Concentration in the Red Meat Packing Industry

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Contents

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Acknowledgments

The packer concentration study has required the concerted efforts of a large number of people since October 1991.

We appreciate the contributions of members of an Interagency Working Group who advised GIPSA on the study. We wish to express special appreciation to members of a subgroup of the Working Group. This subgroup assisted in drafting project statements that were included in the request for proposals, evaluated applicants' technical proposals, assessed contractors' technical reports, and reviewed summary reports on the study. Members of the subgroup, in addition to GIPSA employees, are: Roy Levy (Federal Trade Commission), Matt Wright (Department of Justice), Fred Linse and John Bird (Commodity Futures Trading Commission), and Ken Nelson and James MacDonald (Economic Research Service, USDA).

While the members of the subgroup provided significant input to the contractors and GIPSA, the views expressed in this and other reports on the packer concentration study are not necessarily those of the individuals or the Federal agencies and departments that assisted and advised the Department of Agriculture on the study.

A consultant (Sterling Marketing Inc.) provided technical advice on development of the cost and revenue survey instrument used in the study.

The research contractors on the study toiled under difficult conditions to complete their work. They adjusted their original data specifications and research methods because some data did not exist or could not be obtained in a practical manner.

USDA appreciates the hard work and diligence of the government employees and contractors in completing the study. USDA also appreciates the comments and suggestions of 51 individuals and organizations on the study's procedures and scope (in response to a request in the *Federal Register*), and the participation of the respondents in the large data collection effort.

Executive Summary

There is a long history of concerns about the effects of concentration in the meatpacking industry. Concentration has increased sharply in recent years. For example, the four largest packers accounted for 82 percent of steer and heifer slaughter in 1994, versus only 72 percent in 1990 and 36 percent in 1980. Packers have also increased their use of vertical integration and coordination arrangements, reducing the role of public markets where the terms of trade are openly visible to all.

Those concerned about the effects of concentration and integration focus on their effects on prices and the price discovery process. Firms in a concentrated processing industry may be able to reduce prices paid to suppliers. Some observers fear that increases in vertical integration and coordination may amplify the potential for exercise of market power. Some also express concern that large packers may use vertical coordination arrangements as a means of blocking their smaller competitors from sources of supply, or as a mechanism for discriminating among livestock sellers. At the least, vertical coordination arrangements reduce the prevalence of open-market transactions, thereby restricting the availability of market information.

Those who believe concentration and integration present no threat argue that livestock prices are higher due to increased efficiency and lower costs realized by large packers and by vertical coordination arrangements. They argue that without the size economies, consumer prices would be higher, livestock prices would be lower, and fewer animals would be sold.

The debate involves a few fundamental questions: Do large firms possess and use market power? Do potential efficiency gains of larger firms offset potential adverse market power effects of concentration? How do vertical coordination arrangements affect production costs, livestock and meat quality, price discovery, and market access? What is the role of Federal regulation in preventing large firms from abusing potential market power, and in monitoring the industry?

Past studies have provided inconclusive or contradictory information on the implications of concentration. The organization of the industry has changed markedly in recent years. Additional information is needed to resolve the uncertainties about the effects of concentration and vertical integration as the industry continues to adapt to external forces that affect the supply of, and demand for, its products.

Congress included $500,000 in the Department of Agriculture's (USDA) Packers and Stockyards Administration (now Grain Inspection, Packers and Stockyards Administration (GIPSA)) 1992 fiscal-year appropriation to conduct a study of concentration in the red meat packing industry. Both the Senate and House Committee reports expressed concerns about concentration in the meatpacking industry. Prior to beginning the study, GIPSA solicited public input and received comments from 51 individuals and organizations on the scope and approach of the study. Input was also obtained from other Federal agencies. An interagency working group reviewed the public comments and recommended priority research topics.

Seven projects, described below, were selected to address areas identified in the House Committee report accompanying the FY 1992 appropriation. Six of the projects were conducted by researchers from various universities. The seventh project was completed by USDA. This report is a summary of the findings of those projects. The underlying reports of the university researchers will also be released after confidential firm-specific information is removed.

The projects conducted in this study examined issues that were considered most pressing at the time the study was initiated. Many of the analyses needed detailed confidential data drawn from meatpackers' records. The study, and data upon which it is based, cover only a limited period of time--mostly April 1992 through March 1993--because of the costs and time required for collecting, processing, and analyzing such detailed data. The study did not address longer-term patterns in packer behavior, costs and returns, or changes in livestock prices over a full cattle (about 10 years) or hog (about 4 years) cycle. The study results suggest that sustained monitoring and analysis provide the best opportunity to examine such longer-term issues as the industry evolves and as market conditions change.

The following is a brief overview of the study's seven projects and their key findings.

Project: Definition of Regional Cattle Procurement Markets

Market definitions are important for analysis of the effects of concentration on prices, for monitoring competitive behavior, and for antitrust analysis. The objective of this project was to define relevant regional cattle procurement markets. Three approaches were used. One examined the degree to which regional cattle markets are linked as reflected in prices reported by the U.S. Department of Agriculture's Agricultural Marketing Service's Market News. Another examined packing plants' geographic procurement patterns and volume responses to price changes at other plants. The third examined how prices paid by individual packing plants were related to each other over time.

Only cash market purchases were examined. The omission of captive supply purchases from the analyses may influence results if geographic purchase patterns differ for captive supply cattle. (Captive supplies are defined as livestock controlled by or committed to a packer more than 2 weeks prior to slaughter through a forward contract, marketing agreement, or packer feeding program.) Some of the key findings of the project were:

* On average, packers obtained 64 percent of their cattle within 75 miles of their plants, 82 percent within 150 miles, and 95 percent within 270 miles. Cattle procurement areas showed considerable overlap among plants.

* Cattle prices among plants tend to move together, maintaining longrun spatial equilibrium. Arbitrage

costs among the various geographic regions were relatively small. This suggests that price information flows readily among plants and geographic regions.

* In general, fed-cattle prices in all U.S. regions are linked, suggesting a broad national market for fed cattle.

* Some regional differences exist. Plants in the Middle region (MN, IA, NE, CO, KS, and TX) generally appear well-linked, while links among plants in the West and East are not as strong. Differences in the West and East regions may not be strong enough to consider them separate markets.

* Identification of geographic boundaries as prescribed in the Department of Justice and Federal Trade Commission merger guidelines would require separate analysis for each proposed merger or acquisition. Application of the guidelines could result in narrower geographic markets for cattle procurement.

* Due to insufficient data on cow and bull procurement, no analysis was done to determine whether "cows and bulls" and "steers and heifers" are in the same market.

* The results provide strong evidence that measurement and analysis of concentration in beef packing need to focus on relatively broad geographic markets. Rigid regional boundary lines cannot easily be identified because arbitrage and livestock movements create considerable overlap among areas. Market areas identified in this study are much broader than in many previous studies.

Project: Price Determination in Slaughter Cattle Procurement

Information about packers' purchasing and pricing decisions is needed to understand how livestock markets function and to monitor the industry for anti-competitive behavior, such as price discrimination or market allocation. This project analyzed detailed data on slaughter cattle procurement transactions by the 43 largest steer and heifer slaughter plants, owned by 20 different firms, from April 5, 1992 to April 3, 1993. Responses by packers and by a sample of feedlots to a survey supplemented the data.
The objective of the research was to identify and assess factors affecting packers' choices of procurement and pricing practices in the slaughter cattle market. The analysis also identified important factors determining differences in cattle prices. The research produced numerous summary statistics that provide new descriptive information about cattle pricing and procurement methods. Some of the key findings of the research were:

* The spot market remains the predominant procurement method, and over 83 percent of cattle are priced by either liveweight or carcass-weight pricing methods. Few firms rely on other methods for procuring or pricing a large proportion of cattle slaughtered.

* Cattle purchased through forward contracts bring lower prices than cattle delivered on the spot market, while cattle purchased using marketing agreements bring higher prices. This finding is consistent with the findings of the captive-supply project discussed below.
* Large packing plants obtained nearly half of their cattle from large feedlots while small plants obtained less than one-quarter from large feedlots.

* Prices vary, as expected, with cattle quality characteristics such as type, average weight, quality grade, and yield grade. After controlling for such factors, there is evidence that larger plants pay higher prices than smaller plants, although the evidence was inconsistent across regions. Prices were not significantly different in the region including Colorado, Kansas, Nebraska, and Texas.

* The study found that prices in local areas are affected very little by differences in concentration in those regions for the time period studied.

Project: Role of Captive Supplies in Beef Packing

Various arrangements are used by packers to obtain cattle 2 or more weeks prior to slaughter. Cattle obtained through these arrangements are known as captive supplies. Industry observers and participants frequently express concern that packers may use captive supplies to lower prices paid for cattle. Three objectives were addressed in this analysis of captive supplies: (1) determine the purpose and extent of captive-supply use; (2) determine whether use of captive supply affects prices paid for fed cattle; and (3) estimate supply and demand for captive supply and determine how changes in market conditions affect longrun use of spot markets and captive supply. The main findings are as follows:

* Packers simultaneously decide the number of cattle to obtain through forward contracts and through cash markets on a day-to-day basis.

* Increases in cash market prices led to increased use of packer-fed, forward-contracted, and marketing agreement cattle by large plants, consistent with theoretical expectations. Increases in variability in cash market prices led to increased use of forward-contracted and marketing agreement cattle.

* As plant utilization increases, the use of captive supply also increases. This suggests captive supplies could be used to enhance plant utilization.

* The use of forward contracting, marketing agreements, and packer feeding varied widely, and with no systematic relation to specific firms, plant locations, or geographic regions.

* Some, but not all, plants use captive supply to help maintain slaughter levels at full capacity, with packers' price expectations determining their specific use of captive supplies. Expectations of rising prices increase the volume of captive supply used, whereas expectations of falling prices lead to decreased use of captive supply.

* Based on analysis of individual transactions, forward-contracted cattle appear to be priced lower than cattle sold in the cash market on the same day, while marketing agreement cattle are priced slightly higher.

* The overall effect of increased use of captive supply on shortrun prices paid for cattle in the cash market appears to be negative but very small.

* The study provides an overall description of the role of captive supply in the industry that suggests, at most, rather modest net effects for the period analyzed by the study.

Project: Effects of Concentration on Prices Paid for Cattle

Congress and industry participants have expressed concern about the effects of increased concentration among packers. Concentration increases the potential for firms to use market power. This project used plant-level data to examine whether large beef packers exert market power. Cost and revenue data were analyzed for 15 steer and heifer slaughter plants. The research was based on a model of packing plant behavior that assumed plants maximize profits given fixed plant capacity.

* The research encountered several data and methodological difficulties and did not obtain definitive results about the possible use of market power, an outcome consistent with the findings of the literature review project.

* The results of econometric analysis were not consistent with assumptions necessary for the models to produce valid tests for market power. Further tests using different statistical methods provided additional evidence that the data were inconsistent with critical assumptions of the model chosen for the research.

* The data already collected could be analyzed further, and perhaps additional data collected, to develop better models of slaughter plants' procurement behavior and perform valid tests of competitive behavior.

Project: Vertical Coordination in Hog Production

The use of alternative procurement and pricing arrangements has been increasing in hog production. This project provides baseline information on industry use of these new methods for vertical coordination, and develops projections suggesting where current trends may lead. Vertical coordination in the U.S. hog-pork industry was examined to determine current vertical coordination arrangements and their effects on the structure, conduct, and performance of the industry. Telephone interviews were conducted with the largest pork packers, hog producers, and feed companies that are likely to influence vertical coordination. Major findings are listed below:

* Survey participants realize economic benefits from vertical coordination, which will become increasingly common. Industry participants expect a more consolidated, tightly linked hog-pork industry by 1998.

* Long-term marketing contracts benefit packers and producers by improving product quality and reducing transaction costs.

* The seven largest hog producers (more than 500,000 hogs per year) marketed 90 percent of their hogs through long-term marketing contracts.

* Large producers are more dependent than packers on marketing contracts. Only eight of the 19 leading packers purchased 10 percent or more of their hogs through long-term marketing contracts in 1993.

* Many large hog producers cite the assurance of a market outlet as an important benefit of long-term contracts.

* Contracting has been associated with expansion of hog production in some regions. The Southeast and other non-traditional hog producing areas are adopting vertical contracting more quickly. They also are increasing their share of U.S. hog production.

* In 1998, the majority of market hogs purchased by packers is still expected to be through spot markets, especially in the North Central region.

* The regional shifts in hog production and slaughter, and changes in the size of production and slaughter operations have significant potential implications for industry structure and performance. For example, increased expansion in the West and Southwest may drive out less efficient producers in the North Central region.

Project: Hog Procurement in the Eastern Corn Belt

This project on meatpackers' hog procurement in the eastern Corn Belt addresses market definition issues in pork similar to those addressed in the project on cattle markets discussed above. The project was conducted using confidential, plant-level GIPSA data on live hog purchases and USDA, AMS *Market News* price data. The general objectives were to: (1) identify slaughter plants' hog procurement areas, (2) determine if prices are linked among the areas, and (3) determine whether procurement patterns are efficient.

Spatial patterns of procurement and prices paid by packers may provide information regarding competitive practices. They can be examined to determine the relative economic efficiency of plant location-livestock shipment relationships. Inefficient patterns may encourage structural change, such as plant closings and mergers. The main findings are:

* Delivered prices paid for hogs processed by packing plants in the eastern Corn Belt increased an average of 0.4-0.7 cent per cwt for each additional mile in the distance to the supply source, contrary to expectations based on market theory. This suggests that packers absorb some of the transportation costs incurred for similar hogs purchased farther away from the plant. Since the price differences were small and some factors relevant to procurement decisions could not be analyzed, evidence was inconclusive but suggested that price patterns were competitive.

* Observed procurement patterns represent a relatively efficient market, as optimal least-cost patterns would reduce total slaughter and transaction costs by less than 1 percent compared with actual costs.

* Pricing patterns observed in *Market News* price data were consistent with the existence of a single national market for pricing of slaughter hogs.

Project: Literature Review

The U.S. meatpacking industry has undergone significant structural change since 1900. Economic theory and methods for evaluating its performance have similarly evolved. This project reviewed and synthesized pertinent research literature to describe these evolutionary processes, and to assess the current state of knowledge about the structure, conduct, and performance of the livestock slaughter industry. Major findings were:

* Economic factors, especially technological change, have been critical to most of the structural changes in commercial meatpacking since the 17th century.

* Research literature, on balance, suggests that conduct in the red meat packing industry is not consistent with perfect competition as defined by economic theory. However, limitations in analytical methods and problems in interpretation and measurement rendered empirical assessments of competition in the meatpacking industry inconclusive.

* Further understanding of the meatpacking industry depends on workable models of firms' pricing conduct (for short-term monitoring) and on the study of competitive dynamics in the industry. This requires appropriate price data for short-term monitoring as well as longitudinal data at the firm and plant level to describe how entry, exit, mergers, market shares, and other factors change the industry over time.

Summary

The concentration study suggests that the meatpacking industry is complex and dynamic. Conclusions are as follows:

* The projects used different research models and methods yet produced consistent findings in those areas where the projects overlapped.

* The findings showed that different pricing and procurement arrangements (including captive supplies and contracting), and structural characteristics affect conduct and performance in the meatpacking industry. Given the persistence and importance of these issues, and rising concentration, there is a continuing need to monitor and analyze behavior and structural changes in the industry, and to take corrective action when necessary.

* Areas identified as having promise for future surveillance and analysis include procurement and pricing practices of individual firms; rivalry and cooperation among firms; and contracting arrangements and other forms of coordination.

* Follow-up research is needed to resolve significant modeling and data issues to address the effects of concentration on prices paid for cattle.

* Monitoring and analysis could be strengthened with development of improved methodological capabilities and models that better describe firm behavior and industry outcomes and with improved procedures to obtain confidential plant- and firm-level data on procurement transactions, operating costs and revenue, and contractual arrangements.

* The study has shown that quick answers to complex market structure and behavior issues are not available. Steady sustained monitoring and analysis provide the best opportunity to obtain timely, meaningful information as the industry evolves and market conditions change.

Introduction

Background

There is a long history of concern about the impacts of concentration in the meatpacking industry. The Sherman Antitrust Act was passed partly because of farmers' concerns over concentration. Control by five packing companies in the early 1900's led to investigation by the Federal Trade Commission, and eventual passage of the Packers and Stockyards Act of 1921. Concentration declined after the 1920s, but in recent years has increased sharply, as shown by the following table.

The role of public markets (auctions and terminals), where the terms of trade are openly visible to all, has been waning for several years as packers have moved to purchasing livestock directly from producers. Recently, packers have increased their use of vertical integration and vertical coordination arrangements that further reduce the role of public markets.

Concerns about concentration and integration focus on their effects on prices and the price discovery process. The structure of an industry (e.g., number and size distribution of firms) is influenced by the supply of its inputs, demand for its products, and nature of its production technology. Structure in turn influences competitive behavior and performance of the industry. Firms in a concentrated processing industry that utilizes a specialized input such as meat animals may be able to reduce prices paid to suppliers.

Some observers fear that increases in vertical integration and coordination may amplify the potential for exercise of market power. There is concern that large packers may use vertical coordination arrangements as a means of blocking their smaller competitors from sources of supply, or as a mechanism for discriminating among livestock sellers. At the least, vertical coordination arrangements reduce the prevalence of open-market transactions, thereby restricting the availability of market information.

There are opposing arguments. Some industry observers argue that livestock prices are higher due to increased efficiency and lower costs realized by large packers, and by vertical coordination arrangements, and that these gains more than offset any adverse effects of large market shares and higher concentration levels. They argue that without the size economies, consumer prices would be higher, livestock prices would be lower, and fewer animals would be sold.

This debate involves a few fundamental questions.

* Do large firms possess and use market power?

* Do potential efficiency gains of larger firms offset potential adverse market power effects of concentration?

* How do vertical coordination arrangements affect production costs, livestock and meat quality, price discovery, and market access?

* What is the role of Federal regulation in preventing large firms from abusing potential market power, and in monitoring the industry?

Past studies have provided inconclusive or contradictory information on these questions, and have stressed the need for better answers. In addition, the organization of the industry has changed markedly in recent years. Additional information and answers are needed to resolve the uncertainties as the industry continues to adapt to external forces that affect the supply of, and demand for, its products.

The Department of Justice (DOJ), Federal Trade Commission (FTC), Commodity Futures Trading Commission (CFTC), and Grain Inspection, Packers and Stockyards Administration (GIPSA) require information to meet their mandates for industry oversight in a manner that encourages competitive conduct while facilitating, rather than hindering, appropriate adaptation to forces for change in industry structure and behavior.

Share of total slaughter accounted for by four largest firms

Year	Slaughter		
	Steer and heifer	Hog	Sheep and lamb
		Percent	
1980	36	34	56
1985	50	32	51
1990	72	40	70
1994	82	46	73

Congress included $500,000 in the Packers and Stockyards Administration (P&SA) 1992 fiscal-year appropriation to conduct a study of concentration in the red meatpacking industry. Both the Senate and the House Committee reports expressed concerns about concentration in the red meatpacking industry and concerns that the P&SA--now Packers and Stockyards Programs (P&S), Grain Inspection, Packyards and Stockyards Administration (GIPSA)—did not have the information needed to analyze the causes and impacts of concentration. The Senate Committee report directed that at least $250,000 be used to contract with universities and other organizations. The House Committee report stated that the study be conducted consistent with GIPSA's confidentiality requirements.

Study Approach

The potential study was sufficiently broad that public input was solicited on its scope and approach. Input from other Federal agencies was sought as well. GIPSA solicited public comments through a notice in the *Federal Register* on January 9, 1992. Comments were received from 51 individuals and organizations, including 7 meatpacking firms and meatpacking trade associations, 12 livestock markets and livestock market trade associations, 5 consultants, 15 persons associated with universities, and 8 others. The most commonly recommended research suggestions were to define procurement markets; analyze the price discovery process; and examine vertical integration/coordination issues, especially the role of packers' captive supplies of cattle.

GIPSA established an interagency Working Group with representatives from GIPSA (chair), the Agricultural Marketing Service (AMS), the Economic Research Service (ERS), the National Agricultural Statistics Service (NASS), and the Office of General Counsel (all USDA), plus the DOJ, FTC, and CFTC.

This group reviewed the public comments and recommended priority research topics. Subgroups worked closely with GIPSA to develop specific project proposals used to solicit competitive bids from researchers. A subgroup comprised of economists from CFTC, FTC, Justice, and ERS, and economists and other technical staff in GIPSA reviewed the bid proposals and, later, reviewed research reports of the contractors and this summary report, which was prepared by GIPSA.

Selection of Projects

The projects selected address areas identified in the House report as well as topics identified by the Government Accounting Office (GAO) in an October 1991 report on P&SA.[1] GAO had reviewed P&SA's work and recommended that P&SA collect and analyze data necessary to define and monitor regional livestock procurement markets.

Although there is a wide range of concentration issues and many are interrelated, the study focused on cattle and hog procurement markets. Several of the projects thus had overlapping data requirements. This increased efficiency in data collection, tabulation, and analysis, and maximized the use of available resources.

Six contracts were awarded in September 1992. A seventh project was added later. The project plans and contractors selected are listed below.

* *Regional Cattle Procurement Markets* examines regional procurement markets for slaughter cattle within the continental United States (Oklahoma State University with collaborators at Kansas State University and Iowa State University).

* *Price Determination in Slaughter Cattle Procurement* examines individual purchase transactions for slaughter cattle and appropriate supplemental information to identify common procurement patterns and practices in order to explain and/or predict purchase and pricing decisions of beef packers (Texas A&M University).

* *Role of Captive Supplies in Beef Packing* examines the use of captive supplies and captive-supply arrangements by beef packers, and determines interrelationships between captive supplies and the structure, conduct, and performance of slaughter cattle markets. Captive supplies are cattle that are controlled by or committed to a packer more than 2 weeks prior to slaughter through a forward contract, marketing agreement, or packer feeding program (Oklahoma State University with collaborators at Kansas State University).

