profits of their rival firms. Some behavioral differences were noted between the two merger experiments that contributed to the findings.

The *FCMS* data are similar to real world data, and econometrics models were used to estimate the merger effects. The results suggest that mergers may have positive, short-run impacts on market prices. However, the data has limitations like the length of the experimental periods. Perhaps more than ten weeks is required for the merged firms to recognize their potential market power and use it to adversely affect transaction prices. This should be a future study.

Chapter four explained the effects of advertising for beef. In the graphical analyses, the changes in generic and brand advertising expenditure of beef, and per capita beef consumption showed lagged effects as other researchers found.

For the results of impulse responses, the brand beef advertising is more effective than generic beef advertising when the case of generic and brand beef advertising was considered. Generic advertising doesn't affect beef consumption. However, all brand advertising increases beef consumption, and beef consumption responds most sensitively to poultry advertising among brand advertising.

In the relationships between meat prices, beef price itself decreased its consumption, but pork price increased beef consumption. For the relationships between meat consumption, beef consumption increased in respond to a pork consumption decrease and poultry consumption increase.

This analysis used quarterly data on advertising expenditures, meat prices, and meat consumption. A shorter data period may give better results. This should be a future study also.

REFERENCES

Chapter I

USDA, Agricultural Statistics Board, National Agricultural Statistics Service, *Meat Animals Production, Disposition, and Income: Final Estimates by State, 1993-97*, Statistical Bulletin No. 959, http://usda.mannlib.cornell.edu.

Chapter II

Brorsen, B.W., J.T. Akridge, M.A. Boland, S. Mauney, and J.C. Forrest. "Performance of alternative component pricing system for pork." *Journal of Agricultural and Applied Economics* 30(December 1998): 313-324.

Dhuyvetter, K.C., T.C. Schroeder, D.D. Simms, Ronald P. Bolze Jr., and Jeremy Geske. "Determinants of Purebred Beef Bull Price Differences." *Journal of Agricultural and Resource Economics* 21(2) (1996): 396-410.

Fausti, S.W. and B.A. Qasmi. "Grid Pricing versus Average Pricing for Slaughter Cattle: An Empirical Analysis." Presented at *Western Agricultural Economics Association Annual Meeting*, Fargo, ND, July 11-14, 1999.

Feuz, D.M, S.W. Fausti, and J.J. Wagner. "Analysis of the Efficiency of Four Marketing Methods for Slaughter Cattle." *Agribusiness*. 9-5(1993):453-463.

Feuz, D.M. "Live, In-the-Beef, or Formula: Is there a "Best" Method for selling Fed Cattle?" Selected Paper presented at the Western Agricultural Economics Association Annual Meeting, Reno Nevada, July 1997.

Feuz, D.M. "Market Signals in Value Based Pricing Premiums and Discounts." Presented at *Western Agricultural Economics Association Annual Meeting*, Fargo, ND, July 11-14, 1999.

Grain Inspection, Packers and Stockyards Administration. *Packers and Stockyards Statistical Report: 1997 Reporting Year*. U.S. Department of Agriculture, Washington DC, June 1999.

Jacobson, R.E. and F.E. Walker. "Efficiency Considerations in Butterfat Differential and Component Pricing of Milk." *American Journal of Agricultural Economics* (May 1973): 214-16.

Jones, R., T.C. Schroeder, J. Mintert, and F. Brazle. " The Impacts of Quality on Cash Fed Cattle Prices." *Southern Journal of Agricultural Economics* (December, 1992):149-162.

Lenz, J.E., R.C. Mittelhammer and J.K. Hillers. "Pricing Milk Components at Retail via Hedonic Analysis." *Journal of Dairy Science* 74(No. 6, 1991): 1803-1814.

Livestock, Meat and Wool Weekly Summary and Statistics. AMS-USDA.

National Carcass Premiums and Discounts for Slaughter Steer and Heifers. AMS-USDA.