* *Effects of Concentration on Prices Paid for Slaughter Cattle* consists of an empirical analysis of the effects that concentration in slaughter cattle procurement have on prices paid for slaughter cattle (Virginia Polytechnic Institute and State University).

* *Vertical Coordination in Hog Production* examines the economics of vertical integration and coordination arrangements in the hog-pork subsector and the implications of these links for structure, conduct and performance in the hog slaughtering and processing industry (Hayenga, Rhodes,

Grimes, and Lawrence Partnership).

* *Hog Procurement in the Eastern Corn Belt* reviews hog procurement practices in the eastern Corn Belt using previous GIPSA data. The project examines prices paid, procurement areas, etc., by hog slaughtering plants in the region (Economic Research Service, USDA).

* *Literature Review* consists of a review and synthesis of pertinent research literature on structure, conduct, and performance issues relating to the meatpacking industry (University of Nebraska).

Data needs were large and overlapped projects. Three types of data were needed by outside contractors: procurement (transaction) records of beef packers, cost and revenue records of beef packers, and information on contracting and procurement practices and trends.

Transaction records included all pertinent information (for example, delivered cost of cattle, dates of purchase and slaughter, animal quality, type of transaction, seller name and address) on individual procurements for 1 year for packing plants with annual slaughter of more than 75,000 head of steers and heifers (see appendix A). These plants account for over 90 percent of total beef slaughter.

Cost and revenue records included weekly and monthly data on specific categories of operating expenses and revenues for all beef packing plants slaughtering at least 75,000 head of steers and heifers annually.

Contractor surveys were conducted to learn why packers enter into certain types of procurement contracts, to anticipate procurement trends, and to analyze vertical contractual arrangements.
Contractors were required to establish secure rooms and to agree in writing not to release any confidential data or other sensitive information about the study.

Scope and Limitations

This study examined issues considered most pressing at the time the study was initiated. An important contribution of this study arises from the uniqueness of the data collected for the research. As described in the ensuing chapters, many of the analyses used detailed confidential data drawn from meatpackers' records. Such data have not previously been available for analysis of the structure, conduct, and performance of the industry. Research entails tradeoffs, however. Costs and time required for collecting, processing, and analyzing such detailed data limited the period of time that the data could cover. Some issues, such as analysis of packers' behavior, costs and returns, and changes in livestock prices over the course of a full cattle or hog cycle, require data over a longer time period and, therefore, were not examined.

Organization of Report

This report summarizes the work of the contractors. Their objectives, research methods and procedures, data used, and results are presented for each project. Portions of the respective chapters draw liberally from the contractors' reports to GIPSA, with some language from the contractors' reports. Also included at the end of each chapter is a synopsis that includes GIPSA's assessment of the research findings.

* Chapter 1 examines regional cattle procurement markets. Market definitions are relevant for analyses of the effects of concentration on prices paid and for monitoring competitive behavior. GAO also recommended that GIPSA define relevant procurement markets.

* Chapter 2 examines procurement and pricing patterns of beef packers.

* Chapter 3 looks at the role of captive supplies in beef packing. Industry observers and participants frequently express concern about packers' use of captive supplies. This project assesses potential impacts.

* Chapter 4 analyzes the effects of concentration on prices paid for cattle. Concentration is generally thought to increase potential for firms to use market power.

* Chapter 5 addresses vertical coordination in hog production. Vertical coordination is increasing in hog production. Production contracts are growing rapidly in the Southeast and other areas, and marketing contracts are becoming more prevalent in the Midwest. This project looks at trends in vertical arrangements.

* Chapter 6 examines hog procurement in the eastern Corn Belt. The project examined procurement records of packers in the eastern Corn Belt to learn if prices are affected by distance from packing plants, the presence of competing packers, and other factors.

* Chapter 7 reports on the findings of the literature review.

* Chapter 8 summarizes the study. The appendices contain additional details about the data collection and a list of references reviewed in the literature review project.

Chapter 1
Definition of Regional Cattle Procurement Markets

Introduction and Objectives

This project was managed by Clement E. Ward, Oklahoma State University, and jointly conducted by Stephen R. Koontz, Oklahoma State University; Marvin L. Hayenga, Iowa State University; and Ted C. Schroeder, Kansas State University. The project's objectives included:

* examine and identify regional fed-cattle procurement markets within the continental United States;

* identify cattle procurement patterns within and among firms and geographic areas; and

* propose appropriate methodology to analyze geographic market boundaries and factors affecting market boundaries including, but not limited to: analyses of supply and demand elasticities; analyses of price similarities and differences among regions; and examination of procurement patterns, transportation costs, packing plant and feedlot characteristics, competitive conditions in procurement and downstream markets, and multiplant operations.

The research team's objectives were to delineate procurement markets for beef packing plants, examine regional competition for cattle in specified locations, and examine individual plants' reactions to other plants' strategies in the area. Three separate analyses were conducted:

* Arbitrage cost models were developed to identify regional market boundaries between USDA AMS *Market News* reporting regions and to examine the degree to which regional cattle markets are linked by estimating the distribution of implied transaction costs in observed data.[2]

* Plant-level fed-cattle transactions data were used to perform trade area mapping to examine procurement market boundaries and to develop plant-level supply functions to examine procurement relationships between plants.[3]

* Time-series methods were used to examine spatial cattle market price linkages to determine strength of regional price relationships, efficiency of specific market regions in incorporating supply and demand information, plant and/or firm price leadership, and possible market segmentation.[4]

Arbitrage Cost Models Using Public Price Data

Arbitrage cost models were used to define regional markets by estimating the transaction costs implied in observed prices across geographic areas. This method uses spatial-equilibrium arbitrage conditions to estimate a relationship that describes the implied arbitrage costs. Spatial-equilibrium arbitrage conditions state that if the difference is large enough to cover the transaction cost, price in a high-price region must equal price in a low-price region plus transaction costs. In other words, arbitrage occurs when livestock can be purchased in a low-price region, transported to a high-price region and sold at a price that covers the purchase

price plus transaction costs (for example, shipping and commissions). Arbitrage will continue until price differences between regions are less than transaction costs. If the difference between regions is less than transaction costs, price movements (for like cattle) may be unrelated or related due to changes in common supply and demand conditions.

Arbitrage models ignore movements in regional prices due to changing supply and demand conditions that are common between markets and focus on changes in relative prices due to arbitrage conditions. Common movements in regional prices due to arbitrage identify market boundaries, whereas common movements due to similar changes in supply and demand do not.

The model examines price differences between paired geographic areas. The parametric relationship specified is based on three mutually exclusive arbitrage regimes: (1) binding arbitrage from one region to another; (2) binding arbitrage in the reverse direction; and (3) no binding arbitrage between regions. The transaction costs between the two regions are restricted to positive values. There is no explicit use of actual transaction cost data in the model. Rather, arbitrage costs are revealed by how large the difference between the two prices becomes and the frequency of these large differences. Parameters in the model reveal (1) the means and variances of the arbitrage costs, and (2) the probabilities of arbitrage from one region to another and in the opposite direction.

The probabilities of observing arbitrage are a function of arbitrage costs and changes in supply and demand that influence regional prices. An econometric procedure was used to estimate the arbitrage model for 120 possibilities. The results yield information on the arbitrage cost distributions and the probabilities of arbitrage between each of 16 geographic areas.
Arbitrage cost parameter estimates identify whether different regions were likely to be contained in the same economic market if prices change sufficiently in one of the regions. Low arbitrage costs suggest the areas in question are contained in the same economic market. High costs suggest economic market separation.

The probability that no arbitrage occurs from one market to another when the price in the first market is 5 percent below the second market's price was calculated to conform with the U.S. Department of Justice and Federal Trade Commission 1992 Horizontal Merger Guidelines.[5] A large probability of no arbitrage implies that the two markets are segmented and do not pass the DOJ/FTC 5-percent rule. A small probability of no arbitrage implies that the two markets are in the same economic market.

Data

Publicly available data (USDA, AMS LS-214 report of daily fed-cattle prices for 16 direct and terminal markets) were used in the arbitrage cost models. The study period was from January 1980 through December 1992. Prices, with minor exceptions, were for Choice yield grades 2-4 1,100-1,300 lb. steers. Arizona and Southern California prices were for 900-1,100 lb. steers.

Table 1--USDA, AMS regional prices, 1980-92

Market	Live weight price			Number of observations
	Average	Minimum	Maximum	
		$/cwt		
Illinois	67.54	48.50	82.50	3,315
Iowa	68.05	49.75	82.00	3,315
Eastern Nebraska	68.17	50.00	82.25	3,315
Western Nebraska	68.08	49.25	82.00	3,315
Colorado	68.31	49.25	81.87	3,315
Eastern Kansas	64.07	50.75	75.12	1,785
Western Kansas	68.65	50.25	82.50	3,315
Texas, Oklahoma, New Mexico	68.70	50.25	82.00	3,315
Arizona	68.13	49.75	80.00	3,300
Southern California	68.08	50.00	80.50	3,315
Northern California	67.60	50.75	80.25	3,186
Washington	67.59	50.25	81.75	2,926
Idaho	67.67	49.50	82.00	3,139
Lancaster County, Pennsylvania[1]	67.73	49.50	84.00	3,315
Omaha[1]	67.82	50.00	82.87	3,315
Sioux City[1]	67.60	49.25	83.25	3,315
All markets	67.73	48.50	84.00	

[1] Terminal markets

Results

Fed-cattle prices across all markets averaged $67.73/cwt, with prices ranging from $48.50/cwt to $84/cwt (table 1). Markets in the Southern Plains generally had higher prices than terminal markets and markets in the Northwest and East.

The majority of the estimated arbitrage cost parameters were significant at conventional levels of statistical tests.[6] In general, mean arbitrage costs were all reasonably small, between 1 and 5 percent of average price

levels. Distances between markets were identified and transportation cost estimates were calculated based on a $0.40/cwt/100 miles variable cost. Arbitrage and transportation cost estimates were closest for neighboring markets. However, the majority of arbitrage cost estimates were well below the transportation cost values. The small estimated arbitrage costs suggest that all U.S. fed-cattle markets are closely linked. However, the strength of the linkage varies between geographic areas.

Asymmetries in the arbitrage costs from one market to another and vice versa reveal market separation. For example, the arbitrage cost estimate from Idaho to Texas was $1.72/cwt and from Texas to Idaho was $3.13/cwt, with both figures below calculated transportation costs. This asymmetry suggests that, within the well-linked national fed-cattle market, the Texas market achieves a much lower discount to the Idaho market than Idaho does to Texas before regional flows of cattle change. There are similar, though less pronounced, asymmetries between markets in the Southwest and the Midwest and Plains regions. Markets in the Plains States achieve larger discounts to Midwest markets than Midwest to Plains. This implies that it is more costly for Plains markets to arbitrage to Midwest markets. Generally, arbitrage costs were lower when a smaller volume market arbitrages to a larger market (with higher regional meatpacking plant capacity), and are higher when a larger market arbitrages to a smaller market. These arbitrage cost asymmetries suggest that the larger markets would mitigate any exercise of market power in smaller markets, but also suggest that smaller outlying markets should not be considered relevant when examining market power in larger markets.

The estimated probabilities of observing arbitrage were relatively small. The distribution of fed-cattle prices across markets does not change often since binding arbitrage conditions were not triggered often, even though arbitrage costs were relatively low. The probabilities of arbitrage were all very small within and between markets in the Plains and Upper Midwest States. However, the probabilities were much larger and asymmetric between the central U.S. markets (Plains and Midwest) and markets in the eastern, southwestern, and northwestern United States. For example, the probability of arbitrage from Texas to Idaho was 4.7 percent, from Idaho to Texas, 28.4 percent.

The asymmetries in the arbitrage probabilities were similar to that of the arbitrage costs. It is more costly for large-volume market areas to arbitrage smaller market areas. Therefore, the probability of arbitrage is lower for the larger market areas. There is some separation of trading between both coasts and central market areas, and between southwest and northwest market areas. Larger volume market areas may be studied in isolation because the effects of neighboring small markets will be small, whereas analysis of the smaller volume market areas should include neighboring larger market areas.

Estimates of the probability of arbitrage generated from the DOJ/FTC 5-percent rule lead to similar conclusions about the extent of regional market areas. The eastern United States (Pennsylvania), Southwest (California and Arizona), and the Northwest (Washington and Idaho) each exhibit some independence. For example, if prices decline 5 percent in the north-central United States, Upper Midwest and Plains cattle will move to the Northwest, but the reverse does not occur. The Upper Midwest region, including Illinois, Iowa, E. Nebraska, E. Kansas, Omaha, and Sioux City, appears to be a separate economic area; W. Nebraska, Colorado, W. Kansas, and Texas is another economic area. There appears to be effective arbitrage from the Upper Midwest to the Plains, but less so from the Plains to the Upper Midwest.

Cross Elasticities of Supply Using Transactions Data

This project used two approaches--trade area mapping and cross elasticities--to determine relevant markets. In trade area mapping, a firm's business contacts are plotted on a map; the extent of the area covered suggests the trade area or relevant market. Market overlaps are the area shared by two or more competitors. Cross

elasticities measure the responsiveness of the quantity purchased by a firm to the change in price paid by another firm.

Trade Area Mapping

This portion of the study focused on short-term competitive interaction in fed-cattle procurement by beef slaughter plants. This analysis examined spot market transactions. Observations without location information or originating from Canada were not used.

The basic unit for mapping packing plants' trade area was the seller's county. The percentage of cattle purchased within specified distances from each plant (75, 150, and 250 miles) was calculated. A radius from the border of the county in which the packer is located was calculated. All cattle purchased from any county that is entirely or partially within the given radius were included in the plant's total.

Plants were grouped into five regions: East--east of the Mississippi river; West--west of Colorado; MidNorth--north of Kansas; MidSouth--south of Nebraska; and Middle--combined MidNorth and MidSouth regions (table 2). The Middle region includes 10 of the largest cattle feeding States.

Table 2--Beef packing plant locations

Region	States with plants	Number of plants
East	Illinois, Wisconsin, Michigan, Pennsylvania	7
MidNorth	Minnesota, Iowa, Nebraska, Colorado	17
MidSouth	Kansas, Texas	12
West	Arizona, Utah, California, Idaho, Washington	7
Total		43

The total number of cattle within each of the radii (75, 150, and 250 miles) were calculated as a percentage of the total cattle purchased by a particular plant. The maximum distance that cattle were hauled to each plant and the distance that each plant went to purchase at least 95 percent of its cattle were also determined. On average, packers obtained about 64 percent of their cattle from within 75 miles of their plants, about 82 percent from within 150 miles, and almost 92 percent from within 250 miles (table 3). The average distance containing 95 percent of total cattle purchased was 270 miles. The maximum distance cattle were hauled was 1,140 miles with an average maximum distance of 655 miles. Several packers procured cattle from more than 1,000 miles away.

Table 3--Beef packers' procurement distances

Region	Cattle procured within:

	75 miles	150 miles	250 miles
		Percent	
East	31	52	78
MidNorth	64	83	94
MidSouth	76	90	95
West	72	90	93
Total	64	82	92

Nearly half of the plants procured cattle from Canada which, due to unavailability of location and distance information, were not included in the summary statistics. Thirty-four plants purchased less than 1 percent of their cattle from Canadian sources, while two plants purchased substantial portions of their cattle from Canadian sources.

Trade Area Overlaps

Trade area overlaps were determined as the percentage of a packer's total cattle procurement that originated from a county where cattle were also purchased by one or more other packers. Overlaps involving plants under common ownership were excluded from the analysis because these plants were assumed not to compete with one another. In the Middle region, several firms own multiple plants. Significant trade area overlaps (10 percent or more of a packer's total procurement) exist for all plants and among all regions. All plants had significant overlaps with at least 1 and up to 20 plants (table 4). Plants in the West had fewer significant overlaps than plants in the Middle region. Eastern plants had fewer significant overlaps as well, but had more overlaps with the Middle region than did the West region.

Table 4--Beef packing plant procurement overlaps

Region	Overlaps for plants	
	Total[1]	Significant[2]
	Number	
East	10-30	4-15
MidNorth	21-40	13-22
MidSouth	12-35	3-20
West	2-19	1-7

[1] Includes other plants owned by same firm.
[2] 10 percent or more of plant's total procurement, excluding same-owner plants.

Results

A number of significant overlaps in procurement exist between plants and regions. For example, if plants in the MidSouth depressed cattle prices enough to receive monopsony profits, the artificial depression of prices would divert cattle to the nearest plant in the West or the MidNorth paying a higher price. Thus, in order for a cartel formed in, say, the northeastern MidNorth region to be effective, it would have to include plants from the East because significant procurement overlaps also exist between the eastern MidNorth and East regions.

Based on the procurement overlaps, no region can be isolated as a separate geographic market. For most analytical purposes, the relevant geographic procurement market for fed cattle appears to be the entire United States. However, the shortrun competitive linkages among plants clearly grows more tenuous with increasing distance. As the competitive impacts are filtered through intermediate competitors, the strength of the impacts and the reaction speed is dissipated. Plants 1,500 miles apart probably would not have the strength or speed of competitive impacts to consider them part of the same market.

The ability of competing packers or feedlots to transport cattle between regions must also be incorporated in a trade area analysis. Nine plants shipped cattle over 900 miles, and the maximum distance shipped was 1,140 miles. The incremental cost of shipping 50,000 pounds of live cattle is approximately 30-40 cents/cwt (live weight) per 100 miles. Thus, a cartel formed in one part of the country would be vulnerable to competitive bids by more distant plants that would raise prices. A 2-percent increase in live cattle prices could warrant a 300-500 mile extension in procurement areas.

Considering actual procurement areas in 1992-93 and the incremental costs of extending those areas if cartel-like activity offered lower cost opportunities for nonmembers, the areas east of the Rockies and west of Pennsylvania appear to have sufficiently strong competitive interplay to be considered part of the same geographic market. Further, plants on the edges of that area have a competitive interplay with other plants near them. Mergers among plants within 1,000 miles would include them as potential competitors in the same relevant geographic market; only plants in the most distant parts of the United States or Canada might be excluded from a current competitor analysis, though their potential for building a competing plant in the area

would probably lead to their inclusion.

Procurement Volume Response to Relative Prices

If a plant's volume is significantly affected by a competing plant's price, conceptually they both should be in the same market for competitive or antitrust case analysis. Models expressing the quantity purchased by a plant as a function of its competitors' prices were hypothesized to examine market boundaries (see Box 1, "Volume-Response-to Price-Model" for additional detail on the model). These models were examined for plants and for firms to investigate procurement interactions on a daily basis.

Data

GIPSA obtained data covering April 5, 1992-April 3, 1993 from the procurement records of all plants slaughtering more than 75,000 head of steers and heifers per year.[7] The original data set consisted of transactions data for a total of 200,616 kill lots (transactions) of cattle slaughtered in 43 U.S. plants. The usable data set included 103,442 kill lots of cattle slaughtered in 28 plants. The final data set accounted for 67 percent of the 43 plants' steer and heifer slaughter procured in cash-market transactions. (See Box 2 for characteristics of lots analyzed.)

To standardize the daily delivered price series for each plant or firm, a quality-adjusted price was derived from the respective cattle cost series. This process involved estimating an implicit price model using cash market transactions data for each plant over all usable observations. These plant-specific models were then used to estimate the price that plant would have been expected to pay each day for a lot of cattle possessing a particular set of quality traits. The price adjusting model is:

> Price = f (cattle type {steer, heifer, Holstein, mixed}, yield grade, lot size, average hot weight of lot, no. of days between purchase and kill dates, wholesale value of cattle, and average plant price)

The plant-specific models were used to estimate a daily carcass beef price at each plant for a 150-head lot of steers that (1) graded 60 percent Choice or better, (2) were 95 percent yield grade 1-3, (3) had average carcass weight of 730 pounds, and (4) were purchased 7 days prior to slaughter. For each day that cattle were purchased in the cash market by the plant, the actual price paid for each lot was adjusted for quality and the simple average of these quality-adjusted prices was used as the plant price for that day. For the volume-response model, the adjusted daily price utilizing all usable transactions for each plant was used. For the share-response model, only the transactions in the specific region r were used to calculate adjusted daily prices.

Price series for all plants have a trend (nonstationary) over the study period. To deal with nonstationary prices, a detrending procedure was used to estimate the volume-response model. The daily weighted-average-adjusted price for all 28 plants was calculated, with each plant's price series then divided by this average price. Plants that were owned by a single firm may respond differently due to arbitrage possibilities in other plants and regions. The volume-response model was also estimated for firms to determine firm price responsiveness relative to individual plants. Geographic regions for the share-response model were State boundaries. Only two States were examined, Nebraska and Texas.

Plant Volume-Response Results

Prices at competing plants explained 5-77 percent of the variation in a plant's daily volume. For 22 of the 28 plants, prices at competing plants explained 42-77 percent of an individual plant's procurement volume. On average, plants' same-day-procurement volumes were inversely related to 1-2 other plants' prices. Plants'

procurement volumes were affected mostly by other plants within the same geographic areas.

Firm Volume-Response Results

Volume response for 9 firms (aggregated over the 28 plants) was examined based on same-day and previous-day prices at other firms. Analysis showed that for 8 of 9 firms, prices paid by other firms explained 50-94 percent of the firms' daily procurement volume. On average, firms' procurement volumes were inversely related to same-day or previous-day prices paid at two other firms. The four largest firms and five smallest firms exhibited a similar number of competitive interactions with other firms. However, the large firms responded mostly to price changes by the other top firms while the smaller firms generally responded to price changes by the other smaller firms.

Plant Share-Response Model

Nebraska and Texas plant share-response equations showed little responsiveness to other plants' prices. These results were due to the modeling approach, which was not well suited to analysis of packing plant behavior because it restricts the usable observations to an arbitrarily assigned region (States), and because the daily market share of each plant in a particular State does not appropriately reflect overall plant competitiveness.