Packers and Stockyards Administration. "Packers and Stockyards Statistical Report, 1990 Reporting Year." P&S Statis. Rep. No. 92-1, U.S. Department of Agriculture, Washington, DC, November 1992.

Parcell, J.L., T.C. Schroeder and F.D. Hiner. "Determinants of Cow-Calf Pair Prices." *Journal of Agricultural and Resource Economics* 20(2) (1995): 328-340.

Perrin, R.K. "Component pricing of soybeans and milk." *American Journal of Agricultural Economics* 62(August 1980): 445-55.

Schreoder, T.C., C.E. Ward, J. Mintert, and D.S. Peel. "Beef Industry Price Discovery: A Look Ahead." *Price Discovery in Concentrated Livestock Markets*: Issues, Answers, Future Direction. W.D. Purcell, ed. Blacksburg, VA: Research Institute on Livestock Pricing, February 1997.

Schroeder, T.C. "Fed Cattle Price Grids: What's your Critter Worth?" Cattle Profitability Conference. Kansas State University, Manhattan, August 1997.

Schroeder, T.C. and J.L. Graff. "Grid Pricing: Valuing Cattle Quality Information." Presented at *Western Agricultural Economics Association Annual Meeting*, Fargo, ND, July 11-14, 1999.

Updaw, N.J. "Social Costs and Benefits from Component Pricing of Soybeans in the United States." *American Journal of Agricultural Economics* (November 1980): 645-655.

Ward, C.E. "Market Structure Dynamics in the Livestock-Meat Subsector: Implications for Pricing and Price Reporting." In *Key Issues in Livestock Pricing: A Perspective for the 1990's*, W. Purcell and J. Rowsell Eds., Blacksburg, VA: Research Institute in Livestock Pricing (1987): 8-53.

Ward, C.E., T.C. Schroeder, and D.M. Feuz. Fed Cattle Pricing: Live Weight and Dressed Weight. Oklahoma State University Extension Facts WF-556, June 1998a.

Ward, C.E., T.C. Schroeder, and D.M. Feuz. Fed Cattle Pricing: Founds and Grids. Oklahoma State University Extension Facts WF-557, June 1998b.

Chapter III

Anderson, J.D. *Dynamic Price Adjustment, Price Discovery, and Vertical Coordination in Cattle Markets*. Ph.D. thesis. Oklahoma State University. Stillwater, OK: 1998.

Anderson, J.D., C.E. Ward, S.R. Koontz, D.S. Peel, and J.N. Trapp. "Experimental Simulation of Public Information Impacts on Price Discovery and Marketing Efficiency in the Fed Cattle Market." *Journal of Agricultural and Resource Economics* 23(1998):262-278.

Azzam, A.M. and J. R. Schroeder. "The Tradeoff Between Oligopsony Power and Cost Efficiency in Horizontal Consolidation: An Example from Beef Packing." *American Journal of Agricultural Economics* 77(November 1995):825-836.

Bacon, K.J., J. Trapp, and S. R. Koontz. "Modeling and Forecasting Short-Run Fed Cattle Slaughter." *Proceeding of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management*, M.L. Hayenga, ed. Ames, IA: Iowa State University, April 1992.

Carlton, D.W. "Contract, Price Rigidity, and Market Equilibrium." *Journal of Political Economy*. 87(1979):1034-1062.

Carlton, D.W., and J.M. Perloff, *Modern Industrial Organization*, 2nd ed, New York: Harper Collins College Publishers, 1994.

Caswell, J.A. "Aggregated Concentration: Significance, Trends, and Causes." *Issues After a Century of Federal competition Policy* R.L. Wills, J.A. Caswell and J. Culbertson, eds. Lexington, MA: Lexington Books, 1987.

Choi, S-C. *Essays in Agribusiness: Price-Reporting Accuracy, Vertical Coordination, and Ethnic Food Marketing*. Ph.D. thesis. Oklahoma State University. Stillwater, OK: 1998.

Connor, J.M., and F.E. Geithman "Mergers in the food industries: Trends, motives, and policies," *Agribusiness* 4(4, 1988):331-346.

Federal Trade Commission. "Conglomerate merger performance: An empirical analysis of nine corporations." *Staff report, FTC,* Washington, DC, February 1972.

Friedman, D, and S. Sunder. *Experimental Methods: A Primer for Economists*. New York: Cambridge University Press, 1994.

Hill, R.C. *Learning and Practicing Econometrics: SAS Handbook*. Wiley, John & Sons, Incorporated. New York, 1993.

Hunnicutt, L. and Q. Weninger. "Market Power in Beef Packing: Where Are We and

What's Next?" *Research Bulletin 7-99*, Blacksburg, VA: Research Institute in Livestock Pricing, August 1999.

Judge, G.G., R.C. Hill, W.E. Griffiths, H. Lütkepohl, and T-C Lee. *Introduction to the theory and Practice of Econometrics*. Second Edition. Wiley, John & Sons, Incorporated. New York, 1988.

Koontz, S.R., P. Garcia, and M.A. Hudson. "Meatpacker Conduct in Fed Cattle Pricing: An Investigation of Oligopsony Power." *American Journal of Agricultural Economics* 75(1993):537-548.

Lichtenberg, F.R., and D. Siegel. "Productivity and Changes in Ownership of Manufacturing Plants." *Brookings Papers on Economic Activity* 3(1987):643-683.

MacDonald, J.M. "The microdynamics of structural change: Patterns of merger and diversification activity among food manufacturers," *Agribusiness* 4(2, 1988):143-156.

Marion, B.W. "Restructuring of Meat Packing Industries; Implications for Farmers and Consumers." *Food System Research group Working Paper 2*, University of Wisconsin-Madison, December 1988.

Marion, B.W. and D. Kim. "Concentration Change in Selected Food Manufacturing Industries: The Influence of Mergers vs. Internal Growth." *Agribusiness: An International Journal* 7(September 1991): 415-431.

Mueller, W.F. "Conglomerates: A 'non-industry." *The Structure of American Industry.* Sixth Ed., Macmillian, New York, 1982.

Ravenscraft, D.J., and F.M. Scherer. "Mergers, sell-offs, and Economic Efficiency." *Washington: Brookings Institution*, 1987.

Scherer, F.M. "Corporate Takeovers: The Efficiency Arguments." *Journal of Economics Perspectives* 2(1988):69-82.

Schroeder, J. "Estimation the Degree of Market Power in the Beef Packing Industry." *Review of Economics and Statistics* 69(1987):158-162.

Schroeder, J., and A.M. Azzam. "Measuring Market Power in Multi-Product Oligopolies: The U.S. Meat industry." *Applied Economics* 22(1990):1365-1376.

Schroeder, T.C, R. Jones, J. Mintert, and A.P. Barkley. "The Impacts of Forward Contracting on Fed Cattle Transaction Prices." *Review of Agricultural Economics* 15 (May 1993):325-327.

Slaughter Cattle Procurement and Pricing Study Team. *Price Determination in Slaughter Cattle Markets*. U.S. Department of Agriculture, Grain Inspection, Packers and

Stockyards Administration, RR 96-2, September 1996.

Ward, C.E, S.R. Koontz, and T.C. Schroeder. "Impacts from Captive Supplies on Fed Cattle Transaction Prices." *Journal of Agricultural and Resource Economics* 23(December 1998):2 494-514.

Ward, C.E. "Comparative Analysis of Cattle Slughtering and Fabricating Costs." *Agribusiness: An International Journal* 9(1993):441-451.

Ward, C.E. "Inter-Firm Differences Between Fed Cattle prices in the Southern Plains." *American journal of Agricultural Economic* 74(May 1992):480-485.

Ward, C.E., S.R. Koontz, D.S. Peel, and J.N. Trapp. "Price Discovery in an Experimental Market for Fed Cattle." *Review of Agricultural Economic* 18(1996):449-466.