Spatial Fed-Cattle Transaction Price Relationships

This objective addressed three issues. First, Granger causality for 28 plants was estimated to determine to what extent price leadership and dominant price discovery plants existed.[8] (When a plant's price affects prices at numerous other plants, that plant is a leader in price discovery.) Second, cointegration tests were used to determine whether longrun price relationships existed across plants. Third, error correction models were estimated to determine the speed of price adjustment to longrun spatial equilibrium (that is, how quickly plants change prices in response to price changes at other plants).

VAR Model

Several time-series analyses were conducted using daily plant prices. The first method employed was vector autoregression models (VAR). If prices at one plant statistically explain prices at another plant, then prices at the first plant affect prices at the second plant. For all 28 plants, 756 paired estimations were made. If the paired price effects are bidirectional (that is, one plant affects another and vice versa), 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.

Within the framework of the model, a plant may respond to actions by a plant not included in the analysis. Bivariate analysis may overstate the direct relationships between plants. The relationship may be indirect through prices at each plant being directly related to prices at other intermediate plants. Finally, lack of any paired price effects suggests that the plants may not operate in the same relevant market. This analysis used three types of VAR models: (1) using price levels, (2) using first-differenced prices (difference between today's price and yesterday's price), and (3) using error-correction models with first-differenced price data.

Cointegration Model

Spatial price integration refers to prices across plants that do not diverge widely from each other. Plants with cointegrated prices maintain a stable spatial price relationship, suggesting the plants are in the same relevant procurement market. The cointegration model provides estimates of how quickly prices at each plant respond to deviations from longrun spatial equilibrium. The speed of spatial price adjustment provides evidence of market participants' reactions to new information. The more rapidly prices across locations adjust to each other, the stronger the spatial competition. Strong spatial competition suggests that plants operate in the same geographic market. A speed-of- adjustment parameter close to one indicates a rapid adjustment and a value close to zero suggests slow adjustment.

Modeling Factors Related to Cointegration, Causality, and Speed of Adjustment

Degree of cointegration, level of causality, and speed of price adjustment to longrun equilibrium are all variables that contain additional information for economic analysis. Economic factors were expected to be related to all of these statistics. Three models were designed to test the relationships between selected economic factors and the strength of cointegration, significance of causality, and speed of adjustment.

Data and Plant-Adjusted Prices

The data cleaning procedures and usable data for these models were the same as described above in the section, "Cross Elasticities of Supply Using Transactions Data." Average daily cattle prices for each plant derived from delivered costs were adjusted using equation 3. Distances between plants were estimated as optimized routes using *Key Travel Map*.[9] Procurement overlap of plants represents the percentage (rounded to the nearest percent) of cattle purchases by a plant that overlap the other plant's procurement area. The percentage of cattle purchased in the cash market and the slaughter number were calculated from the original GIPSA-supplied data set.

VAR Results

The VAR models were first estimated using price levels. Statistical results indicated most prices were significantly affected by other plants' prices. Prices at 11 plants in 8 States significantly affected prices at 90 percent or more of the other 27 plants. At the other extreme, plants affecting prices at only a few other plants would suggest that these plants are price followers. Two plants affected prices at less than 30 percent of the other 27 plants. All but three of the plants affected prices at half or more of the other plants. This result suggests that price effects are strong with considerable information flowing across plants. Regionally, 80 percent of the paired comparisons for plants in Nebraska, Colorado, Kansas, and Texas were strongly related. For all 28 plants, 77 percent of the paired comparisons were strongly related.

The results from tests for causality of first-differenced prices contrast price-level results. Causal relations were still common, but less frequent vis-a-vis price levels. For first-differenced prices, no plants affected prices at 90 percent of the other plants, but four in Nebraska and Kansas affected prices at 80 percent of the other plants. In both VAR models (price levels and first-differenced prices), the High Plains (NE and KS) was a geographic center of price discovery.

Cointegration Results

The cointegration tests suggest that nearly all of the plants' prices were cointegrated with each other. Over 96 percent of the 756 plant paired comparisons were significantly cointegrated. This indicates that on a daily basis for the study period, a longrun spatial equilibrium price existed among the different plants; that is, prices across plants did not significantly diverge from each other. The conclusion can be drawn that market

information and arbitrage opportunities keep prices from diverging.

Error Correction VAR Results

With nonstationary data and prices at the various plants generally cointegrated, an error correction VAR model was also used. Similar tests to the other VAR models were used to analyze these results. Prices at 3 plants were affected by prices at 20 or more plants. Five plants affected prices at 20 or more other plants. Plants in Nebraska were price leaders, which is more consistent with the results from the first-differenced models than the price-level VAR models.

Speed-of-adjustment estimates indicate how rapidly price at a particular plant reacts to restore longrun spatial equilibrium when price changes at another plant. A value of one suggests immediate reaction within the same day and a value close to zero suggests slow reaction. The average speed-of- adjustment value was 0.33, suggesting that one-third of the deviations from spatial price equilibrium were typically corrected in 1 day.

Cointegration, Causality, and Speed-of- Adjustment Results

In general, most of the variables had the expected signs and were statistically significant. Plants located near each other exhibited prices that were strongly cointegrated and adjusted rapidly to price shocks, as expected. Procurement overlap was an important determinant of spatial price relationships. Cointegration increased, as expected, for plants whose trade areas overlap. Similarly, firms having overlapping trade areas were more likely to have significant price causality with each other. Plants with overlapping trade areas also tend to react more quickly to spatial price disequilibrium.

Plants that have high percentages of cattle purchased in the cash market were less likely to have prices cointegrated with other plants, slower to adjust to price changes elsewhere, and more likely to be influenced by price changes at other plants. This observation suggests that as plants reduce their use of the cash market, they may be more apt to use external markets (for example, cash markets in other regions or futures markets) as sources of market information to determine their cash market bids as opposed to incurring the increased costs of discovering local prices.

Larger plants had prices that (1) were less likely to be cointegrated, (2) responded more slowly to deviations from spatial equilibrium, and (3) were less apt to be affected by price changes at other plants. This result suggests that large plants operate more independently than smaller plants in discovering daily prices. Larger plants generally maintain slaughter nearer to capacity than smaller plants to achieve cost competitiveness. Thus, larger plants may have greater concern about operating near capacity than about small relative price differences. This situation could also be a result of larger plants simply having a larger burden of price discovery than their smaller counterparts. That is, larger plants have higher total costs associated with prices that do not accurately reflect local market conditions (since their purchases are greater). Therefore, they have greater need to lead price discovery, suggesting less cointegration and less adjustment to prices in other locations. Larger plants also may have more influence over prices because they purchase more cattle over larger regions.

Plants that were owned by the same firm were likely to have cointegrated prices. This indicates that firms having plants in different locations can more easily ship cattle across plant locations or can make purchases at the fringe of each plant's trade area that could be shipped to either plant. Speed of adjustment was positively related to whether the plants were owned by the same firm, suggesting that prices at different plants also adjust more rapidly to shocks if the plants are owned by the same firm.

Conclusions

In general, fed-cattle prices in all U. S. geographic regions are linked, suggesting a broad national market for fed cattle. Plant prices tend to move together, maintaining longrun spatial equilibrium, and arbitrage costs among the geographic regions are relatively small. This suggests that price information flows readily between plants and across geographic areas.

Within the national fed-cattle market, price linkages are strongest within the Midwest and Plains regions, with the leading price discovery points in Nebraska and Kansas. Plant prices in these two regions were strongly cointegrated, responding quickly to changes in price movements. However, the analyses using the 5-percent rule from DOJ/FTC merger guidelines suggest that Midwest and Plains regions may be in the same market, but the East, Southwest, and Northwest regions may not have the strength or reaction speed to be considered part of the same market.

Summary

The researchers employed standard econometric and statistical methods as did previous research examining similar issues. The project's findings, in general, were consistent with previous research.

The project accomplished most of the objectives in the request for proposals. Due to insufficient data on cow and bull procurement, no analysis was done to examine if "cows and bulls" and "steers and heifers" are one market or separate but linked markets.

The statistical and econometric analyses rely critically on the quality and representativeness of the data utilized. Approximately 50 percent of the original steer and heifer transactions data (for all or a portion of 28 of the 43 plants) were used for these analyses. The findings could be affected if purchase patterns of plants deleted from the analyses are different from plants included in the analysis. Twenty-three of the 28 plants in the analyses are owned by the 4 largest firms, which slaughtered approximately 78 percent of the cattle in 1992. By region, 3 of 7 plants in the East, 14 of 17 in the MidNorth, 9 of 12 in the MidSouth, and 2 of 7 in the West were in the analysis.

The analysis did not include cattle purchased through captive-supply arrangements. The omission of those cattle would be significant if geographic purchase patterns for them are different than for the cattle included in the analysis. A test for such differences was not conducted, but there is no *a priori* reason to assume they would differ. Data for many of the smaller plants or plants that slaughtered mixed maturities and varieties of cattle also were not used.

The three separate analyses arrived at the same general conclusion: fed-cattle prices in all geographic areas are linked, suggesting the presence of a broad national market for fed cattle. Some regional differences exist. Plants in the Middle (MN, IA, NE, CO, KS, and TX) region appear well linked, while the links between the West and East regions relative to the Middle region are not as strong.

This project provides strong evidence that measurement and analyses of concentration in beef packing need to focus on relatively broad geographic markets. Solid boundary lines cannot be identified because arbitrage and livestock movements result in substantial overlap among areas.

While the analyses of arbitrage costs, cross-price elasticities, and prices indicate the presence of broad

geographic markets, application of other standards might lead to different conclusions. For example, application of DOJ/FTC merger guidelines requires separate analysis for each proposed merger or acquisition.

Chapter 2
Price Determination in Slaughter Cattle Procurement

Introduction and Objectives

The project was led by Professor Gary W. Williams of Texas A&M University, and the research team included Professors Oral Capps, Jr., H. Alan Love, H.L Goodwin, Ernest E. Davis, and John P. Nichols, as well as Jim Bob Ward, Wendi Adams, Tanya Johnson, and Connie Schiller, all of Texas A&M.[10]

The original request for proposals called for the contractor to "examine individual purchase or sale transactions for slaughter cattle, and obtain appropriate supplemental information, to identify common procurement patterns and practices to explain and/or predict purchase decisions of beef packers. ... The findings should be used to develop theoretically-based empirical models, if possible, which can be used to test hypotheses regarding pricing and procurement behavior."
The research team proposed to identify and assess factors affecting procurement and pricing practices in the slaughter cattle market by analyzing daily transactions records of all major beef packing plants and by surveying major packers and large feedlots.

More specifically, the research team proposed to address the following questions:

* What were the characteristics, nature, and patterns of slaughter cattle procurement activities of the packing plants? This part of the analysis provides descriptive data summaries (means, standard deviations, and ranges) on cattle costs, seller characteristics (such as feedlot location and size), procurement and pricing methods, transaction characteristics such as lot size, yield, and quality, and plant characteristics such as size,location, capacity utilization, and ownership.

* Did statistically significant relationships exist among the patterns, characteristics, and dimensions of the slaughter cattle procurement activities of the plants relative to key characteristics of the purchase transactions? This analysis used the statistical analysis of variance (ANOVA) technique to identify groups of plants (grouped, for example, by size, location, or capacity utilization) associated with differences in average cattle costs, yields, quality, and other transaction characteristics.

* What major factors affected the choice of slaughter cattle procurement and pricing methods and the costs of cattle purchased by the plants? Firms choose among four common cattle procurement methods and three pricing methods. This part of the analysis used multivariate statistical techniques to identify the most important factors determining differences in cattle prices and the choice of pricing and procurement methods.

Two primary sources of data were used. The first included details of all slaughter cattle kill lots of 35 or more head for the 43 largest steer and heifer packing plants during April 5, 1992-April 3, 1993 (see appendix A). Daily slaughter summaries of all cattle purchased during that period also were used. The second source contained responses, from the packing plants and a random sample of feedlots, to surveys that provided qualitative information not available in the transactions data. Supplemental data on plant capacities and outputs were obtained from a Beef Packer Costs and Revenue Survey conducted by GIPSA (see appendix B).

The Transactions Data: Descriptive Summaries

The data set included information from 200,616 individual kill lot transactions, covering over 23 million head of cattle, during April 5, 1992-April 3, 1993. Buyers were the 43 largest steer and heifer slaughter plants, which were owned by 20 different firms. Standard data-editing procedures were used to identify data errors, omissions, and anomalies and to make appropriate statistical adjustments.

Although the primary concern of this study is with concentration among packers, the data indicate some concentration among sellers as well. While cattle were purchased from 19,396 different sellers, the 152 sellers (0.8 percent) who sold at least 32,000 head of cattle accounted for 43 percent of all head sold. Most sellers (88.8 percent) sold less than 1,000 head, and together accounted for only 13.9 percent of all cattle sold, or 3.2 million head.

Twenty-three of the 43 plants were owned by the "Big Three" packing firms: ConAgra (6 plants), Excel (6), and IBP (11). Together, the Big Three accounted for 75 percent of all transactions and 81 percent of all steers and heifers purchased. Plants operated by the Big Three are larger and used more intensively than other plants examined. Mean capacity (maximum daily throughput) at Big Three plants was 3,698 cattle per day, versus 1,343 at the other plants. Mean capacity utilization of the Big Three firms' plants was 76 percent, compared with 60 percent for the other plants.

On average, larger plants, whether operated by Big Three firms or not, paid more for cattle.[11] The largest plants (more than 4,000 head per day capacity) paid 2.7 percent more per head ($883 versus $860) than smaller plants (under 2,000 head per day). The differences also were apparent in the liveweight and carcass prices computed from delivered costs. Price per cwt, liveweight, was 5 percent higher at the large plants, and price per cwt hotweight (after slaughter), was 3 percent higher. As discussed later in the chapter, regression analysis showed that much of the difference in liveweight prices could be explained by differences in cattle and lot characteristics. Plants with higher levels of capacity utilization also paid higher prices on average.

The Big Three firms' plants accounted for 75 percent of all lots in the entire sample. They accounted for 88 percent of lots in the Southern Plains, 84 percent in Mountain States, and 78 percent in the West North Central region, none in the North Atlantic States, 39 percent in the Pacific region, and 60 percent in East North Central States.[12]

Large slaughter plants, regardless of ownership, differ from smaller plants in other important ways. Large plants typically deal in larger transactions. Plants with capacity in excess of 4,000 head per day averaged 148 cattle per transaction, while those with capacity under 2,000 per day averaged 76 cattle per transaction. The largest plants form regional networks with the largest feedlots: feedlots selling more than 32,000 head per year are located near the largest packers, and sell two-thirds of their cattle lots to the large plants. In turn, large packers obtain 42 percent of their lots from the largest feedlots. By contrast, the smallest packers obtain 19 percent of their lots from the largest feedlots.

Larger plants also obtain higher yields (hotweight of beef divided by liveweight of the cattle). The larger plants realized average yields of 63.04 percent while smaller plants averaged 61.3 percent.[13] Higher plant-capacity utilization also was associated with higher yields and larger lot sizes.

Four methods of cattle procurement appear in the transactions (table 1, see box for definitions): (1) forward contracts, (2) marketing agreements, (3) spot market, and (4) packer fed. Spot markets are used for most

transactions (82.3 percent of the lots and 78.8 percent of the cattle). Small firms use spot markets almost exclusively, whereas the Big Three packers are more likely to use alternative procurement methods. ConAgra, Excel, and IBP account for 73 percent of spot market transactions, but 88 percent of marketing agreements and 95 percent of forward contract transactions. Smaller firms are active in packer-fed procurement. For example, smaller firms in California and Arizona accounted for 42 percent of the packer-fed lots.

The largest feedlots are also more likely than small feedlots to use alternative procurement strategies. Feedlots handling more than 32,000 cattle per year accounted for 26 percent of spot market transactions, but 39 percent of forward contracts, 64 percent of marketing agreements, and 83 percent of packer-fed transactions.

On average, prices received for cattle offered under forward contracts were about 3 percent lower than those offered under other methods. In this case, lower prices likely reflect an adjustment for reduced risks that the method offers the sellers. There were no significant price differences among the three other methods.

Three different pricing methods are used: (1) carcass weight, (2) formula,[14] and (3) liveweight. Liveweight accounted for 46 percent of the transactions, carcass weight 37 percent, and formula 17 percent.

The pricing methods used typically varied with the procurement method (table 5). Liveweight pricing was the most common method for spot market transactions (54 percent), but was rarely used for forward contracts and marketing agreements. Most forward contracts (73 percent) were priced on the basis of carcass weight, while formula pricing was used for most marketing agreements. The Big Three firms, although relying primarily on liveweight and carcass-weight pricing, were far more likely to use alternatives as well. The Big Three firms handled 93 percent of the formula-priced lots and 85 percent of the carcass-weight arrangements. No significant differences in mean cattle costs were observed among the pricing methods.

Table 5--Use of alternative methods of cattle procurement and pricing

Pricing Method	Procurement method				Total
	Forward contract	Packer fed/owned	Marketing agreement	Spot market	
			Number of lots		
Carcass weight	10,297	2,467	1,221	61,416	75,408
Formula	2,931	792	14,663	15,184	33,570
Liveweight	821	2,220	104	88,401	91,549
Total	14,057	5,480	16,011	165,047	200,616

Note: Row and column entries do not sum exactly to totals because of omission of entries where method is unknown. For example, "forward contract" entries sum to 14,049; column total of 14,057 includes 8 forward contracts with unknown pricing methods.

In summary, one procurement method and two pricing methods are used for over 80 percent of transactions. The three largest slaughter firms rely primarily on spot market procurement and the two most common pricing methods (liveweight and carcass-weight), but they also account for most of the cattle marketed under other pricing and procurement mechanisms. With the exception of several smaller firms located outside the major feedlot and slaughtering regions, the other firms tend to rely almost exclusively on the most common pricing and procurement methods.

Packer Choices Among Procurement and Pricing Methods

The researchers analyzed factors that may influence a packer's choice of procurement method. This analysis required the use of a statistical model called a polychotomous choice model.

The objective in this type of model is to evaluate how changes in one variable, say distance, alter the probability that a lot will be procured and priced by one of the methods, while holding constant the values of other variables. This last point is a key reason for performing multivariate analysis. Many of the variables have some correlation: for example, plant capacity, lot size, and regional firm share all tend to be interrelated. In a simple analysis of variance, larger lot sizes could be associated with marketing agreements (for example), but that could be because larger plants buy larger lot sizes and use marketing agreements. Multivariate analyses enable one to determine whether large plants are more likely to use marketing agreements on larger lot sizes while holding capacity constant in the analysis.

The following explanatory variables were used in the procurement model:

(1) average revenue/cwt;

(2) plant capacity;
(3) capacity utilization;
(4) lot size;
(5) average weight per head;
(6) number of days between purchase and slaughter;
(7) the regional firm share of the packer;
(8) the distance between seller and packer;
(9) seasonality;
(10) cattle type;
(11) yield grade of the lot; and
(12) quality grade of the lot.

Over 182,000 observations were used in the analysis, after deleting observations with missing values. In such a large data set, a distinction needs to be made between substantive differences and statistically significance differences. It is common practice to report that an estimated coefficient is statistically significant, in the sense that we are reasonably sure that the true coefficient is not zero (for example, that the effect of changes in lot size on the choice of procurement is not zero). In huge data sets like this, almost all coefficients will be statistically significant; however, the estimated effect could be extremely small and thus of no practical importance (it might not be substantively significant).[15] In these cases, it is important to focus on the size of a coefficient, and not just its statistical significance.

The principal results for the procurement model are as follows. Forward contracting is strongly and consistently associated with high levels of capacity utilization, and is far less likely to be used for heavier and overfinished cattle. Forward contracting is also strongly associated with increases in the number of days between purchase and slaughter. Marketing agreements also are far less likely to be used for heavier and overfinished cattle, and seem to be used by individual packers to acquire specified yield grades.

Cattle procured from distant locations (more than 300 miles away) were less likely to be packer-fed or to come under marketing agreements. Packer-fed arrangements were more likely where regional packer concentration was high.

The procurement model can be assessed through its success in predicting actual procurement choices. Spot markets are used in 81 percent of all transactions. A poor model, one that simply assumed that spot markets would always be used, would be right 81 percent of the time. The procurement model developed by the contractor had mixed success. It overpredicted use of spot markets (predicted their use in 93 percent of the cases), but underpredicted the use of marketing agreements and packer-fed arrangements. It did a good job of predicting the use of forward contracts.

Analysis of Cattle Transactions Prices

A multivariate regression analysis was conducted of the factors causing differences in prices paid for slaughter cattle in 182,007 lots slaughtered between April 1992 and April 1993. Economic theory suggests that prices in a competitive market will vary with cattle characteristics; some characteristics are more valuable to packers (due to their effect on operating costs), and prices are likely to reflect these differences. Costs of negotiating a transaction may vary with some characteristics of the lot (such as lot size) or with the methods of procuring and pricing the lot. If so, prices will also be affected. Prices of beef also affect cattle prices. Finally, competitive factors, associated with the size of the buying firms and plants, and the number of local competitors, may be associated with differences in prices paid for cattle.

The price chosen for analysis was the delivered liveweight cost per hundredweight, as reported by packers in the transactions sample. The explanatory variables included:

(1)average revenue/cwt;
(2) plant slaughter capacity;
(3) lot size (number of cattle);
(4) average weight of the lot;
(5) regional concentration in the cattle market;
(7) distance between buyer and seller;
(8) cattle type;
(9) quality grade of the lot;
(10) yield grade of the lot;
(11) procurement method; and
(12) pricing method.

It is important to gauge the size and importance of the regression coefficients, in addition to statistical significance, when assessing regression results. The average liveweight price of cattle was $75.07 per hundredweight, with a standard deviation of $5.01. If prices are distributed normally around the mean, roughly 95 percent of the observations will fall within two standard deviations from the mean, or between $65.05 and $85.09.

Regression results are reported for all plants in table 6, along with means and standard deviations for the explanatory variables. Separate analyses were also conducted for three regions. With few exceptions, results of the regional models were generally consistent with results of the national model.

Table 6--Regression analysis of slaughter cattle prices[1]

Variable	Coefficient value	t ratio	Variable mean[2]	Standard deviation[2]
Constant	83.10	698.71	--	--
Average revenue/cwt	0.0095	23.22	$126/cwt	0.17
Plant capacity	0.0057	59.63	278/hr	75
Lot size	0.0021	29.97	120 head	99
Average weight in lot	-0.0078	-100.34	1,171 lbs	104
Regional concentration	-0.00021	-35.69	3,865 points	1,185
Distance<100 miles	0.19	11.06	52.6 percent	NA
Distance, 100-300 miles	-0.07	-3.56	32.4 percent	NA
Quarter 2, 1992	-0.014	-0.74	26.5 percent	NA
Quarter 3, 1992	-1.84	-102.07	23.4 percent	NA
Quarter 1, 1993	3.73	196.55	22.7 percent	NA
Dairy	-5.45	-148.26	4.0 precent	NA
Fed Holsteins	-5.59	-119.63	2.0 percent	NA
Heifers	-0.93	-56.25	32.5 percent	NA
Mixed	-3.65	-126.40	6.4 percent	NA
Yield grade 1	0.32	11.11	6.0 percent	NA
Yield grade 3, 4, or 5	-0.15	-11.28	46.1 percent	NA
Select	-0.11	-6.91	28.9 percent	NA
Forward contract	-1.74	-63.76	7.6 percent	NA
Packer fed	-0.57	-14.34	2.9 percent	NA
Marketing agreement	0.54	17.99	8.6 percent	NA
Carcass weight	-0.18	-5.00	37.9 percent	NA
Formula	-0.25	-17.07	18.2 percent	NA
R-squared .54				

[1] Dependent variable is delivered liveweight lot cost per hundredweight.
[2] Entries with no standard deviation are binary or qualitative variables indicating a condition that was either true or false. Entries for these variables in the variable mean column are the actual percent of transactions for which the condition was true.

The largest sources of price variation were associated with temporal movements in prices and with differences

in cattle types. Nationally, prices in the third quarter of 1992 were lowest, averaging $1.84/cwt below prices in the base period, which was the fourth quarter of 1992. Prices in the first quarter of 1993 exceeded prices in the base period by $3.73/cwt.

Lots chiefly made up of fed steers or heifers accounted for 87.5 percent of all sample lots. Lots made up chiefly of heifers brought prices that were 93 cents/cwt below steer-dominated lots sold in otherwise comparable transactions, and cattle types other than fed steers and heifers brought substantially lower prices. Lots with a predominance of dairy cows were priced $5.45/cwt lower than steer-dominated lots, and fed Holstein lots were $5.59 lower, all else equal. Mixed lots brought prices $3.65 below steer- dominated lots.

Plants realized different average revenue per cwt for the beef they sold. These variations had a small association with cattle prices. Since differences in average revenue across plants primarily reflect differences in the extent of further fabrication of carcasses, the result suggests that cattle prices are not strongly affected by the extent of fabrication, but that plants that do more fabrication are likely to pay slightly higher prices for cattle.

Other measures of cattle quality and lot uniformity had statistically significant price effects. Lots that chiefly contained "select" grade cattle brought prices that averaged 11 cents/cwt below lots chiefly containing "choice" grade cattle. Lots that chiefly contained yield grade 1 brought prices 32 cents/cwt above those containing mostly yield grade 2 cattle, which in turn brought prices 15 cents/cwt above lots dominated by cattle in yield grades 3, 4, or 5.

Lot characteristics, other than cattle type, also affected cattle prices. A one-standard-deviation increase in lot size (219 versus the mean of 120) increased prices by 20.8 cents/cwt. A one-standard-deviation increase in average cattle weight, from a mean of 1,171 pounds to 1,275, reduced prices by 81 cents/cwt. That is, prices were discounted for heavier weights that may have been due to lots containing a large proportion of overfinished cattle or heavier exotic breeds.

Firm and plant characteristics had statistically significant, and in some cases large, effects on cattle prices. Nationally, larger plants paid more for cattle, on average. A 75-head-per-hour increase in slaughter capacity (one standard deviation), was associated with a price increase of 43 cents/cwt. Over the relevant range, the smallest plants (100 head/hr average) paid $1.14/cwt less than the largest plants (300 head/hr average) for comparable cattle with comparable lot characteristics. At about 1.5 percent, the $1.14 price difference, which adjusted for cattle and lot characteristics, was much smaller than the 5-percent price difference discussed earlier in the descriptive statistics.

The effects of plant size were not consistent across three separate regional analyses. Results for the region including Illinois, Iowa, Minnesota, and Wisconsin were consistent with the national results. However, the region encompassing Arizona, California, Idaho, Utah, and Washington showed that larger plants paid significantly lower delivered prices for cattle. Results showed no significant association between plant size and cattle prices for the primary cattle feeding and slaughtering region including Colorado, Kansas, Nebraska, and Texas.

The researchers defined nine marketing regions to measure concentration: Nebraska; Texas; Kansas; Colorado; California and Arizona; Idaho, Washington, and Utah; Iowa and Illinois; Wisconsin and Minnesota; and Pennsylvania. Herfindahl index values were calculated for each marketing region.[16] For purposes of comparison, a market with only four equal-size firms would generate an index of 2,500, while a market with only two equal-size firms would generate an index of 5,000. Seven of the nine regions had index

values between 3,000 and 5,500, and one had only one packer.

Higher levels of regional buyer concentration had a negative and statistically significant, but small, effect on cattle prices. A one-standard deviation increase in the Herfindahl index (an increase of 1,185), was associated with a decline in cattle prices of 25 cents/cwt.
Procurement and pricing methods had an important influence on cattle prices. Approximately 81 percent of the cattle lots were procured through spot markets. Because forward contracts reduce feeders' price risks, they should bring lower prices, and they do. Cattle obtained through forward contracts (7.6 percent) were priced $1.74/cwt below cattle on the spot market, while cattle obtained through marketing agreements (8.6 percent) brought prices that were 54 cents/cwt greater than spot market prices ($2.28 above forward-contracted cattle). Packer-fed cattle were priced 57 cents/cwt below comparable cattle on the spot market. Prices reported for packer-fed cattle are uninformative because they are not arms-length transactions--packer-fed cattle are transferred between two units of the same firm.

The statistical analysis indicated that prices for cattle priced on a carcass-weight basis were about $0.18 per cwt lower than prices for comparable cattle priced on a liveweight basis. Prices for cattle priced on a formula basis were more than $0.25 per cwt lower than prices for comparable cattle priced on a liveweight basis.

Packer and Feeder Surveys

Questionnaires were sent to the 42 largest beef packers and a sample of 195 large feedlots to obtain information on each group's perceptions and preferences regarding key aspects of their trading relationships, including pricing and procurement methods, weight and shrink arrangements, and the effects of feedlot and cattle characteristics on cattle prices and sales. Twenty-six packers (62 percent) and 116 feedlots (60 percent) responded to the survey.

Most packers reported that prices are discounted for a set of cattle characteristics: dark cutters (an appearance defect that lowers the quality grade of a carcass), muddy coats, inconsistent lot quality, excessive ear/loose skin, unusually large or small frames, unusually high yield grades, or poor seller reputations. Feedlots reported sharply different perceptions. About a third of the feedlots agreed that frame and yield grade characteristics led to discounts, and just over half thought that dark cutters and muddy coats brought discounts.

The two groups agreed on price premiums. Slightly more than half in each group thought that premiums were paid for cattle in higher quality grades, and 40 percent thought that greater lot uniformity brought price premiums.

Packers and feeders were also asked to rate a series of feedlot services and characteristics, scoring each on a series ranging from 1 ("not important") to 5 ("very important"). Average feedlot scores were systematically lower than packer scores (feedlot operators were less likely to think that a service was "very important"), but the rankings were quite similar. Each group rated "honesty," "reliability," and "dependable delivery dates" as being important (mean scores over 4).

The next highest rankings went to factors that affect cattle quality ("feed mostly steers," "feed mostly non-Brahman cattle") and factors that affect lot uniformity. Here, though, the packers assigned higher scores that were consistent with their responses regarding price discounting.

Differences in perception were reported for other questions as well. Packers thought that poor and

inconsistent cattle quality and undesirable cattle types were major reasons for lost sales at a feedlot. Feedlot operators placed much lower valuations on those factors.

Packers and feedlot operators also responded to a series of questions regarding the use of various methods of pricing and procuring cattle. Feedlots reported that the cattle they sold in 1993 were priced primarily on a liveweight basis, while packers reported using a wider variety of methods and less reliance on liveweight. The packers' responses were more consistent with the transactions data analyzed in this study. Each group reported a strong preference for liveweight pricing.

About half of the respondents in each group reported using forward contracts in 1993, albeit for small shares of total marketings (less than 10 percent of cattle), consistent with the analysis of transactions data. Larger feedlots were more likely to sell some cattle on contract. Each group reported a preference for liveweight pricing for contract cattle.

Conclusions

Prices for slaughter cattle varied over the course of the study year, in response to temporal fluctuations in demand and (presumably) feeding costs. This finding is consistent with findings reported in chapters 1 and 3. In each relevant analysis, temporal shifts were the most important determinant of differences in cattle prices.

Prices also varied with cattle characteristics. The statistical analysis shows that prices varied with cattle type, average weight, quality grade, and yield grade, with higher prices being paid for more desirable types, weights, and yields. This finding is consistent with the findings of the other projects included in this study. The survey of large packers and feedlots suggests that prices also vary with other indicators of cattle quality, such as observable evidence of the ease of processing.

The researchers also found that, controlling for temporal effects, cattle quality, and lot characteristics, different firms and plants paid different prices for cattle. The regression analysis, the summary statistics, and the analysis of variance results all found that larger plants paid more for cattle. The largest plants appeared to pay more for cattle, on average, than did the smallest plants in some regions. The regression analysis provided limited evidence of local market power; regional buyer concentration had a negative and statistically significant, but small, association with cattle prices. Buyer concentration tended to be higher in fringe areas, where smaller plants were located.

Most cattle are sold through spot market transactions, and most are priced using one of two common pricing methods. Some firms use alternative pricing and procurement methods for a significant number of transactions, but few rely on the alternatives as a primary mechanism for acquiring and pricing cattle. Alternative pricing and procurement methods were associated with small differences in prices paid. In the regression analysis, cattle purchased under forward contracts brought $1.74 per cwt. (liveweight) less than delivered prices for similar cattle obtained on the spot market, while market agreement cattle brought prices about 54 cents above spot market prices.

The researchers also found some significant concentration among feedlots. Less than 1 percent of sellers were in the largest size class (sales of more than 32,000 head per year), but accounted for nearly half of all cattle sold.

The largest feedlots sold most of their cattle to the largest beef packing plants, and were more likely than small feedlots to use alternative procurement and pricing methods.

Summary

This study's results revolve around three key issues.

1. The study provides useful insight into procurement and pricing methods. It describes the incidence of each method, and identifies some key linkages to firm, plant, and cattle characteristics. The researchers identified linkages between buyer concentration and packer-fed procurement; they show that differences in beef prices received by packers are associated with their choice of cattle procurement method; and they highlight linkages between procurement methods and cattle characteristics.

Packer-fed cattle represent a form of vertical integration. The economics literature on vertical integration suggests that firms are likely to integrate vertically when buying and selling sides of the market are highly concentrated and when buyers and sellers must make significant irreversible investments. In that case, use of spot markets would be risky, and integration could be used to induce investment. It is instructive, in this instance, that packer-fed arrangements are used more in regions (Arizona,California, and Colorado) with few slaughter plants. These plants arrange their own supplies with nearby feedlots.

Nearly all firms relied on spot market procurement and liveweight or carcass-weight pricing methods. Nine of the 20 firms examined relied exclusively on spot markets, while 4 others used spot markets for at least 98 percent of their cattle. Fourteen of the 20 used *only* liveweight or carcass weight pricing. Three firms accounted for over 96 percent of all cattle procured through marketing agreements. Three firms accounted for more than 86 percent of packer-fed cattle.

There were only isolated instances where packer feeding or formula pricing accounted for a significant portion of an individual plant's or firm's purchases.

The data suggest clearly that there is a strong element of distinctive corporate strategy in procurement decisions. Since marketing agreements, packer feedings, and formula pricing are strongly identified with only a few firms, future analyses may benefit by combining data analysis with close case studies of the relevant firms.

(2) The analysis suggests that differences in lot characteristics are important determinants of differences in prices paid for cattle lots. The regression analysis shows the price effects of differences in the number of cattle in a lot, the average weight of the cattle, the mix of cattle types, and measures of yield and quality grade. Each factor affected cattle prices. Moreover, since lot characteristics differ across packers and geographic regions, future analyses of prices across regions, buyers, or sellers need to account for differences in cattle characteristics.

The price analysis shows little evidence of exercise of market power, based on price differences across regions where buyer concentration varied. The effect of buyer concentration on prices paid was statistically significant and negative (lower prices where concentration is high) but quite small. The most concentrated regions in this study were not dominated by the Big Three firms. Rather, the most concentrated regions are on the fringes of the major cattle feeding and slaughter locations. Conagra, Excel, and IBP owned 23 of the 43 steer and heifer slaughter plants in the sample, but none of the plants in the most concentrated regions of California, Arizona, and Pennsylvania.

This finding is consistent with the analysis reported in chapter 1. In that analysis, plants outside of the principal slaughter regions were found to pay lower prices for cattle. It is also possible that the estimated

negative effect of concentration was in part due to other factors associated with the characteristics of the fringe regions that had higher levels of concentration, rather than to concentration.

The analyses reported in other chapters found that prices do not behave as if procurement markets are local, and this analysis found only small effects of buyer concentration on price. Concentration could be mismeasured, either because the concentration measure excludes the shipments of small competitors (only sample plants enter the calculation) or because the relevant markets are improperly defined. But perfect measurement would not be likely to change the results. Because of the way the Herfindahl indexes are defined, adding small rival shares will not materially change the index values. Given the pattern of price variation observed in this analysis and in the analyses reported in the other chapters, there appears to be no geographic redefinition of markets or respecification of the model that would give buyer concentration a large effect.

The results suggest there is little scope for the exercise of local market power. That could be because transportation costs for fed cattle are not high enough to isolate a market. If it costs 30-40 cents/cwt. (liveweight) to ship 50,000 pounds of live cattle an additional 100 miles (see chapter 1) then a 2-percent reduction in local live cattle prices could make it attractive for sellers to ship cattle another 300 to 500 miles, to more distant plants.

Linkages to other markets, specifically markets for feeder cattle, could also limit the exercise of market power in slaughter cattle markets. Transportation costs for feeder cattle are lower than for slaughter cattle. If a slaughter plant became the sole buyer in a region and sharply reduced its offer prices for slaughter cattle, the prices that local feedlots could offer for feeder cattle would also fall. As a result, feeder cattle would be shipped to feedlots in other regions with more favorable prices. Over time, the supply of fed cattle to a monopsony slaughter plant could be quite price elastic (flat, therefore affording little effective market power in procurement of cattle), if the supply of feeder cattle to the region was price elastic.

(3) A final caution is in order. This project used a large volume of data for a single year. The strength of the database lies in its size, precise price information, and detailed measures of cattle, buyer, seller, and transaction characteristics. Those strengths allowed the researchers to provide useful estimates of the effect of the characteristics on cattle prices, and to assess the likely effects of spatial differences in buyer concentration on prices during the period studied. The database does not, however, cover a long period of time. It cannot be used to assess how long-term shifts in consumer demand ultimately affect cattle prices and cattle characteristics, and it cannot be used to estimate the effect of changes in nationwide concentration on cattle prices.

Chapter 3
Role of Captive Supplies in Beef Packing

Introduction and Objectives

A study of the use of captive supplies was conducted by Clement E. Ward and Stephen R. Koontz, both of Oklahoma State University, and Ted C. Schroeder and Andrew P. Barkley of Kansas State University.[17] GIPSA asked the contractors to determine the extent to which various captive-supply arrangements are used, and to determine relationships between captive supplies and the structure, conduct, and performance of slaughter cattle markets. Of particular interest is the effect of captive supplies on prices paid for cattle. Captive supplies are defined as cattle that beef packers own or contract to purchase 2 weeks or more before slaughter.

Packers may contract for future delivery of livestock through an exclusive marketing agreement with individual feedlots, in which price is based on market prices at the time of slaughter. Packers may also purchase cattle through forward contracts in which price is specified in advance or is based on futures prices or some other formula. Different types of captive-supply arrangements may be used in different circumstances and have different impacts.

The contractors proposed three specific objectives:[18]

* Determine the purpose, strategic use, and extent beef packers and cattle feeders use captive supplies;

* Estimate demand and supply for forward-contract cattle and how changes in market conditions affect longrun spot and contract fed-cattle sales and prices (longrun determinants of captive supplies);

* Estimate the impacts of deliveries of captive-supply cattle on transaction prices for fed cattle (shortrun effects of captive supplies).

Findings Of Packer and Feeder Surveys

The 25 largest beef packing firms and 25 largest cattle feeding firms were surveyed. Fifteen of the 25 feeding firms and 6 of the 25 packing firms responded to the voluntary mail survey.

Survey responses supported the industry perception that use of captive supplies is seasonal, generally higher in the late spring and early summer months. Cattle feeder respondents generally believed meatpackers use captive supplies to guarantee a given quantity of cattle of a given quality, to gain leverage in the cash market, and to better control deliveries of cattle. Insufficient information was received from packers to ascertain their reasons for using captive supplies. Feeders and packers agreed that current cash market prices most determined delivery date of captive-supply cattle.

Respondents identified three impacts from use of captive supplies: (1) captive supplies benefit packers who use them; (2) captive supplies ensure a given supply of cattle to packers; and (3) captive supplies reduce market information since fewer prices are reported publicly. Cattle feeders additionally believed that captive

supplies benefit feeders who use them but benefit packers more, and that captive supplies result in lower cash market prices.

Shortrun Effects of Captive Supplies

The shortrun analysis sought to evaluate relationships between captive supplies and cash or spot-market prices. The analysis consisted of modeling and estimating three sets of relationships:

* interdependencies between *deliveries* of captive supplies and cash market prices of fed cattle;

* relationships between *inventories* of captive supplies and cash market prices of fed cattle; and

* price differences between fed cattle purchased in spot or cash markets versus those purchased by captive-supply methods.

Impacts of Captive-Supply Deliveries on Cash Market Prices

Cattle placed on feed usually will reach slaughter weight and finish within 3-6 months. As cattle approach slaughter weight and quality, there is a market window of 3-4 weeks during which they may be delivered for slaughter. During this period, packers could purchase some cattle in the cash market, and then decide the volume and timing of deliveries from inventories of captive-supply cattle. Alternatively, they could make their decisions about taking deliveries from captive-supply inventories first, then determine the volume to purchase in the cash market.[19]

The researchers developed an economic model to describe the simultaneous nature of decisions regarding daily flows from captive-supply inventories and the cash market price impacts of those flows (see box, "Model 1"). The model hypothesizes that (1) the percentage of available forward-contracted cattle taken by a plant on a given day is determined by basis, market price, and percentage plant utilization; (2) the percentage of available packer-fed cattle taken on a given day is determined by expected market prices, cash market prices, and percentage plant utilization; (3) the percentage of available marketing agreement cattle taken on a given day is determined by the nearby futures market price (a measure of expected cash price), the current cash market price, and percentage plant utilization; and (4) decisions to take deliveries of captive-supply cattle and to make purchases in cash markets are made simultaneously.

Impacts of Captive-Supply Inventory on Cash Market Prices

A second model analyzed the impact of the current inventory of captive-supply cattle on current prices for cattle purchased in the cash market. This model hypothesizes that prices for cattle in the cash market are determined by current captive-supply inventories instead of deliveries from those inventories (see box, "Model 2").

Impact of Captive-Supply Procurement Practices on Cash Market Prices

A third model was specified to estimate the relationship between prices for fed cattle and the method of procurement. This model hypothesizes that the prices of cash-market purchases and prices of captive-supply purchases are determined simultaneously by the same set of variables. However, it hypothesizes differences between prices depending on the source (that is, cash versus the three captive-supply forms) (see box, "Model 3").

Data Used for the Analysis

Data were collected by GIPSA from 43 plants owned by 20 firms for each transaction of 35 head or 40,000 pounds or more slaughtered from April 5, 1992, through April 3, 1993. GIPSA provided data on 200,616 cattle procurement transactions (observa- tions). The final data set contained 139,189 usable observations from 28 plants owned by 9 firms. Missing data for selected variables reduced the num- ber of observations available for some of the analyses. The final data set accounted for 71 percent of total steer and heifer slaughter by the 43 plants surveyed.

The information obtained by GIPSA for each kill lot transaction is reported in appendix A. Delivered prices used in the analysis were computed from packers' costs for cattle. Secondary data used in the analysis included daily boxed-beef cutout values from USDA-AMS, and daily live cattle futures market prices from the Chicago Mercantile Exchange.

Findings

Packers made decisions to purchase cash-market cattle and to take delivery of forward-contracted and marketing agreement cattle, but not packer-fed cattle, simultaneously. Changes in the percentage of a packer's inventory of captive-supply cattle purchased on a given day affect the prices packers pay for cattle in the cash market. An increase of 1 percentage point in a packer's inventory of forward-contract cattle that the packer purchased on a given day was associated with lower prices (3-5 cents per cwt) paid for cattle in the cash market on that day. For marketing agreement cattle, the same increase was associated with even lower prices (10-41 cents per cwt) paid for cattle in the cash market on that day. An increase of 1 percentage point in a packer's inventory of packer-fed cattle that the packer purchased on a given day was associated with changes in cash-market prices varying from 30 cents per cwt lower (14-day inventories) to 20 cents per cwt higher (28-day firm-level inventories).[20]

One day's deliveries of forward-contracted, marketing agreement, and packer-fed cattle usually equaled less than 4 percent of the 28-day inventories of the respective types. Thus, a 1- percentage-point increase in one day's deliveries would represent a large change in the percentage of captive supply. As a practical matter, any changes in one day's use of captive supply, as measured by the model, would be relatively small, and therefore any effect on prices paid for cattle purchased in the cash market would be very small.