Ward, C.E., S.R. Koontz, T.L. Dowty, J.N. Trapp, D.S. Peel. "Marketing Agreement Impacts in an Experimental Market for Fed Cattle." *American Journal of Agricultural Economics* 81(1999):2 347-358.

Williams, W.F. "The Meat Industry." In *Market Structure of the Agricultural Industries*, John R. Moore and Richard G. Walsh Edited, Ames, The Iowa State University Press (1966):38-67.

Williamson, O. "Economics as an Antitrust Defense: The Welfare Tradeoff." *American Economics Review* 58(March 1968):18-36.

Williamson, O. "The economics of discretionary behavior: managerial objectives in a theory of the firm", *Markham*, Chicago, IL, 1967.

Chapter IV

Armington, P.S. "A Theory of Demand for Products Distinguished by Place of Production." *International Monetary Fund Staff Papers* 16(1969):159-177.

Barten, A.P. "Consumer Demand Functions Under Conditions of Almost Additive Preferences." *Econometrica* 32(January-April 1964):1-38.

Brandt, J.A. and D.A. Bessler. "Forecasting with Vector Autoregressions Versus a Univariate ARIMA Process: An Empirical Example with U.S. Hog Prices." *North Centural Journal of Agricultural Economics* 16(1984):29-36.

Braschler, C. "The Changing Demand Structure for Pork and Beef in the 1970s: Implications for the 1980s." *Southern Journal of Agricultural Economics* (December 1983):105-110.

Brester, G.W. and T.C. Schroeder. "The Impacts of Brand and Generic Advertising on Meat Demand." *American Journal of Agricultural Economics* 77 (February 1995): 969-979.

Capps, O. Jr. and J.A. Lambregts. "Assessing Effects of prices and Advertising on Purchases of Finfish and Shelfish in a Local Market in Texas." *Southern Journal of Agricultural Economics* (July 1991):181-194.

Capps, O. Jr. and J.D. Schmitz. "Effect of Generic Advertising on the Demand for Fluid Milk: The Case of the Texas Market Order." *Southern journal of Agricultural Economics* (December 1991):131-140.

Chang, H-S and H.W. Kinnucan. "Advertising, Information, an Product Quality: The Case of Butter." *American Journal of Agricultural Economics* 73(November 1991):1195-1203.

Chavas, J-P. "Structural change in the Demand for Meat." *American Journal of Agricultural Economics* (1983):148-153.

Chen, P.Y. and M.M. Veeman. "An Almost Ideal Demand System Analysis for Meats with Habit Formation and Structural Change." *Canadian Journal of Agricultural Economics* 39(1991):223-235.

Choi, S. and S. Kim. "Testing for Structural Change: The Demand for Meat." *American Journal of Agricultural Economics* (February 1982):227-236.

Dahlgran, R.A. "Complete Flexibility Systems and the Stationarity of U.S. Meat Demands." *Western Journal of Agricultural Economics* (1987):152-163.

DeBenedictis, L.F. "A Vector Autoregressive Model of the British Columbia Regional Economy." *Applied Economics* 29(1997):877-888.

Dickey, D.A. and W.A. Fuller. "Distribution of the Estimators for Autoregressive Time Series with a Unit Root." *Journal of American Statistical Association* 74(June 1979):427-431.

Doan, T.A. *RATS: User's Manual*, Version 4. Evanston, IL, Estima,1992.

Goddard, E.W. and A.K. Amuah. "The Demand for Canadian Fats and Oils:A Case Study for Advertising Effectiveness." *American Journal of Agricultural Economics* 71(August 1989):741-749.

Green, R.D., H.F. Carman, and K. McManus. "Some Empirical Method of Estimating Advertising Effects in Demand Systems: An Application Dried Fruit." *Western Journal of Agricultural Economics* 16(1):63-71.