The impacts on cash-market prices from the absolute inventory of captive-supply cattle were consistently negative and small. However, when considering the possible differential impacts of captive-supply methods, results were mixed. According to the statistical findings, a 1,000-head increase in the inventory of forward-contracted cattle was associated with an increase of 1-2 cents per cwt in prices paid in the cash market. A 1,000-head increase in inventories of marketing agreement cattle was associated with prices in the cash market 1-4 cents per cwt lower. A 1,000-head increase in 28-day inventories of packer-fed cattle was associated with prices 17-18 cents per cwt lower in the cash-market. However, a 1,000-head increase in 14-day packer-fed inventories measured at the plant level was associated with an increase of 7 cents per cwt in cash market prices.

Forward-contract prices were $3.02-$3.16 per cwt lower on a dressed-weight basis than were prices for cash-market cattle. Prices for marketing agreement cattle were 7-10 cents per cwt higher, while prices for packer-fed cattle were not significantly different from cash-market prices.

On balance, a relatively weak relationship was found between cash-market prices and deliveries of cattle from inventories of captive supplies, and between cash-market prices and inventories. The negative association between deliveries of marketing agreement cattle and cash-market prices, and between cash-market prices and inventories of marketing agreement cattle were consistent. Increased deliveries of forward-contracted cattle were associated with reduced prices in the cash market while increases in inventories of forward-contracted cattle were associated with increased cash-market prices. Increased deliveries of packer-fed cattle from 14-day inventories were associated with reduced cash-market prices, but increased deliveries from 28-day inventories were associated with increased prices in one version of model 1.

Prices paid for forward-contracted cattle were significantly lower than for cattle purchased in the cash market. Prices paid for marketing agreement cattle were significantly higher than prices paid in the cash market, and prices paid for packer-fed cattle were not significantly different from those paid for cash-market cattle.

In conclusion, captive supplies had a small price reducing impact in the cash market over the 1-year study period. However, some cautionary notes:

* Numerous factors explained the variation in cash-market prices for fed cattle, but at best, only 86 percent of the variation was explained by the models. Including other variables that systematically accounted for additional variation in fed-cattle prices could alter the signs and significance of the coefficients on the key captive-supply variables.

* Results differed by time of year and by captive-supply type. Consequently, the same analysis with data covering a different time period could result in different findings.

* The statistical analysis found that the overall shortrun impact of captive supply on prices for fed cattle tended to be negative, and that prices differed among procurement methods. However, the size of the price effects and differences were generally small enough that it would be difficult to observe cash-market prices and note such price differences except for the difference between forward-contract and cash-market prices. The latter results are consistent with the theoretical expectation that forward contracting serves as a mechanism for transferring price risks from producers to packers.

Longrun Determinants of Captive Supplies

The research analyzed longer term relationships based on monthly data. The first part of this analysis was the development of a model of fed-cattle markets incorporating the demand for and supply of captive-supply cattle.

The mixture of cash-market, forward-contracted, and marketing agreement cattle in the total supply offered by feedlots was hypothesized to be determined by the cost of uncertainty, which would be reflected in price variation. The model assumes that sellers are willing to accept a discounted price for forward-contracted and marketing agreement cattle in return for a reduction in price variability. Packers' relative demand for cash-market cattle versus forward- contracted and marketing agreement cattle was assumed to be a function of the relative price of forward-contracted and marketing agreement cattle versus cash-market cattle. The model was used to determine the theoretical impacts of a change in each of the explanatory variables on prices of cash-market, and prices of forward-contracted and marketing agreement (FCMA) cattle.

The model indicated that independent increases in cash-market price variability would lead to decreases in prices of FCMA cattle and increases in cash-market prices (table 7). Increases in cash-market demand would

cause all cattle prices to increase. The effect would be greater on cash-market than FCMA prices, so the difference in prices would increase. Increases in FCMA demand would also cause all prices to increase, but FCMA cattle prices would increase more, so the price difference would decrease.

Table 7--Theoretical predictions of the fed-cattle monthly market model

Explanatory variable	Effect of increase in explanatory variable on:		
	FCMA price	Expected cash-market price	Price difference*
		Direction of change	
Cash-market price variability	-	+	+
Cash-market demand	+	+	+
FCMA demand	+	+	-
Feedlot capacity	-	-	+
No. of feeders relative to no. of packers	-	-	+

* Expected cash-market price minus price of forward-contracted and marketing agreement (FCMA) cattle.

Increases in feedlot capacity or number of feeders relative to packers would cause both cash-market prices and prices of FCMA cattle to decline. In each case, FCMA prices would decline more, so the difference between cash-market and FCMA prices would increase.

An empirical model was developed to estimate the determinants of captive-supply use (see box).[21]

The empirical model was estimated for all captive-supply, packer-fed cattle, and other captive-supply cattle (forward-contracted and marketing agreement) to evaluate the determinants of each type.[22] Additional estimates were derived with the data split into two groups--16 plants having monthly average slaughter of less than 50,000 head, and 15 plants with slaughter averaging 50,000 head or more--to determine if captive-supply use was related to the size of the packing plant. An additional set of estimates was derived with plant-identity variables added to the model.

Data Used for the Analysis

The research used data provided by GIPSA on monthly packer-fed, forward-contracted, and marketing agreement cattle use by 31 plants (12 firms) during 1989-93. Cash prices were obtained from USDA, AMS, deflated by the personal consumption expenditures implicit price deflator. Futures price data were obtained from the Chicago Mercantile Exchange, and U.S. slaughter data were provided by the Western Livestock Market Information Project.

A slight downward trend in total captive-supply use was observed over 1989-93, but captive-supply levels

fluctuated annually. FCMA cattle accounted for around 75 percent of the total captive supply, or an average of 9,100 head slaughtered per plant per month. Just under 3,000 head of packer-fed cattle were slaughtered each month.

Packer feeding remained fairly constant as a percentage of slaughter, averaging just over 6 percent. FCMA cattle decreased from 18 percent of annual slaughter in 1989 to 15.5 percent in 1993. Both the level of packer feeding and packer feeding as a percentage of slaughter remained fairly constant across months, whereas use of FCMA cattle increased in April, June, and December. However, the peaks in FCMA cattle as a percentage of slaughter in April and December were due in part to decreases in total slaughter levels.

A large variation in volume of captive supply used was observed across plants. This variability does not appear to be related to ownership of the plants or to plant location.

Findings

The empirical model explained roughly 45 percent of the variation in use of total captive supply. As hypothesized, the statistical results showed a strong positive relationship between cash-market prices 4 months prior to slaughter and the volume of total captive supplies, for all plants and for large plants. A 1-percent increase in cash prices led to a 1.7-percent increase in the use of total captive supplies by all plants, and a 2.7-percent increase by the large plants. However, a 1-percent increase in cash-market prices led to a 1.4-percent reduction in the use of total captive supplies by the smaller plants. Higher futures basis (cash price minus futures price) had a slight negative effect (less than 0.1 percent) on volume of total captive supply used by all plants and by the largest plants. There was no statistically significant effect of futures basis on use by the smaller plants.

Contrary to the initial hypotheses, cash-market price variability did not have a significant effect on total captive supplies. The expected quantity of cattle available, as measured by slaughter 1 year prior, also was not a significant determinant of total captive-supply use. Slaughter 1 year prior may not be a good measure of current cattle availability.

Plant utilization 1 year prior had a highly significant and large positive effect on total captive-supply use. For each 1- percent increase in plant utilization 12 months prior, use of total captive supply by all plants and large plants increased 0.8 percent, and 1.7 percent for small plants. The researchers interpreted this as evidence that plants use captive supplies to maintain slaughter levels at full capacity because of the high costs associated with operating below capacity.

The two plant capacity variables had a highly significant and large, but complex, effect on captive-supply use. Examined together, the variables indicated that as capacity increases, use of total captive supply decreases until capacity reaches approximately 58,000 head per month. Above that size, volume of captive supply increases as capacity increases. These results suggest that use of captive supply is more intensive by small plants and large plants, but that plants of average size use less.

Results for packer-fed cattle only, and for FCMA cattle only, were similar to those for all forms combined. The same explanatory variables had only slightly different relative effects in each case, except cash price variability had a small positive effect on the volume of FCMA cattle used by large plants. Also, a 1- percent increase in packer feeding had a very small negative effect on the use of FCMA cattle by all plants and by large plants, and a 1- percent increase in use of forward contracting and marketing agreements had a similarly small negative effect on the use of packer feeding. These results suggest that some plants substitute between

packer feeding and other forms of captive supply.

Utilization and capacity variables continued to be important determinants of captive-supply use when plant-identity variables were included in these models. Cash prices were not found to be a significant determinant of captive-supply use when plant identity was included. The plant-identity variables showed that plants differ in their use of packer feeding and other captive-supply arrangements, even after allowing for other determinants of captive-supply use.

Conclusions

Day-to-day decisions to purchase cattle on the cash market and to use forward-contracted cattle were found to be made simultaneously. Daily increases in the rate of deliveries of forward-contracted and marketing agreement cattle had a slightly negative effect on daily cash-market cattle prices. The overall effect of captive supplies on prices paid for cattle in the cash market was negative but small.

Prices paid for cattle delivered under forward contracts on any given day were about $3.00 per cwt lower (dressed-weight basis) than prices for similar cattle on the cash market. Prices for cattle obtained through marketing agreements were about 10 cents per cwt higher than prices for cash-market cattle. There were no significant differences between prices reported for cattle transferred from packers' own feeding operations and prices they paid for similar cattle on the cash market.

Increases in cash market price were found to lead to increases in the monthly quantities of packer-fed, forward-contracted, and marketing agreement cattle used by large plants. Cash-market price variability is positively associated with the volume of forward-contracted and marketing agreement cattle used by large plants, but does not determine volume of packer-fed cattle. Increased plant utilization has an important positive effect on use of all forms of captive supply, which was attributed to the high costs of slaughtering below full capacity. Some packers substitute between packer feeding and other forms of captive supply in attempting to attain full-capacity slaughter levels. The use of captive supplies was found to be higher among small plants and large plants than for plants characterized by average capacity levels.

After accounting for other hypothesized determinants of packer feeding, forward contracting, and marketing agreement use, the use of these types of captive supply was extremely variable, with the variation apparently not systematically related to firm identity, plant location, or geographic region.

Summary

The research used new, abstract models and complex variables to analyze the effects of captive supply. The findings are therefore subject to validation. The analysis examined factors that affect packers' decisions to use captive supplies, but did not address fundamental economic forces that affect packers' and feeders' decisions to enter into captive-supply arrangements.

Data were examined covering monthly use of captive supplies by 31 plants (12 firms), and daily decisions by 28 plants operated by 9 major firms. The 28 plants included in the shortrun analysis accounted for 82 percent of 1993 federally inspected steer and heifer slaughter, and the 31 plants in the longrun analysis accounted for 87 percent.

Increases in cash-market price and cash-market price variability were found to lead to increases in the monthly quantities of captive supply used by large plants. These findings are consistent with the hypothesized relationships derived from the researchers' theoretical models.

The researchers concluded that increased plant utilization had a positive effect on use of all forms of captive supply, thus rejecting the hypothesis that as utilization falls, plants increase the use of captive supply. A possible problem with the analysis is that the utilization variable measured plant utilization 12 months prior, not current levels. Current capacity utilization and use of packer feeding and other forms of captive supply may be jointly determined by other factors, suggesting that a simultaneous model may be more appropriate than the one employed. The relationship between plant utilization and the use of captive supplies thus remains unresolved.

The researchers concluded that plant capacity has a positive effect on use of all forms of captive supplies for the largest and smallest plants. However, the results suggest that large plant size alone does not necessarily lead to an increase in use of packer feeding or other captive supplies. Plants with higher levels of utilization also tend to make greater use of captive supplies to maintain those levels. While these findings are likely related to packers' attempts to avoid the high costs of slaughtering below capacity levels, causality is uncertain.

Some plants appear to use packer feeding and other captive supply in attempting to maintain slaughter levels at full capacity, with expected prices determining their specific use. The findings indicate that expected higher prices increase the volume of packer feeding and other captive supply used, whereas expectations of falling prices lead to decreases.

Forward-contracted cattle appear to be priced lower than cash-market cattle on the same day, while marketing agreement cattle are priced slightly higher. The overall effect of increased use of captive supply on shortrun prices paid for cattle in the cash market appears to be negative but small. The study provides an overall description of the role of captive supply in the industry that suggests, at most, rather modest net effects.

Chapter 4
Effects of Concentration on Prices Paid for Cattle

Introduction and Objectives

A study of the effects of concentration on cattle prices was conducted by Wayne D. Purcell, S. Murthy Kambhampaty, Paul J. Driscoll, and Everett D. Peterson, all of the Virginia Polytechnic Institute and State University.[23] The request for proposals called for an empirical analysis of the effects of concentration in slaughter cattle procurement markets on prices paid for slaughter cattle, taking into account all other variables that may affect prices paid in particular markets.

Growth of firm and plant size in recent years generally is believed to have led to increased technical efficiency and lower per-unit processing costs. There is also concern that increased firm size may have enabled firms to exert market power. The contractors proposed to test for the possible exercise of market power using plant-level data. The research approach was based on an underlying model of packing plant behavior that assumed packing plants maximize profits given fixed plant capacity.

The Behavioral and Empirical Models

The model assumed that a profit-maximizing plant will increase its purchases of cattle in a given week until the additional or marginal revenue (net of cattle cost) earned from products derived from the last animal slaughtered is exactly equal to the additional cost of purchasing, slaughtering, and processing that animal. That is, a firm increases output as long as there is a positive net return on each additional unit produced, and profits are maximized at the output level where marginal revenue equals marginal cost.

The model was constructed to allow additional purchases by packers with market power to increase the prices paid for cattle. The empirical test for market power, the primary objective of the research, determined whether the marginal cost of increasing output explicitly included an increase in cattle prices resulting from increases in cattle purchases by individual plants (see box on the following page).

The effect of increased purchases on prices paid was estimated with an econometric model that included a system of equations for (1) variable slaughtering and processing costs, (2) the share of variable costs due to labor and energy, and (3) the equality of marginal revenue and marginal cost. A model that omits the equation for equality of marginal revenue and marginal cost postulates only cost-minimizing behavior. This study's model included the equation that postulates profit-maximizing behavior. If firms do not behave so as to maximize profits, as assumed in the model, the model cannot distinguish between the effects of market power and other factors that affect prices.

Data for the Analysis

The model required data on individual plants' costs and revenues for each period in which cattle purchase decisions are made, assumed to be 1 week. Cost and revenue data were obtained via mail survey from the 43 largest U.S. steer and heifer slaughter plants.[24] Weekly data for some cost items were estimated from monthly data because the costs were assumed to be fixed or constant within individual months (such as salaried labor),

or because practical considerations made it unlikely that data would be available on a weekly basis (such as electricity consumption). Data were requested for April 5, 1992-April 3, 1993.

The data requirements were stringent and several data problems were encountered. Firms were contacted to obtain corrections and clarifications; data and analyses were adjusted when possible and appropriate to complete the research.

Plant Size

Shortrun cost functions included a measure of plant size to represent fixed inputs. Plants were requested to provide maximum chain speed (head per hour) for slaughter and fabrication at the beginning and end of the data period.[25] Beginning and ending slaughter chain speeds were averaged to measure size of plants that only slaughtered cattle. The average of beginning and ending fabrication rates was used to measure size of plants that performed fabrication.

Outputs

Plants provided volume and value data on weekly shipments of nonfabricated carcasses; fabricated whole-carcass equivalents; fabricated primals; fabricated subprimals; other fabricated cuts; and trimming, boneless beef, and grinding material from the fabrication line.[26] These categories distinguish products by the amount of processing required to produce them.

The yield of products from a cattle carcass was expected to fall within a relatively narrow range based on industry norms. However, the fabrication yields (calculated from weekly observations on fabricated product shipments and weight of carcasses from slaughter) varied widely, and differed considerably from an expected 0.75 cutability ratio of fabricated meat to chilled carcass weight. Some nonfabricating plants reported weekly carcass shipments that differed considerably from the volume of carcasses slaughtered that week.

The plants may not have used uniform definitions in reporting shipments of fabricated versus nonfabricated products, and some week-to-week variation in cutability ratios may be due to changes in week-to-week inventory. Thus, the researchers chose to use chilled carcass weight from slaughter as a standardized measure of output across all plants. Output price was then calculated as the sum of revenues from products and byproducts net of the cost of in-shipments, divided by the chilled carcass weight of slaughter.

The researchers initially proposed to group plants by type of fabricated product shipped, under the assumption that plants producing similar products use similar technology and have similar cost structures. They eventually decided instead to distinguish only between slaughter-only and slaughter-fabrication plants, due to uncertainties about the uniformity of fabricated product definitions used by the plants.

Cattle and Meat Inputs

Plants reported the weekly dressed carcass weight of cattle slaughtered and total delivered cost of the cattle. They also reported volumes and delivered cost of in-shipments of carcasses and meat. Plants were dropped from the analysis if in-shipments of carcasses, fabricated meats, or byproducts constituted a large, undefined share of total volume. It was believed that such plants would confuse the cost relationships.

Nonmeat Operating Inputs

Plants provided weekly data on hours and costs of hourly labor for total plant operations, slaughter operations, and fabrication operations. Weekly overtime hours and costs, and fringe-benefit costs were also obtained. The plants provided monthly salaried labor costs and employee counts.

Plants provided data on both regular and overtime hours and pay by week. Overtime and regular hourly labor were combined as a single measure of labor input.[27] A weighted average of regular and overtime wages, including the cost of fringe benefits, was calculated.

Monthly fuel and electric costs and quantities were allocated to weeks based on the number of working days in each period. Quantities of fuel and electricity used were converted to an index based on energy content. A price index was calculated by dividing the cost of fuels and electricity by the fuel quantity index. A quantity index was created for all other variable inputs (water, sewage treatment, packaging, and other materials) based on total product output, assuming these inputs were used in fixed proportions to output. A composite price of all other inputs was calculated by dividing total costs of the inputs by the other input quantity index.

Final Data Set Used

The analysis was conducted using plants that were located in two regions, one extending from Nebraska to the Texas Panhandle, including southwestern Iowa and Colorado, and the second consisting of Washington and the Idaho Panhandle. Four plants in those regions were excluded from the analysis because they had significant volumes of carcasses shipped in from other slaughter plants. Five additional plants were dropped because of data questions regarding key variables.

Fifteen plants were included in the analysis. Four plants shipped only carcasses and 11 shipped fabricated meat. In some instances, plants did not provide weekly data for the final week, and in other instances the beginning monthly data periods could not be exactly matched to weeks in the weekly data. Some weekly observations thus had to be dropped from the data and the final analysis covered less than a full 52-week period. The slaughter-only plants had an average chain speed of 216 head per hour, with weekly shipments averaging 5.9 million pounds of chilled carcasses (table 8). The 11 plants shipping fabricated product averaged 273 head per hour fabrication rate, and shipped an average of 9.6 million pounds of fabricated product per week.

Table 8--Selected production, cost, and revenue measures for selected beef slaughtering and fabricating plants, by type of plant, April 1992 - March 1993

Measure	Plants by type of production	
	Slaughter only	Slaugter-Fabrication
	Head/hour	
Slaughter chain speed	216	308
Fabrication chain speed	NA	273
Weekly meat inputs:	1,000 pounds	
Cattle slaughtered, dressed weight	5,933.3	14,868.6
Inshipments:		
Carcasses	0.00	219.3
Fabricated meat	0.00	31.0
Weekly product shipments:		
Carcasses	5,907.2	698.1
Fabricated meat	0.00	9628.1
Trim, bnls., gndg. material from fab.	0.00	1,493.7
Revenue per Cwt Shipped:[1]	Dollars	
Carcasses	112.39	96.03
Fabricated meat	NA	165.95
Hides	7.53	8.02
Trim, bnls., gndg. material from fab.	NA	80.35
Hourly labor per cwt. shipped:	Hours	
Slaughter[2]	.143	.139
Fabrication[3]	NA	.469
Costs per cwt. shipped:	Dollars	
Cattle for slaughter[4]	120.29	120.21
Meat purchased[5]	NA	102.85
Total operating costs:		
Slaughter operations[6]	3.14	3.17
Fabrication operations[7]	NA	9.28
Total plant operations[8]	3.05	9.56

Measure	Plants by type of production	
	Slaughter only	Slaugter-Fabrication
Hourly Labor:		
Slaughter[6]	1.64	1.56
Fabrication[7]	NA	5.00
Total[8]	1.50	4.83
Energy[8]	.27	.45
Miscellaneous inputs[8]	.32	2.02

[1] Carcass, fabricated meat, and trim revenues are per cwt. of each type of product shipped. Hide revenues are per cwt. of carcasses from slaughter.
[2] Hours per cwt. of total chilled carcass weight from slaughter.
[3] Hours per cwt. of fabricated product shipped.
[4] Delivered cost of cattle per cwt. of total chilled carcass weight from slaughter.
[5] Cost per cwt. of inputs shipped into the plant.
[6] Costs per cwt. of carcasses shipped.
[7] Costs per cwt. of fabricated product shipped.
[8] Costs per cwt. of all beef and edible byproducts shipped.

Source: Calculated by Packers and Stockyards Programs, GIPSA, for the 15 plants included in the analysis reported in this chapter.

Estimation Results

The test for market power requires that the estimated cost function have properties consistent with a theoretical shortrun variable cost function. The researchers estimated the system of equations excluding the profit-maximizing relationship, imposing only cost-minimizing behavior on the two groups of plants, to determine if the estimated functions had the required properties. Average variable costs were found to increase as plant size (measured by chain speed) increased, contrary to the results that should be observed when comparing shortrun cost functions for different sizes of plants. This could have been due to failure of chain speed to adequately measure size, variation in the processing activities performed by the plants in each group, or econometric problems such as model misspecification.

A variation of the model was estimated, replacing chain speed as a measure of size with a variable to account for the effects of factors unique to individual plants. This "fixed effects cost function" model accounted for differences in processing activities and size across plants. When the fixed effects cost functions were estimated separately for the slaughter-only plants and for plants that both slaughtered and fabricated, the results yielded cost functions consistent with theory and indicated that both groups of plants operated in the range of increasing returns to scale.

When the profit-maximizing condition was added to the system, results suggested that the test for market power was positive and statistically significant. Addition of the profit-maximizing condition, however, yielded substantially different results for the cost curves compared to results obtained when the condition was omitted. Moreover, one of the cost functions implied an unusual marginal cost curve having an unexpected

inverted <F2B>U<F255D>-shape. The results called into question the adequacy of the model's specifications, and thus the findings for the test of market power.

Additional tests were performed to examine further whether the data were consistent with profit-maximizing behavior as postulated in the model. These tests were based on the proposition that the profit earned with the price-quantity combinations (both inputs and outputs) used by a profit-maximizing plant in any given week must equal or exceed the profits that the plant would have earned had it used the quantities of any other week with the current week's prices. In addition, changes in output were assumed to affect cattle and fabricated beef prices, with different price adjustments used to simulate various market-power effects. If input-output combinations from other weeks, in combination with the current week's adjusted prices, would have yielded greater profits, this would be evidence that the plant was not profit-maximizing.

Results of the tests on weekly data varied with the degree of market power assumed, but overall the results suggested that plants failed to select profit-maximizing levels of cattle purchases a significant proportion of the time. Similar results were obtained when the tests were applied to the data aggregated into monthly periods, and to analysis of firm-level behavior.

Conclusions

The behavioral model originally proposed for the test for the exercise of market power was rejected because the firms did not meet the requirement of profit- maximizing behavior, as incorporated in the model. Shortrun cost functions estimated using chain speed as a measure of size showed that variable costs increased as plant size increased, whereas variable costs were expected to decrease with increases in plant size. The analysis suggested that either maximum chain speed is not an adequate measure of plant size or that activities of the plants are too diverse to assume universal technology. Using a modified model incorporating fixed plant effects assuming only cost minimization yielded reasonable estimates of cost functions. Analysis of the latter model with the addition of a profit-maximizing condition produced questionable cost functions. Additional nonparametric test results on a plant-by-plant basis also led to rejection of the assumptions necessary for the model to be used to assess the extent of market power.

The researchers concluded that different models of firm behavior may be necessary to find an appropriate test for market power. One or more of the underlying assumptions of the model used may be invalid. That is, firms' behavior may be consistent with profit maximization, but the chosen model did not accurately represent the manner in which profit-maximizing decisions are made, including the possibility that firms have some influence over prices paid for cattle. Additional information on the behavior of packers may be needed to construct more appropriate models to test for the exercise of market power.

Summary

The analysis did not support any conclusions about the exercise of market power by beef packers. It appears that improved models are needed to more fully incorporate relevant determinants of firms' behavior.

Characteristics of, and possible errors in, the data became an important issue in the research. Some of the data issues resulted from legitimate week-to-week variations in firms' operations that could not be accommodated for lack of weekly inventory data. For example, some of the variation reported for fabricated product yields may reflect changes in inventory levels. Data collected for this research have not been collected previously. Considerable time was spent contacting firms to obtain corrections and clarifications, but complete resolution of the inconsistencies proved impossible within the time and resource constraints on the project. Likewise,

plant-level models of weekly decisionmaking and competitive behavior have not been attempted previously for the meatpacking industry. Although progress was made in this analytical effort, further work is needed to develop models appropriate for the analysis of competitive issues in the industry under differing market conditions and changing industry structure.

Given the data difficulties, uncertainties about firms' planning horizons, and the fact that decisions are made without perfect knowledge, a conclusion that plants do not attempt to maximize profits based on this research is premature. More knowledge was gained about data requirements and analytical models than about packers' use of market power. This is an important, but difficult, issue to resolve. The data already collected need to be analyzed further and this analysis of concentration's effects needs to be replicated.

Chapter 5
Vertical Coordination in Hog Production

Introduction and Objectives

A study of vertical coordination in the U.S. hog-pork industry was conducted by HRGL Partnership (Marvin L. Hayenga and John D. Lawrence at Iowa State University, and V.J. Rhodes and Glenn A. Grimes at the University of Missouri).[28] In its request for proposals, GIPSA asked the contractor to analyze and report on the economics of vertical coordination in the hog-pork subsector and its implications for structure, conduct, and performance in the hog slaughtering and processing industry.

The contractor's objectives were to:

* Determine the relative importance of each type of vertical coordination in hog production.

* Document the types and provisions of these ownership or long-term contract arrangements.

* Determine motivations and incentives for those vertical arrangements.

* Analyze the interrelationship between vertical arrangements and packing industry structure, conduct, and performance.

* Assess likely future levels and location of vertical coordination relationships and their implications.

The contractor focused on contractual arrangements by the largest pork packers, hog producers, and feed companies. Recent innovations in vertical coordination arrangements had not been documented until this study. Many of these linkages involve hog producers, integrators, contractors, feed suppliers, breeding stock suppliers, and meatpackers. Of particular interest were the linkages that packers have been initiating back into hog production via ownership, joint venture, or production contracts. Also of growing importance are new initiatives by packers to establish long-term marketing arrangements with producers. The contractor conducted telephone surveys of large pork packers, hog producers, and feed companies.

Packer Survey Findings

The 20 largest pork packing companies (plants with slaughter capacity exceeding 4,000 head per day) were surveyed by telephone during January and February 1994. Respondents were the packers' hog procurement managers or senior managers knowledgeable about hog procurement. The survey focused on: (1) packers' linkages with hog production operations during 1993, (2) packers' expected changes in their hog procurement arrangements over the next 5 years, (3) packers' perceived advantages and disadvantages of their production or long-term marketing contracts with hog producers, and (4) information regarding packers' solely or jointly owned hog production operations.

The 19 packers that responded to the survey slaughtered 78.6 million hogs in 1993, 86.5 percent of the 90.9 million head of federally inspected commercial hog slaughter. Packers procured 87 percent of their market hogs for slaughter through spot markets in 1993 (table 9).[29] Sixty-eight percent of market hogs were obtained

via spot-market purchases delivered to the packer's plant or buying station, 2 percent were spot-market purchases at terminal or auction markets, and 16 percent were spot-market purchases through dealers or order buyers.

Table 9--Packer coordination arrangements, 1993 and 1998 (projected)

Arrangement	1993 Volume	1993 Volume	Expected 1998 Volume*
	Mil. head	*Percent*	
Spot at plant or station	53.3	67.8	58.9
Spot from terminal or auction	1.9	2.4	1.2
Spot from dealer or order buyer	12.9	16.5	6.1
All Spot Market	**68.1**	**86.6**	**66.1**
Contract -- continuing	3.0	3.8	11.2
Contract -- definite length	5.4	6.9	14.4
All Marketing Contracts	**8.4**	**10.6**	**25.6**
Own or joint facilities	1.1	1.4	5.1
Production contract	0.7	0.9	1.6
All Own/Contract Production	**1.8**	**2.3**	**6.7**
Other	0.3	0.4	1.6
TOTAL	**78.6**	**100**	**100**

*Based on respondents' expected percentages for 1998 and weighted by respondents' 1993 volume.

The very low volume of hogs procured from terminals and auction markets is a dramatic change from the marketing system of 60 years ago when those were the dominant methods of livestock marketing. The direct movement of hogs from larger producers to packers is clearly dominant. Dealers or order buyers still have a minor but important presence in hog procurement, typically supplying marginal needs for a large number of packers. In a few cases, a dealer's or order buyer's business was exclusively with an individual packer, in essence the same as direct purchases by a packer employee.

Packers procured approximately 11 percent of their hogs through long-term (6 months or longer) marketing contracts. Two percent of the packers' hog supply came from production in their own or joint facilities (slightly more than 1 percent) and contract producers' facilities (almost 1 percent).[30]
By 1998, packers expect to purchase only 66 percent of their hogs through the spot market, a 24-percent

decrease from 1993 levels. That decline is expected to be split between reduced buyer/dealer volume and reduced spot-market purchases at plants or buying stations.

Large packers expect to increase sharply their use of long-term marketing contracts, from 11 percent in 1993 to over 25 percent in 1998. Over the same period, packers also expect to triple their own/contract production from 2 to 7 percent.

Marketing Contracts

Marketing contracts typically require an independent hog producer to deliver a specified quantity and quality of market hogs to a packer on or near a specific date. Over half of the packers' hogs acquired through long-term marketing arrangements involved formal written contracts with definite terms of length, often ranging from 4 to 7 years. Half the packers using long-term marketing contracts required a minimum quantity and quality of hogs to be supplied or specified requirements regarding their breeding or genetics.

Prices generally were calculated using a formula base price plus a carcass merit adjustment, determined by the backfat or estimated lean content of the carcass. The base price is typically calculated from a specified single-market price or an average of several market prices reported by USDA that are considered representative by both parties to the contract. If there are concerns about the local market's price representativeness, the base price is tied to markets that are some distance from the local market. More innovative contracts attempt to limit or share risks by linking prices to hog production costs. This is accomplished by incorporating feedgrain or soybean meal prices in formula-priced contracts, by establishing upper and lower bounds on prices paid over the length of the contract, or by sharing the gain or loss from extremely high or low prices outside of the established price boundaries.

Only a few of the packers reported providing resources to the hog producer as part of the contract. Two packers offered credit or loan assistance and one provided breeding stock. Packers are increasingly providing detailed carcass cutout data to producers to assist in hog growers' management decisions.

Packers reported the primary advantages of entering long-term marketing contracts as improved quality, quantity, and consistency of hogs supplied to their plants. A few packers began contracting to emulate rivals' initiatives or to anticipate future demands of large hog producers. Profitable benefits noted by packers include improved plant efficiency, better scheduling, and reduced transaction costs. Packers reported few disadvantages of long-term contracts, among them increased price risk and reduced flexibility.

Packers believed hog producers benefited from long-term contracts in the form of lower financial risk, increased capital availability, and assured access to market outlets. Some packers mentioned lower transaction cost, assured price, quality premiums, complete cutout data, and guaranteed marketing as additional advantages for producers. The most frequent disadvantage noted by packers was the reduced flexibility allowed pork producers under contract. Packers also cited the limited ability of producers to shop around for a better price when contract prices were lower than spot-market prices.

Production Contracts and Packers' Own Production

Only 4 of the 19 packers reported significant hog production in their own, joint, or production contract facilities. The most frequently noted reasons for their own hog production were increased volume and improved control of quality and volume. Other benefits included increased profits and reduced risks from joint ventures.

Packers perceived the benefits to contract producers (growers) or joint venture partners as assured market access, improved financial leverage, capital availability, and reduced risk. Packers perceived few disadvantages for producers, the most important being reduced independence and flexibility.

Expected Producer/Packer Linkages

Packers expect closer working relationships with producers in 1998. These longer term linkages could take the shape of closer or continuing packer-supplier relationships based on quality of hogs provided, guaranteed access agreements, and voluntary integration. Packers expect the need for a consistent supply of quality hogs will be met by a variety of these arrangements, with packers controlling more of their slaughter needs either by long-term arrangements or wholly owned/joint venture hog production. Some packers expressed the opinion that terminal markets would not survive the increased linkages between packers and producers.

Packers expect the hog-pork marketing system will be lower cost with tighter margins. In this environment, the less efficient, smaller producers and packers will have a more difficult time surviving, thus consolidating both the producing and packing industries. With more alliances between packers and producers, less reliance on daily buying in the spot market is expected. Packers have some concerns about relying upon reported market prices for some pricing arrangements, increasing risks for packers involved in longer term pricing arrangements. Some packers feel that restrictive legislation in some States may shift the geographic location of hog production as packers increase their own or contract production of hogs.

Large Producer Survey Findings

The 45 largest hog producers were surveyed by telephone. Respondents were either the owner, CEO, or a top executive. These producers reported marketing a combined 13 million head of hogs and pigs in 1993, consisting of 11.75 million head of market hogs, 1.1 million feeder pigs, and 150,000 head of breeding stock. The mean number of hogs and pigs marketed per producer was 261,725, ranging from 62,000 to more than 1.5 million head.

For the 45 largest producers, 26 were classified as hog and pig production operations, 4 were packer-owned/operated or joint ventures, 2 were divisions of large corporations engaged in both packing and feed sales, 6 were owned/operated by feed companies, 3 were hog producers with breeding stock, 2 were regional farmer cooperatives, 1 was a major builder of hog facilities, and 1 was also a major turkey producer. Twenty-one producers were located in the North Central region (NCR)[31] and 24 in the rest of the Nation (RON).

These producers marketed their 13 million hogs and pigs in 22 States. Forty percent were marketed in 10 States in the NCR. The three leading States in the NCR were Iowa (17.1 percent of the group's national marketings), Minnesota (7.4 percent), and Missouri (7.2 percent). North Carolina and Virginia together accounted for an additional 30 percent of marketings, with the remaining 30 percent in the RON.

Marketing Contracts and Other Pricing Methods

Twenty-seven of the largest producers marketed 8.7 million market hogs, or three-quarters of the 11.75 million head marketed by all 45 producers through marketing contracts. Twenty-one of these producers marketed 100 percent of their market hogs through marketing contracts. Seven megaproducers marketed more than 500,000 head each in 1993. Five of these sold 100 percent of their production through marketing

contracts.

Sixteen of the 45 producers marketed 100 percent of their production through the spot market while 6 others also used the spot market to varying degrees. Spot-market sales accounted for just over 18 percent of the 11.75 million market hogs. Approximately 8 percent of the market hogs were controlled by packers via ownership, joint venture, or contract production.

The large producers in the NCR marketed a higher proportion of their hogs through spot markets, 26 percent compared with 14 percent for large producers in the RON. Large producers in the RON marketed 81 percent through marketing contracts compared with the NCR's 63 percent.

The largest hog producers expect closer ties with packers in the future. These producers projected that their 1998 marketings via spot transactions will decrease to 10 percent, marketing contracts will remain relatively unchanged at 73 percent, and packer-owned/joint ventures will increase to 17 percent (table 10).

Table 10--Largest hog producers' marketings

Marketings	1993			Expected 1998*		
	NCR	RON	ALL	NCR	RON	ALL
			Percent			
Spot Market	26	14	18	11	10	10
Marketing Contracts	63	81	75	59	81	73
Packer Owned/Joint Venture	11	5	8	30	9	17
TOTAL	100	100	100	100	100	100

*Weighted by 1993 size of marketings.

Marketing Contract Provisions

Prices received by 23 of the 27 producers selling through marketing contracts were based on a formula derived from current prices reported at several Midwest markets (terminals and direct) plus premiums or discounts for quality. For the four other producers with marketing contracts, two had a formula that shared price risk, one had a guaranteed floor price, and one had a cost-of-production agreement. These 27 producers reported that 63 percent of their contracts were written. They also reported that 59 percent of their contracts were for a fixed period, while the other 41 percent continued until canceled. Contractual periods ranged from 1 to 15 years. Fifteen of the 27 producers reported having a contract with a single hog packer while the other 12 had contracts with more than one packer. Also, packers usually attached requirements to contracts regarding the quality, size, and timing of the producers' market hog deliveries.

Contract Advantages and Disadvantages

Producers indicated an assured market outlet as the most important benefit of marketing contracts. RON producers ranked benefits (in order of importance) as assured market outlet, reduced market (price) risk, better prices, and reduced transaction costs. NCR producers ranked reduced market (price) risk as most important, with decreased transaction costs second, and an assured market outlet third. Producers along the east coast (50 percent of RON marketings) particularly valued an assured market outlet because there are so few packers, and packing plant capacity has been fully utilized in recent years.

On average, RON producers were less critical of forward contracts than were NCR producers. Only 13 percent of the NCR responses indicated "no costs or problems" with contracting, while just over half of the RON responses had no criticisms. Of the disadvantages reported, most noted was producers' inability to shop for better price bids from other packers. Others included reduced flexibility and lower returns.

Producers were also asked their perceptions of the advantages and disadvantages of marketing contracts for packers. Producers most frequently suggested packers could secure a regular supply of hogs. Other perceived benefits to packers were lower buying costs, better quality hogs, and improved scheduling. The two most suggested disadvantages were potential higher prices and loss of flexibility in packers' operations.

Production Contracts

Finishing contracts are one type of production contract. For finishing contracts, contractors (other producers, packers, or feed companies) typically provide feeder pigs, feed, medication, and technical supervision. Growers typically provide production facilities, labor, utilities, and waste disposal. Grower compensation schedules varied, but the two most common schemes paid fees per head or per pound of gain with incentives and/or discounts. The grower incentives (positive or negative) generally involved feed efficiency and sometimes death loss.

Thirty-nine of the 45 largest producers reported some production contracts. For these producers, the volume of their output under production contracts ranged from a very small percentage of total production to 100 percent. A total of 7.5 million hogs were produced under finishing contracts: 27 percent (2 million) were considered as vertical integration and 73 percent (5.5 million) as horizontal integration. Vertical coordination is a contract between a packer and hog producer, horizontal coordination between a hog producer and another grower (to finish hogs).

Sixteen of the 21 large producers in the NCR contract-finished 46 percent of their 1993 market hogs, while 23 of the 24 large producers in the RON contract-finished 73 percent. For both groups, 63 percent of total hog production was under production contracts.

Producers cited advantages to production contracts as (1) supplementation of available capital, (2) reduced need for hired labor, (3) good community relations, and (4) faster growth. The disadvantages reported by producers included higher costs and lower returns, increased managerial responsibilities, and increased risks.

Only 28 large producers had pigs farrowed under contract, 11 fewer than those who had market hogs finished under contract. Large producers supplied 60 percent of the feeder pigs necessary for market hog production from their own facilities, while producing approximately 40 percent via feeder pig contract farrowing operations. To maintain their own farrowing operations, 39 of the largest producers also reported having contractual or continuing arrangements with sellers of breeding stock.

Expected Industry Changes

Larger producers expect to get bigger by 1998, increasing vertical ties with packers through contracts (marketing and production) and vertical integration. Producers expect a greater emphasis on hog-pork genetics and carcass characteristics, mostly driven by consumer tastes and demands. Producers also anticipate a diminished role for feed companies.

Twenty-five producers listed possible benefits from industry changes, including improved product quality and market acceptance, increased production efficiency, and improved transfer of information and technology. Fifty-nine producers listed potential disadvantages, including tighter producer operating margins, increased environmental regulation, less independence and flexibility in a more vertically aligned marketing system, decreased packer competition for market hogs, and more opposition to corporate farming.

Large Feed Company Survey Findings

Twenty-one of the 22 largest feed companies were contacted in a telephone survey regarding their involvement in vertical coordination in the hog-pork industry. Three firms had little involvement in hog feed sales. Eighteen firms had annual hog feed sales ranging from 20,000 to over 200,000 tons, with trade area closely following the geographic distribution of hog production. Four of the 18 firms were the feed divisions of the large hog producers reported above. Individuals responding to the survey included CEO's, sales or swine product managers, or upper-level managers overseeing a firm's pork industry involvement.

With the exception of the four feed divisions of large hog producers, feed companies had very little involvement in hog production through contracts or in their own facilities. Their principal involvement in hog production was by financing hog feed and/or single groups of pigs. Even this involvement was minor, with over 70 percent of hog feed sold on a cash basis.

Financing Programs

The 18 feed companies offered three basic types of financing programs: short term (30-60 days), ongoing working credit or a rolling credit account, and determined by feeding schedule. Financing varied from feed only to more complex programs including variable inputs and hog facilities. All finance programs required a written agreement between the borrower and the feed company.

Feed companies' primary benefit from their financing programs was increased sales of hog feed. Other benefits mentioned included closer ties to the producer, better future positioning, size economies, competitiveness, and improved dealer network support. Two main disadvantages reported were increased risk of unpaid receivables and increased capital requirements. Other disadvantages cited were increased cost of selling feed and less profitable use of capital.

The feed companies' perceived benefits of their finance programs to hog producers focused on increased access to credit, specifically, more credit, better terms (not necessarily interest rates), less paperwork and oversight than with conventional financing, and convenience of payments and recordkeeping. Perceived disadvantages to producers included producers' loss of flexibility, higher interest rates, and higher feed costs.

Challenges to Feed Companies

Feed companies anticipate tighter operating margins, the need to provide specialized diets and programs specific to clients and/or genetic lines, and the need to provide more specialized client services such as

financing, research, and information dissemination. Other challenges facing feed companies included increased government regulation and rapid technological change. All firms predicted increased consolidation in both the hog feeding and feed company sectors.

Conclusions

During 1993, the extent of packer-producer contractual relationships or packer-owned/controlled production was too small to have major competitive impacts. Industry participants expect a more consolidated, tightly linked hog-pork industry by 1998. By 1998, the majority of market hogs purchased by packers is still expected to be through spot markets, especially in the NCR. Yet, emerging industry trends related to the increased demand for higher quality pork, shrinking margins, and the desire to reduce marketing and price risks are likely to increase the use of long-term contracts and integration.

If long-term arrangements and/or packer-owned/controlled production do become dominant, probable impacts include: quicker industry responsiveness to consumer demands, higher quality products, more branded and differentiated products, more seasonally and cyclically stable production, decreased spot-market volume, potentially more limited market access for hog producers, and increased short-term price volatility for smaller producers and/or producers heavily reliant on spot markets.