Guilker, D.K and M.K. Salemi. "Small Sample Properties of Three Tests for Granger-Causal Ordering in a bivariate Stochastic System." *Review of Economics and Statistics* 64(1982):668-680.

Hall, L. and I. Foik. "Generic versus Brand Advertised Manufactured Milk Products - The Case of Yogurt." *North Central Journal of Agricultural Economics* 5(January 1983):19-24.

Henneberry, S.R. *Advanced Agricultural Prices*. Lecture Note. Oklahoma State University, Spring Semester, 1999.

Hsiao, C. "Autoregressive Modeling and Money-Income Causality Detection." *Journal of Monetary Economics* 7(1981):85-106.

Ikerd, J.E. "The Battle Among Beef, Pork, and Poultry for the Consumer's Meat Dollar." *A.E. Paper 8233*, Department of Agricultural Economics Oklahoma State University, March 1982.

Jeon K-S. *An Examination of Stock Market Properties (Vector Autoregression Approach)*. Ph.D. thesis. University of Missouri. Columbia, MO:1997.

Kang, H. "The Optimal Lag Selection and Transfer Function Analysis in Granger Causality Tests." *Journal of Econometric Dynamics and Control* 13(1989):151-169.

Kim, D-H. *Relative Effectiveness of Monetary and Fiscal Policies: With Emphasis on Disaggregated Private Spendings and Policy Transmission Mechanisms*. Ph.D. thesis. University of Missouri. Columbia, MO:1999.

Kinnucan, H.W. and E.T. Belleza. "Price and Quantitu Effects of Canadian's Dairy Advertising Programs." *Agricultural and Resource Economic Review* (October 1995):199-210.

Kinnucan, H.W. and O.D. Forker. "Seasonality in the Consumer Response to Milk Advertising with Implications for Milk Promotion Policy." *American Journal ofAgricultural Economics* 68(August 1986):562-571.

Kinnucan, H.W., H. Xiao, C-J Hsia, and J.D. Jackson. "Effects of Health Information and Generic Advertising on U.S. Meat Demand." *American Journal of Agricultural Economics* 79(February 1997):13-23.

Larkin, S.L. *Domestic Meat Demand Structure Shifts due to Changing Household Characteristics*. M.S. thesis. University of Arizona. Tucson, AZ:1990.

Lee, J-W. *Econometrics, Korean.* Seoul, Korea, BakYoungSa,1994.

Lee, J-Y. "Generic Advertising, FOB Price Promotion, and FOB Revenue: A Case Study of the Florida Grapefruit Juice Industry." *Southern Journal of Agricultural Economics* (December 1981):69-78.

Leeper, E.M. and D.B. Gorden. "In Search of the Liquidity Effect." *Journal of Monetary Econometrics* 29(1992):341-369.

Lütkepohl, H. and H-E Reimers. "Impulse Response Analysis of Cointegrated System." *Journal of Economic Dynamics and Control* 16(1992):53-78.

Lütkepohl, H. and P. Saikkonen. "Impulse Response Analysis in Infinite Order Cointegrated Vector Autoregressive Processes." *Journal of Econometrics* 81(1997):127-157.

Moschini, G and K.D. Meilke. "Parameter stability and the U.S. Demand for Beef." *Western Journal of Agricultural Economics* (1984):271-282.

Mountain, D.C. "The Rotterdam Model: An Approximation in Variable Space." *Econometrica* 56(March 1988):477-484.

Piggott, R.R., N.E. Piggot, and V.E. Wright. "Approximating Farm-Level Returns to Incremental Advertising Expenditure: Methods and an Application to the Australian Meat Industry." *American Journal of Agricultural Economics* 77(August 1995):497-511.

Pigott, N.E., J.A. Chalfant, J.M. Alston, and G.R. Griffith. "Demand Response to Advertising in the Austrlian Meat Industry." *American Journal of Agricultural Economics* 78(May 1996):268-279.