The total volume of hogs marketed by long-term contracts for the 45 largest producers roughly equaled the volume of market hogs purchased under such agreements by 19 of the largest packers (8.7 versus 8.4 million head). This result suggests that these packers' contracts were almost entirely with the largest hog producers. Also, among the 45 largest hog producers, the use of long-term marketing contracts was highly related to producer size.

Each of 7 megaproducers marketed more than 500,000 hogs per year, more than 2,000 per day for an average of 250 marketing days. Marketings for the other 38 large producers ranged from 62,000 to about 350,000, or 250 to 1,400 market hogs per day. The 7 megaproducers marketed 90 percent of their hogs via long-term marketing contracts, 9 percent through either packer ownership or production contract, and only 1 percent through spot markets. In contrast, the other 38 large producers marketed just over half of their hogs through long-term marketing contracts (53 percent), 41 percent through spot markets, and 6 percent through packer ownership or production contract.

Why is producer size positively related to use of long-term marketing contracts? Many modern hog packing plants do not normally kill more than 10,000 head per day. A megaproducer marketing 2,000-4,000 head per day can supply a significant proportion of a typical packer's daily hog requirement. Both packer and producer want to minimize the disruption to efficient operations associated with either party shopping around on a daily basis. Long-term marketing contracts also reduce the market vulnerability of both parties to short-term opportunism by the opposite party. Thus, as producers become larger and the packing industry more concentrated, the spot market is expected to be less prevalent.

All 4 megaproducers in North Carolina ranked assured market outlet as the first or second most important benefit of long-term contracts, as did 9 of the 13 other large producers outside the North Central region. However, only one of the three megaproducers and only one of the other large producers in the NCR ranked assured market outlet as high. Since large producers were more reliant on long-term contracts than were packers (only 8 of the 19 packers purchased 10 percent or more of their hogs via long-term marketing contracts), the incentives to integrate can be presumed to be greater for large producers, especially outside the NCR, than for packers.

The use of long-term marketing contracts can benefit both packers and producers by improving product quality and reducing transaction costs. For packers, especially in oligopsonistic markets, marketing contracts may reduce the uncertainties of day-to-day procurement and increase a packer's procurement share. For producers, marketing contracts can provide savings in transaction costs by setting quality premiums, and can attenuate the risks of packer opportunism in oligopsonistic markets.

The evolution of vertical integration will depend partly on whether packers expand the use of backward integration into production faster than large producers expand their total share of production. Another factor is the extent to which hog production expands into new regions such as the West and Southwest, particularly Utah, Oklahoma, and Texas. Packing industry expansion (incumbents and new entrants) into areas of limited production, such as the Southwest, is made less risky by building integrated hog production and pork packing operations simultaneously. Increased industry expansion in the West and Southwest may drive out less efficient producers in other regions, especially the NCR. This may also force packers in the NCR to turn to marketing contracts to maintain procurement volume.

Summary

Vertical coordination is increasing in hog production, with important implications for the structure and performance of the hog slaughtering and processing industry. This project examined the types and extent of vertical contracting and the reasons why parties have entered into vertical arrangements.

The researchers interviewed the largest hog producers, hog packing firms, and feed companies. The findings reflect their operations and opinions. Since the 19 largest packers accounted for approximately 86 percent of hog slaughter in 1993 and nearly all of the packers' vertically procured hogs were supplied by the largest producers, these firms' views may drive the industry. The researchers focused on descriptive statistics and qualitative analysis. Although no cause-effect analysis was conducted, the findings and conclusions are consistent with industry anecdotal evidence and the findings of previous research.

The findings suggest that participants realize economic benefits from vertical coordination and that vertical arrangements will become more common. The Southeast and other nontraditional hog producing areas are adopting vertical contracting more quickly, while simultaneously increasing their share of U.S. hog production.

The increasing use of an expanding variety of vertical coordination mechanisms suggests the need for further analysis of specific marketing and production arrangements to assess their impact on producers' and packers' operations and on the competitive structure of the industry.

Chapter 6
Hog Procurement in the Eastern Corn Belt

Introduction and Objectives

The Economic Research Service (ERS), USDA, conducted a study of meatpackers' hog procurement in the eastern Corn Belt using confidential data previously collected by GIPSA and USDA, AMS *Market News* public price data. The general objectives of the study were to determine: (1) slaughter plants' hog procurement areas in the eastern Corn Belt, (2) price linkages among the areas, and (3) the level of efficiency

in the slaughter hog procurement system.[32] Empirical methods used in the study were based on the spatial-efficient-markets theory of Bressler and King[33] and of Hoover.[34]

The GIPSA data set used for this study contained several variables from 26,281 daily live hog purchases by 17 packing plants in the eastern Corn Belt (between eastern Iowa and eastern Ohio). An additional 622 observations from 4 additional plants in Pennsylvania, Virginia, and North Carolina were used in some of the analyses because the plants buy a significant number of hogs in the eastern Corn Belt. The transactions were from two 2-week periods in March 1990 and March 1991. Plant distances were added to the data set by calculating radial distance from the latitude and longitude of the plant location and the hog-source county centroid. The variables used are described below.

* Total delivered price per cwt, defined as total cost per cwt paid for hogs at the plant, including all freight and commission charges.

* Kill date.

* Plant identifier.

* Location where possession was transferred (auction, buying station/dealer, county, farm, plant, and terminal).

* Type of seller (auction, dealer, farmer, and terminal).

* Number of head in the purchased lot.

* Average liveweight per head of purchased lot.

* Radial distance in miles from the plant to the centroid of seller's county.

* Total head purchased from a particular county by all plants surveyed.

* Purchasing plant's 2-week total head purchased from a county as a percentage of the total head purchased by all plants from that county during the same 2-week period (PCTALL).

* Purchasing plant's 2-week total head purchased from a county as a percentage of the same plant's total head purchased from all counties during the same 2-week period (PCTOWN).
* Total number of surveyed plants buying hogs in a county at any time during the 2-week period.

* Calculated freight charge per cwt for purchased lot.

* Seller's county.

Descriptive Analysis

On average, delivered prices per cwt for eastern Corn Belt hogs were about 76 cents lower in 1991 than in 1990, but prices were more variable in 1991. According to USDA, AMS *Market News* price reports, hog prices were lower throughout the entire United States in 1991 than in 1990, so the changes in the study area

were consistent with U.S. changes. Ninety-five percent of the hog prices were within a $5/cwt range on most days in the study.

Average lot size was 9 head larger in 1991 (58 head) than 1990. Freight costs and average weight were nearly unchanged at 56 cents per cwt and 243 lbs. The average distance from the county centroid source to the packing plant increased 21 miles to 116. The average number of hogs sold per county increased from 4,524 to 4,752.

Analysis of patterns of hog shipments showed packer procurement areas overlapped considerably, with individual packers generally purchasing from many counties. The average measure of plant dependency on individual counties declined from 4.3 percent in 1990 to 2.8 percent in 1991.[35] Individual counties' reliance on individual plants declined from 58.6 percent in 1990 to 50.6 percent in 1991.[36]

Econometric Estimation of Price Surfaces

Plants procure hogs in a variety of ways. Plants may purchase hogs directly from the producer-feeder, or through independent dealers. Packers buy hogs at the plant, at buying stations, and auctions. Location theory describes the spatial pattern of prices and marketing expected from competition among plants in this procurement system.

The objective of this phase was to determine if the pattern of prices paid by packers for hogs at different locations was consistent with the predictions of location theory developed by Bressler and King, and Hoover (see box, "The Price Surface Model").

Price-surface issues were addressed empirically in two different ways. First, a global analysis was performed by using the combined data set of 17 plants. Second, separate price surface models were estimated for each plant. According to the Bressler-King spatial price theory, the delivered price to a specific plant, including freight and commissions, should not vary with distance from the source location of the hogs.[37] Empirical price-surface estimation in this study was complicated by several data considerations that might have led to empirical findings not completely conforming with the theory (see box, "Data Issues...").

Results

The results show that quality (as measured by average weight) has the greatest impact on variation in prices paid. Analysis indicated that prices paid increased with procurement distance from the plant. In the two models used, hog prices increased an average of 0.4-0.7 cent per cwt for each additional mile to supply source. The implication is that some plants absorb freight (that is, pay more for similar hogs as buyers move away from the purchasing plant). The result applies after statistically accounting for differences in weight, type sale and seller, packer, and kill date.

The analysis indicated that hog prices increased by a small (2 cents per cwt), but statistically significant, amount for each additional packer buying in a county. Hog prices decreased slightly as the importance of the shipping county to the purchasing plant increased, and the importance of the purchasing plant to a county increased.

The results did not support a finding that spatial price patterns precisely followed the Bressler-King definition of an efficient market since there was a small positive relationship between delivered price and distance to source of hogs. However, this finding did not necessarily imply a poorly functioning market since the

coefficients on the distance variable were small relative to other sources of price variation.

Nonlinear Spatial Equilibrium Model

The objective of this phase was to determine the economically efficient spatial pattern of hog prices. This pattern was estimated using a spatial-equilibrium model of hog procurement, slaughter, and processing. This efficient pattern was compared with the actual pattern of hog procurement and pricing to identify possible inefficiencies.

The model developed could be used to analyze other questions regarding changes in the structure or conduct of the pork packing industry. For instance, the spatial-equilibrium model provides an empirical estimate of the efficiencies associated with consolidation. The model may also be used to calculate the market size around any group of merging plants.

A spatial-equilibrium optimization model of hog procurement by the 17 packing plants in the eastern Corn Belt was developed. The model calculated the optimum number of hogs for each plant to slaughter, the optimum shipping pattern for those hogs, and the maximum price the plant could rationally pay for hogs at each location. The model included plant cost functions, hog shipping costs from source to plant, and wholesale pork values for various weights (qualities) of hogs. Two versions of the model were specified and optimized differing only in the plant cost curves employed.

The model assumed competitive behavior in selling in order to judge actual behavior with the standards of efficient economic performance derived from the model. A model that assumed noncompetitive behavior would have required more complex specification and additional information not available to the researchers.

Additional technical assumptions were:

* Three classes of hogs were assumed, differentiated by weight range.

* Each county represented a supply area.

* Supply of hogs from any county was fixed (perfectly inelastic).

* Quantity of pork produced by each packer was a linear function of number of hogs slaughtered by weight class.

* Each packer received a price for pork determined by the class of hog slaughtered, so gross revenue was a function of the number of each type of hog slaughtered times value of products from that type.

* Packing and transportation costs per head did not vary by type of hog purchased, so transportation costs depended only on origin and destination, and packing costs were a function of total slaughter volume.

Results

The optimization model allocated the fixed supply of hogs from each county among the plants and calculated the value of hogs in each county to each plant. Actual and optimal least-cost patterns were noticeably different. The least-cost shipping pattern would send most hogs to the nearest packer, but most packers

actually purchased hogs in more distant and dispersed counties than indicated by the optimization results. The model solutions often had differences of less than 25 cents/cwt between the optimal price and the second highest price of another competitor. In practice, hogs are priced to the nearest 25 cents/cwt.

The optimal solution reduced total slaughter and transfer costs by less than 1 percent compared with costs calculated for the observed patterns. Information available to buyers and sellers but not included in the models (such as road distances, reputation of trading partners, etc.) could generate pricing efficiencies sufficient to offset the small technical inefficiencies suggested by the models. Therefore, the actual pattern appears to represent a relatively technically efficient market, despite deviations from the calculated optimal patterns.

Also, the most efficient or optimal pattern would tend to give each packer an exclusive procurement territory, a departure from competitive conditions. A competitive but technically inefficient pattern could have overlapping areas contrary to the model's optimal outcome, with only small efficiency losses as long as transportation costs are low. This situation appeared to be the case in this analysis, as there were only small differences between actual and optimal gross returns to packers.

Geographic Market Definition Through Time-Series Analysis

This analysis used USDA, AMS *Market News* price data rather than data from GIPSA. Three time-series approaches were used: (1) instantaneous causality, (2) correlation, and (3) cointegration. Weekly average live hog prices from 16 different locations were analyzed from October 14, 1989 to May 30, 1992.

The objective was to measure interrelationships between hog prices at various points within and outside the study area. If hog prices within the entire United States are closely related, then the study area is part of a single market for determining hog prices. If hog prices throughout the country are weakly related, then multiple geographic markets exist.

The price reporting locations are: (1) Iowa-southern Minnesota direct; (2) Omaha, NE; (3) National Stockyards, East St. Louis, IL; (4) Sioux Falls, SD; (5) Sioux City, IA; (6) South St. Paul, MN; (7) St. Joseph, MO; (8) Oklahoma City, OK; (9) Illinois direct; (10) Lancaster County, PA; (11) Indiana direct; (12) Ohio direct; (13) Georgia-Florida-Alabama direct; (14) Peoria, IL; (15) Kansas City, KS; and (16) Indianapolis, IN. Not all locations reported data for all weeks. Prices reflect the quote for #1-3 quality hogs weighing 240-250 pounds. The results indicate a single U.S. market; week-to-week average prices at one reporting point move simultaneously with prices at all other points. The finding is consistent with a competitive market.

Conclusions

Delivered prices paid for hogs processed by packing plants in the eastern Corn Belt increase slightly as the distance to the source of supply increases. This is not precisely consistent with Bressler-King's and Hoover's theoretical expectations for a price-efficient spatial market. However, since the price differences were small and some factors relevant to procurement decisions could not be analyzed, the authors could not conclude that the pricing patterns were spatially inefficient. Optimal patterns would reduce total slaughter and transaction costs by less than 1 percent, so actual procurement patterns seem to represent a relatively efficient market.

The authors also concluded that U.S. pricing patterns are consistent with the existence of a single national market for pricing of slaughter hogs.

Summary

The research employed standard econometric and statistical methods to examine hog procurement patterns in the eastern Corn Belt. Results suggest that pricing and procurement patterns in the eastern Corn Belt deviated negligibly from theoretically efficient, least-cost patterns. Research findings, although not necessarily consistent with *a priori* expectations, are generally consistent with previous research efforts and suggest a broad national market for slaughter hogs.

Chapter 7—Literature Review

Introduction and Objectives

This chapter summarizes the findings of a literature review conducted by Azzeddine Azzam and Dale Anderson at the University of Nebraska.[38] The objectives of the project include:

* Review and report on pertinent literature on structure, conduct and performance issues relating to the meatpacking industry.

* Review all relevant research literature, prepare a bibliography, and synthesize, with proper citations, what is known and not known about the structure, conduct and performance (and factors affecting these characteristics) of the livestock slaughter industry.

Azzam and Anderson trace the history of the meatpacking industry and describe the evolution of its industry structure. They then address economic theories of market power and empirical applications of the theories to the meatpacking industry, including three evolutionary phases in economists' approaches to the study of competition. Structure-Conduct- Performance (SCP) and New Empirical Industrial Organization (NEIO) studies of competition in the meatpacking industry are detailed in particular. The initial emphasis is on reporting the objectives, basic methods, and findings of the various studies. The authors then appraise the research and the extant knowledge about industry performance, ending with recommendations for alternative approaches to studying competition in the industry.

Historical Perspective

The meatpacking industry has evolved since the 1600's in response to changing technology and demographic forces. In the industry's earliest years, rudimentary preservative technology and transportation systems limited the scale of meatpacking, mainly to curing and packing pork. Beginning about 1820, improved river transportation and increased livestock production encouraged the development of meatpacking in the Ohio Valley. The industry operated primarily in the winter months due to a lack of refrigeration technology, and remained small in scale with little specialization.

By the mid-1850's, railroad transportation permitted the practical hauling of live cattle and encouraged the growth of feeding farther west in Illinois and Missouri.39 However, the lack of refrigeration still required slaughter near the point of consumption, so the packing industry remained clustered in the more heavily populated States farther east.

By the 1880's, refrigerated railcars had been developed that permitted slaughter to occur nearer the point of production, and Chicago had taken over as the primary slaughter site. The early innovators had become the major packers, with Swift, Armour, Hammond, and Morris accounting for two-thirds of U.S. dressed beef supply by 1888. Scale economies in distribution, division of labor, and byproduct utilization favored the larger operations.

Improvements in transportation also lowered costs of hauling, resulting in lower meat prices and higher net cattle prices to producers. Significant increases in production led to a "bust" by 1885. Several large packers were charged in 1890 (the Vest Report) with collusion in the trading of meat and fixing of prices.

Packers attempted to form several trusts or pools between 1890 and 1920. The Allerton Pool, a major subject of the Vest Report, operated until 1893. The Veeder Pool operated intermittently between 1893 and 1903, interrupted by the entry of new packers outside the pool. In 1902, several packers formed the National Packing Company, a nationwide holding company, to circumvent the Sherman Antitrust Act.

Criminal antitrust action was taken against the National Packing Company in 1910. A jury acquitted the packers 2 years later, but the company had already been dissolved. Several other investigations between 1903 and 1920 culminated in the Packer Consent Decree of 1920 and the Packers and Stockyards Act. The Consent Decree required that the packers involved in the lawsuit terminate their interests in affiliated businesses such as transportation.

By the late 1950's, refrigerated trucking and an improved highway system had reduced shipping costs of meat. Feeding relocated to the western Corn Belt and Southern Plains. Terminal stockyards and older plants became obsolete as new independent packers established themselves in these new feeding areas. New slaughter technology, the introduction of Federal grading, and the emergence of retail chain stores that relied on independent wholesalers rather than packer branch houses promoted the new packers. By 1970, the Chicago Stockyards had closed.

The development of boxed beef in the 1970's was a change in the marketing system as well as in technology. It contributed to increased efficiency in shipping, labor utilization, and large-scale dis- assembly, and also served new specialized demands.

Several leading packers were purchased by other entities not previously involved in livestock slaughter or packing during the conglomeration of the 1970's. A decline in red meat production and consumption had left the industry with excess slaughter capacity by the late 1970's. Mergers and acquisitions continuing through the 1980's reduced the number of packing plants and increased their size, across all species.

Azzam and Anderson conclude that while consumer demand and government actions have affected structural change, economic forces and especially technology have been more important.

Alternative Approaches to Performance Evaluation

Azzam and Anderson document the historical evolution of economists' views of competition, theories, and empirical approaches to competition.

Early Views

Prior to the late 1800's, the classical view of economics held that competition equated to rivalry between particular firms. Price cutting, mergers, and cartels were all viewed as acceptable business behavior by economic analysts. Healthy "competition" was believed to limit the power of the state. If monopoly threatened any harmful effects, new entry would serve as a cure. The classical school of economic analysis followed the historical case study approach which detailed how individual firms behaved but did not generate general rules.

By 1890, the neoclassical school of economic analysis held that competition did not refer to rivalry but to a hypothetical market structure comprised of abstract, indivisible firms making abstract output and price decisions so as to preclude rivalry. The neoclassical approach was more concerned with developing

theoretical rules that applied across all firms than with explaining the behavior of any actual firm. The major gap between business theory and reality persisted.

Analyses of Structure, Conduct, and Performance

The first attempts to bridge the gap were made in the late 1920's. A new approach began to incorporate business characteristics such as concentration, entry, and product differentiation into analysis of actual business performance. This approach evolved into what is now known as the Structure-Conduct-Performance (SCP) paradigm of industrial organization. The SCP approach originally focused on individual firms. However, competition research shifted to interindustry cross-section analysis in the 1960's. Concentration was believed to lead to collusion, and in turn to higher prices and profits, as borne out by empirical analysis. Antitrust policy prompted major suits against industries or firms thought to be exercising monopoly power.

Although the SCP approach continues to be applied, dissent has risen over the years. SCP was criticized as subject to measurement and specification errors, and for its failure to properly deal with causality and simultaneity. For example, high profits and large size could be simultaneous results of greater efficiency, skill, and innovation, but SCP methods would focus on the size-profit relationship. Conversely, if monopoly power led to inflated costs, cost biases could mask any market power effects of concentration.

The SCP approach was also criticized on conceptual grounds. The hypothesis that prices and profits increase with concentration also ascribes to concentration overt or tacit collusive behavior, but the models do not describe the nature of this behavior. Various approaches have attempted to model behavior more directly, while others have sought to overcome the empirical weaknesses of simplified SCP analyses. These efforts have led to the third category of analysis identified by Azzam and Anderson.

New Empirical Industrial Organization Analyses

Starting in the 1970's, studies began attempting to measure conduct directly. Known collectively as the New Empirical Industrial Organization (NEIO), these studies model the gap between prices and costs as an unknown parameter to be estimated. The empirical results of the analyses provide a "conduct parameter," which places an industry on the continuum between perfect competition (parameter value of zero) and a cartel or monopoly (value of one).

This conduct parameter satisfies conceptual objections regarding the failure of SCP studies to account for behavior explicitly. However, the estimated conduct parameter is merely an indicator of static equilibrium outcomes of firm behavior. Precise delineation of the actual behavior generating the results requires even more detailed information and analysis. Even when NEIO analyses incorporate fully developed modeling of the decision-making environment of firms, the results are subject to varying interpretation, and the models are empirically demanding. Finally, most NEIO studies rely on static models that may not capture the dynamics of real-world firm behavior. A brief discussion of selected SCP and NEIO studies follows.

SCP Studies of Meatpacking

Azzam and Anderson report results of selected studies of the packing industry that follow the SCP approach. These studies use statistical models to explore relationships between measures of performance (price, margins, etc.) and attributes of market structure. Each of the studies reviewed has its own strengths and weaknesses, but this brief summary does not attempt a full enumeration of the contractor's assessments.

Price Spreads and Concentration

Three studies analyzed price spreads, or margins between two marketing stages, as they relate to measures of concentration. Margins suggest imperfect competition if they exceed the cost of the product's transformation between marketing stages.

Two studies addressed the effect of selling power on margins between wholesale and retail prices. One determined that a 10- percent increase in four-firm concentration in food retailing was associated with a 4-percent increase in margins (Hall, Schmitz, and Cothern, 1979).[40] The other interpreted a positive correlation between packer concentration and wholesale-retail margins as evidence that increased packer concentration raised the retail price of beef (Multop and Helmuth, 1980).