Pritchett, J.G., D.J. Liu, and H.M. Kaiser. "Optimal Choice of Generic Milk Advertising Expenditures by Media Outlet." *Journal of agricultural Resource Economics* 23(1998):155-169.

Reberte, C., H.M. Kaiser, J.E. Lenz, and O. Forker. "Generix Advertising Wearout: the Case of the New York City Fluid Milk Campaign." *Journal of Agricultural and Resource Economics* 21(1996):199-209.

Rhode, V.J, and A. Abou-Bakr. "Advertising-Pricing Conduct in Meat Retailing." *Southern Journal of Agricultural Economics* (December 1974):59-63.

Santos, R.A. "Dynamics of Market Structure, Advertising and Profitability: a VAR Approach." *Applied Economics* 27(1995):631-634.

Sims, C.A. "Macroeconomics and Reality." *Econometrica* 48(January 1980):1-48.

Stigler, G.J., and G. Becker. "De Gustibus Non Est Disputatum." American Economic Review 67(March 1997):76-90.

Theil, H. "The Information Approach to Demand Analysis." *Econometrica* 33(January 1965):67-87.

Theil, H. *System-wide Explorations in International Economics, Input-Output Analysis, and Marketing Research.* Amsterdam:North-Holland, 1980.

Thurman, W.N. "The Poultry Market: Demand Stability and Industry Structure." *American Journal of Agricultural Economics* (February 1987):30-37.

USDA, Agricultural Marketing Service, *Beef Promotion and Research order*, http://www.ams.usda.gov/lsg/mpb/beef/beefchk.htm.

USDA, ERS, Livestock, Dairy, and Poultry Situation and Outlook, various issues.

Ward, C.E., S.R. Koontz, M.L. Hayenga, and T.C. Schroeder. "Definition of Regional Cattle Procurement Markets." In C*oncentration in the Red Meat Packing Industry*, Packers and Stockyards Programs, Grain Inspection, Packers and Stockyards Administration, USDA, February 1996.

Ward, R.W. "the Beef Checkoff Impacts on U.S. Beef Demand." UF#NCA96.1, *University of Florida, Cattlemen's Beef promotion and Research Board, National Cattlemen's Beef Association,* Gainesville, Florida and Denver, Colorado, April 1996.

Ward, R.W. and B.L. Dixon. "Effectiveness of Fluid Milk Advertising Since the Dairy and Tobacco Adjustment Act of 1983." *America Journal of Agricultural Economics* 71(August 1989):731-740.

Ward, R.W. and C. Lambert. "Generic Promotion of Beef: Measuring The Impact of The US Beef Checkoff." *Journal of Agricultural Economics* 44(September 1993):456-465.

Wu, W. *A Dynamic AIDS Analysis for U.S. Meats with Habit Formation and Structural Change*. M.S. thesis. University of Nevada. Reno, NV:1992.

VITA

Jong-In Lee

Candidate for the Degree of

Doctor of Philosophy

Thesis: ESSAYS IN THE BEEF INDUSTRY: GRID PRICES, MEATPACKING FIRM MERGERS, AND ADVERTISING IMPACTS ON BEEF CONSUMPTION

Major Field: Agricultural Economics

Biographical:

Education: Graduate from Yang-Yang High School, Yang-Yang in February of 1980; recrived a Bachelor of Science degree in Animal Science from Kangwon National University, Chunchon in February 1987; completed the requirements for the degree of Master of Science with a major of Livestock Management in Animal Science at Kangwon National University in February of 1993; completed the requirements for the degree of Master of Science with a major of Agricultural Economics at University of Missouri in August of 1997.
Completed the requirements for the degree of Doctor of Philosophy with a major in Agricultural Economics at Oklahoma State University in December of 2000.

Professional Experience: Military Service, Army, March 1982 - July 1984; Sales Department, Dae-Joo Industry Corp., May 1987 - August 1990; Staff, Kangwon National University, Department of Livestock Management, April 1992 - February 1994; Research Assistant, Oklahoma State University, January 1998 - December 2000.