The third study in this group examined the effect of packer buying power in farm markets. It found that beef farm-to-wholesale margins *narrowed* as concentration increased, supporting the argument that larger firms are more efficient. The study showed no relationship between pork packer concentration and margins for pork (Ward, 1988).

Profits, Productivity, and Concentration

The latter study also examined the relationships between concentration and profits and productivity, respectively. It found no relationship between concentration and profits, although data from individual meatpackers revealed a weak positive association between returns and *firm size*. A separate study determined no association between productivity and concentration (Ward, 1987).

Prices and Concentration

Several studies examined the effects of concentration on prices. Most of these dealt with the effect of concentration in meatpacking on prices paid to livestock producers, or oligopsony power.

Aggregate price models dealt with different levels of geographic aggregation. At the *national* level, higher concentration was associated with *higher* prices to producers (Multop and Helmuth, 1980). In smaller geographic areas, prices to beef and pork producers tended to be lower as packer concentration increased (Quail and others, 1986; Marion and Geithman, 1995; Heyneman, 1992; Menkhaus and others, 1981; Miller and Harris, 1981). One study suggested countervailing power in beef feeding as prices paid for cattle tended to increase with feedlot size (Quail and others, 1986).

Transaction price models used data on prices paid to sellers for individual transactions rather than average prices aggregated over some geographic area. The measure of concentration in most cases was number of bidders rather than market share of individual buyers or groups of buyers.

Three studies of beef found that producer prices tended to increase as the number of potential bidders increased (Ward, 1981, 1982, 1992). A sheep study was inconclusive with respect to number of bidders, but found that the largest buyer paid higher prices (Ward, 1984). The 1992 beef study found lower prices paid by larger buyers, but the 1982 study found no relationship between buyer size and price levels.

Plant exit models analyze the effects of increased concentration resulting from plant closure. If packer concentration has a depressing effect on price, a reduction in the number of plants in a region should lead to a

decline in prices paid to producers. Four studies tested for such a relationship in pork slaughter. Two found that prices paid to producers did decline after major buyers exited (Love and Shuffett, 1965; Ward, 1983), but the other two surveyed found no such pattern (Dobbins, 1973; Hayenga, Deiter, and Montoya, 1986).

Plant ownership models are similar to plant exit-price models, but reason that the number of independent firms (owners) is a more accurate measure of buyer concentration in a market area than the number of physical facilities. They assume that buying conduct of multiple plants operated by the same firm is coordinated. However, the study reviewed found no relationship between number of owners and prices paid to producers (Hayenga and O'Brien, 1992).

Spatial price linkages and price transmission models deal with price communication across markets. Linkage models deal with how prices in different geographic markets converge to an equilibrium relationship. Price transmission models analyze whether prices at different levels in the market chain (farm, wholesale, retail) adjust relative levels more quickly when rising than when falling. One study found that price integration or linkages between different regions increased with increasing national concentration in beef packing (Goodwin and Schroeder, 1991). An analysis of price transmission in beef and pork did not establish a cause-and-effect relationship (Balimwacha, 1994).

Other Types of Studies

Definition of relevant markets is necessary to measure concentration before evaluating its effect, and is a key component of most SCP studies. Efforts concerned with market definition illustrate that markets are much larger than single States or the trade areas of individual firms (Schultz, 1988; Hayenga and O'Brien, 1992).

Recently, *vertical integration* has raised concern that packer ownership or control of livestock supply could depress prices paid to producers. The studies reviewed found some statistical evidence of such a negative relationship (Aspelin and Engelman, 1966; Schroeder and others, 1993; Hayenga and O'Brien, 1992).

Economies of large size may offset any potential disadvantages of large firms or concentrated markets. Economies of size, rather than noncompetitive behavior, may also be the source of firm growth and increases in concentration. The studies reviewed found some evidence of such economies (Ball and Chambers, 1982; Sersland, 1985; Ward, 1990).

Summary Evaluation of SCP Analysis of Meatpacking

Most studies reviewed dealt with beef, while lambs received the least treatment. Several studies of beef and pork packing concluded that market power arises from concentration. However, there were conflicting results among the studies, which differed widely in time period and analytical method.
The strongest evidence of market power is in studies dealing with aggregate prices on a regional basis, transaction prices, effect of plant exit on prices, and spatial pricing.

Regional price-concentration studies attempted to avoid the difficulties of measuring price-cost margins by using price as the measure of performance. However, the discrepancy between actual price and competitive price is the true performance measure, and competitive price can only be defined by reference to cost.[41] The methodology and modeling also do not address the link between supply elasticity and prices. Any observed negative relation between price and concentration could be due to shifts in supply or demand that have not been properly specified.

The regional studies that include cost as a control variable use averages that do not allow for any variation in efficiency among packers within a region. Negative correlations between concentration and prices could be due to differences in cost rather than the exercise of market power.

Finally, the regional price-concentration studies are especially subject to estimation shortcomings associated with their assumption of independence across regions. Likely, there are dependencies across regions that require special estimation techniques.

Transaction price studies relate prices of individual transactions to indicator variables representing competition. The authors judge them deficient due to the lack of specific models relating bidding behavior to competitive outcomes, leading to vague interpretations. Differences in cost efficiencies among bidding packers, which may affect the bid, could confound the tests used to measure market power.

Exit study models interpret price declines (relative to a base market) following firm exit as evidence of market power in the market where exit occurred. However, other factors not generally measured in the models could also lead to relative price declines, such as failure to adequately control for changes in the base market used as a reference.

The single study of *spatial price linkages* across regions, which found evidence of increased coordination as concentration increased, was faulted for use of a national measure of concentration. Regional measures, and multivariate rather than bivariate analysis of price linkages, should have been used.

NEIO Studies of Meatpacking

Azzam and Anderson report on NEIO studies that start from a model of firm optimization to generate testable hypotheses about market power.

Oligopoly/Oligopsony Studies

These studies of simultaneous market power in buying and selling generally estimated the value of the *conjectural elasticity* parameter, typically used in NEIO models as an index of conduct. This parameter is derived from a formal model of profit maximization. The estimated value of the conjectural elasticity parameter may range from zero (competitive conduct) to one (cartelized or monopolistic conduct).

One study tested for beef packers' buying and selling power using 1951-83 annual data (Schroeter, 1988). It found statistically significant but limited market power. Also, the study concluded that price distortions did not increase as beef packing became more concentrated during the late 1970's.
A study of the entire U.S. meatpacking industry also found packers to have market power in both livestock procurement and meat sales (Azzam and Pagoulatos, 1990). The study concluded that the effects of market power were larger on prices in the livestock market than in the meat market.
A study of pork packing found noncompetitive prices from 1972 through mid-1979, but a return to competitive pricing from mid-1979 through 1986 (Azzam, Pagoulatos, and Schroeter, 1989). The study suggested that the emergence of very large hog producers might have acted as a check on any market power exercised by hog packers in later years.

A second study of pork found that risk of changes in output prices tended to increase marketing margins, but found no oligopoly distortions (Schroeter and Azzam, 1991). Oligopsony distortions (exercise of market power) early in the sample period eroded as concentration increased later in the period. When the model was

modified to force the effect of output price risk to zero, re-estimation using the same data resulted in statistically significant oligopoly power throughout the entire sample period.

One oligopoly/oligopsony study did not estimate the conjectural elasticity parameter (Azzam, 1992). Instead it modeled beef packers perceptions' about relations between price changes in input and output markets and changes in industry output. If an industry is competitive, individual firms should not encounter price changes as they change output levels. Results showed there was oligopsony power in the live cattle input market, but no oligopoly power in marketing beef.

Several of the largest meatpacking firms operate both cattle and hog plants. Such joint production of substitute products requires more complex modeling to adequately measure market power. The pricing and/or output decisions of a firm in the market for one product may both affect and be affected by responses in the other market. One study estimated a model of joint beef and pork production (Schroeter and Azzam, 1990). This study found evidence of noncompetitive conduct.

Oligopsony Models

Oligopsony models dealt with potential packer buying power in live cattle markets and assumed that packers behaved competitively in selling their output. One model *simulated* the effects of changes in concentration, away from a baseline configuration, on prices and quantities purchased in regional livestock markets (Azzam and Schroeter, 1991). The study results indicated that even perfect collusion might have only minor effects, with cattle prices depressed about 1 percent and volume 1.5 percent. The relatively small simulated effects reflect the high estimate of regional supply elasticity. The model was subsequently used to evaluate the tradeoff between market power and efficiency gains as the industry consolidates (Azzam and Schroeter, 1992). The theoretical simulation suggested that the benefits of efficiency increases during recent consolidation in beef packing may have offset any negative effects of increased market power.

One oligopsony study used a technique that explicitly allowed the data to identify changes in the exercise of power, both with respect to amount and timing (Azzam and Park, 1993). Its results indicated no statistically significant evidence of market power in cattle markets from 1960 until 1977. Following a transition period (1977-82), a small but statistically significant degree of market power was evidenced in cattle markets after 1982.

An oligopsonistic group of firms, or cartel, exercises market power by establishing and maintaining a cooperative price. Cartel members can enforce or maintain the cooperative price by utilizing "trigger price" levels at which all members will abandon the cooperative price and begin competing. The strategy assumes that actual prices reached that trigger level only because some member cheated on the agreement. Prices that appear to follow a trigger pricing strategy suggest the existence of a cartel exercising market power. One study tested for evidence of such a strategy in daily beef margins from May 1980- September 1982, and from July 1984-July 1986. The degree of market power was lower in 1984-1986 (Koontz, Garcia, and Hudson, 1993). Increased use of contractual procurement arrangements and greater volatility of fed-cattle supplies may have lessened the ability of packers to maintain cooperation.

Only one surveyed study considered the possibility that packers might experience inadequate supplies when procuring cattle (Stiegert, Azzam, and Brorsen, 1993). Under such circumstances, packers may set bid prices to ensure that margins cover average processing costs (APC). The analysis indicated that packers did follow an APC pricing strategy, but only in the face of anticipated supply shortfalls. In instances of unexpected but small shortfalls, packers continued to follow the APC approach. When there were large unexpected shortfalls

such that supplies were significantly inadequate, packers competed aggressively and margins narrowed.

Oligopoly Model

The one oligopoly model study examined explicitly incorporated longrun effects by allowing for changes in the number and size of firms (Holloway, 1991). This study implemented a model of price spreads under perfect competition to examine the response of retail meat prices to shifts in retail demand and farm commodity supply. The study's findings, based on 1955-83 data, showed perfect competition.

Bilateral Oligopoly Models

One study evaluated three different types of relationship between packers and retailers: packer dominance, retailer dominance, and bargaining (Azzam and Zhang, 1992). This study was an effort to develop a framework to test market power at different vertical stages in the marketing channel. Results suggested that bilateral oligopoly characterizes the wholesale beef market. Retailers exercise market power in retail sales, but a bargaining approach is used in packer-retailer transactions. Packers, however, were competitive in procuring cattle.

Summary Evaluation of NEIO Analysis <R>of Meatpacking

Results were not consistent across the studies reviewed. The few studies of pork did not provide significant evidence of market power. A pattern of results suggested exercise of market power in live cattle markets, but price impacts seemed small and perhaps more than offset by cost reductions associated with consolidation. Market power *did not* increase with concentration as theory would suggest, and evidence indicated that packers were unable to sustain any cooperation in restraining prices paid for cattle. In appraising the NEIO studies, Azzam and Anderson concluded that empirical implementation has not equaled theoretical rigor due to lack of appropriate data and model complexity.

The oligopoly/oligopsony study that found limited exercise of market power in beef packing required an assumption of equal power in both input and output markets. Models used in other studies did not require equality in both markets and obtained different results. Similarly, several of the studies imposed a restriction that the extent of market power be constant within specified periods, but studies that allowed the data to identify changes demonstrated that such a constancy assumption was questionable.

Azzam and Anderson concluded that most studies suffered from limits to their scope. Studies differed in their level of product aggregation and in the completeness of the models implemented. The single study that explicitly incorporated multiproduct decisionmaking used an incomplete empirical implementation, leading to questionable results. The bilateral monopoly study that attempted to be all-encompassing also ended up with oversimplified empirical modeling that limited the generality of the results.

The oligopsony model that found evidence of net welfare gains under simulated consolidation assumed fixed costs were equal before and after industry consolidation. This assumption may not be valid given the replacement of old plants with larger ones with improved technologies.

Conclusions

The researchers' description of historical industry evolution suggests that changes in the meatpacking industry have resulted from technological change and dynamic rivalry between firms. The basic question addressed by

this project was whether the evidence from Structure-Conduct-Performance and New Empirical Industrial Organization studies is persuasive enough to warrant the conclusion that competition in the meatpacking industry is deficient. Taken as a whole, the literature review led to the conclusion that the answer is no.

Many SCP studies indicated the existence and exercise of market power. However, the failure to use appropriate theoretical models of conduct in these studies makes industry generalizations questionable.

The NEIO studies show a persistent gap between the actual price of livestock and the competitively determined price predicted by theory. However, the studies have not incorporated sufficient detail to prove noncompetitive behavior.

Azzam and Anderson propose a different direction for research on competition in the packing industry. Complex modeling and extensive data requirements for empirical implementation handicap the SCP and NEIO models. Additionally, the researchers question whether either the SCP or NEIO approaches, based on a static perfectly competitive benchmark, are of real value for policy guidance. They recommend instead that research focus on the *process* of competition or the rivalrous interaction between competitors, and on competitors' strategies for responding to technological and market forces, as the business history of the industry suggests.

Specifically, the researchers recommend two approaches. First, develop empirical pricing models for short-term monitoring. Such models infer conduct from spatial price linkages rather than from concentration, as in SCP studies, or in estimation of conduct parameters as in NEIO studies. Second, study the dynamics of the competitive process, making use of data describing changes at the firm and plant level, to better understand the effect of market and technological forces on the evolution of firm behavior and industry structure.

Summary

The literature review provided an interpretation of the industry's evolution as opposed to a comprehensive description of its current structure. The review assessed whether past research has been able to establish that the industry is not competitive. Azzam and Anderson did not review the studies contained in other chapters of this report, which were not available to them.

The findings of the extensive literature reviewed were inconclusive about the effects of concentration, primarily because of limitations in the methods or data, or both, in the research reviewed. While the body of evidence from the literature was insufficient to support a finding of noncompetitive behavior, it also cannot conclude that the industry is competitive.

Recommendations for future work stress a need to focus more directly on data disaggregated to the firm and plant level to provide a better understanding of the dynamics of individual firm behavior and rivalry between firms.

Chapter 8
Summary

The concentration study suggests that the meatpacking industry is complex and dynamic. Fundamental economic forces such as consumer demand, processing technology, and animal characteristics, play a major role in driving change in the industry. Firms that reduce costs and improve product quality and service gain a competitive advantage. These market forces will continue to encourage growth in firm size and additional contractual arrangements for the production and sale of cattle and hogs.

Beef Packing

The largest beef packing firms play a major role in the industry. Large firms are most likely to use captive supplies and different pricing and procurement methods.

Market Definition

The economic market in which fed cattle are purchased for slaughter is essentially national in scope. While some regional differences exist, especially west of the Rocky Mountains and east of the Mississippi River, cattle movements and price adjustments among areas are strong. Kansas and Nebraska tend to lead the price discovery process and price linkages are strongest between the Midwest and Plains regions, the major feeding and slaughtering regions.

The presence of a large geographic market does not necessarily mean that cattle are transported across the country for slaughter. Over 80 percent of cattle are transported less than 150 miles to a packing plant. However, the cost of transporting cattle is low enough and cattle movement patterns overlap enough that price changes move rapidly across areas. Moreover, per-head transportation costs for feeder cattle are lower than for slaughter cattle. If packers in one area paid higher prices than in other areas, feeders in the higher price area could pay more for feeder cattle. Over time, this supply adjustment would mitigate price difference among areas and contribute to a large geographic market area for fed cattle

Price Determination

A wide variety of pricing and procurement arrangements exist among feedlots and packers. Delivered prices may be affected by the pricing and procurement methods chosen. The spot market remains the predominant procurement method, accounting for 79 percent of the cattle in the study.

Prices paid for cattle are affected by characteristics of the cattle and of the lots. As expected, lower prices were paid for heifers, Holsteins, select-grade cattle, cattle in yield grades 3, 4, and 5 (compared with yield grades 1 and 2), and cattle having lower dressing yields. Lower prices also were paid for cattle in smaller lots and cattle priced on a formula basis. Higher prices were paid by larger plants in the Illinois, Iowa, Minnesota, and Wisconsin region, but the result was not consistent across regions. Larger plants in the California, Idaho, Utah, and Washington region paid lower prices while prices paid by larger plants were not significantly different from prices paid by smaller plants in the Colorado, Kansas, Nebraska, and Texas region.

Packers buy large quantities of their cattle from large feedlots. While the study identified sales by over 19,000 sellers, the 152 largest sellers (less than 1 percent) each sold more than 32,000 head of cattle during the study period and together accounted for 43 percent of the cattle sold. On the other hand, nearly 90 percent of the sellers sold less than 1,000 head each, and together accounted for only 14 percent of the cattle sold.

Large packing plants (slaughter more than 4,000 head per day) obtained nearly half of their cattle from the large feedlots, while small plants obtained less than one-quarter from large feedlots. Average dressing yields were higher at large versus small (slaughter less than 2,000 head per day) plants, although the difference likely is attributable to differences in cattle characteristics or use of pencil shrink.

Some procurement methods are associated with specific pricing methods. For example, carcass-weight pricing was used for about 75 percent of the lots of cattle sold through forward contracts while formula pricing was used for over 90 percent of lots sold through marketing agreements. Liveweight pricing was the most common pricing method for spot market transactions.

Only a few firms use the less common pricing and procurement methods (e.g., formula pricing, packer feeding, forward contracting and marketing agreements). For example, 9 of the 20 beef packers included in the study relied exclusively on the spot market for cattle, and 4 others relied on the spot market for 98 percent of their cattle purchases. The three firms that were the leading users of marketing agreements accounted for over 96 percent of all such cattle purchases. However, less than 13 percent of the total purchases of those firms was through marketing agreements. The three leading users of packer-fed cattle accounted for more than 86 percent of such cattle. Just over 6 percent of the total purchases of these three firms were packer-fed.

Further analysis of actual procurement records of the packers would yield additional insights regarding procurement strategies of individual packers and groups of packers. Analysis would be strengthened with additional information, such as bid information, from feedlots as well.

Captive Supplies

Captive supplies had only a small, downward effect on cattle prices in the cash market during the study period, April 1992-March 1993. Packers use captive supplies more when cattle prices are high and less when prices are low. As a result, captive supplies tend to have a moderating effect on cattle prices. Packers paid $1.75-$2.00 per cwt lower delivered prices (liveweight) for cattle purchased through forward contracts than they did for cattle obtained through the cash market. The lower price may represent compensation for transferring price risk from feeders to packers. Packers paid higher delivered prices for cattle obtained through marketing agreements. Overall, the effects of captive supplies appear to be quite small.

Feedlots and packers enter into captive-supply arrangements because they each perceive gains from the arrangements. Captive-supply arrangements vary considerably among packers; some use a particular type of captive supply, others not at all. The volume of captive supplies is relatively low in relation to the total number of cattle slaughtered, and has not been increasing. Forward contracts, marketing agreements, and packer feeding each have different implications and need to be examined separately.

While the study concluded that the effects of captive supplies were small, several questions persist such as the impacts of captive supplies during market downturns and their structural implications over time.

Market Power

Concentration is a concern because it can enable firms to use market power. The study found that prices in local areas are affected very little by differences in concentration in those regions. This is consistent with the finding that market forces tend to operate at the national level. The analysis did not determine definitively whether large firms use market power to affect prices paid for cattle nationwide.

Pork Industry

Slaughter hogs appear to be bought and sold in a single national market. Different regions are linked sufficiently that price adjustments occur rapidly throughout the Nation.

Prices paid for hogs by packers in the eastern Corn Belt increased slightly as distance to source of supply increased. This indicates that sellers do not absorb all of the transportation costs associated with greater distances from packing plants. This finding is inconsistent with the economic assumption that prices received by sellers located away from markets should decrease by the amount of the transportation costs. While lower prices near packing plants may suggest the effects of local monopsony power, the price differences observed in this study were too small to reach such a conclusion.

Procurement patterns in the eastern Corn Belt suggest relatively efficient transportation of hogs, although hog movement patterns showed considerable overlap among packing plants. If all hogs were shipped to the nearest plant (the least-cost delivery pattern), total transaction costs would be reduced by less than 1 percent.

The incidence of contracting in hog production and marketing during the study period was too small to have major competitive impacts. However, the importance of contracts is growing rapidly, led by some of the largest hog producers. Most of the hogs produced by the seven largest producers in 1993 were sold through long-term marketing contracts. The trend toward contracting is largely driven by economic forces. Contracts offer packers an opportunity to improve hog quality and ensure a steady supply of the types of hogs they want. Contracts offer producers an opportunity to have an assured market for their hogs and enable them to be paid on the basis of hog quality. Contracts also provide an opportunity for some new producers to gain the expertise, financing, and other economic assistance they need to get started. These considerations suggest that contracting imparts efficiencies. Due to these perceived benefits, an increasing share of hogs is likely to be produced or marketed through contract arrangements in the future, reducing the share through spot markets.

Collecting and Processing Data

The study showed that published data are not adequate to fully understand, monitor, and analyze competitive conditions in the cattle and hog industries.

Collection and processing of data needed for the study was time-consuming. Records are not always consistent among packers nor do individual packers necessarily maintain uniform records. Even procurement records, which are the most consistent among packers, are not uniform. Considerable effort is required to ensure compatibility of data. It may be possible to analyze and monitor the meatpacking industry with fewer confidential procurement data, but sampling and other statistical and econometric analyses are needed to better identify the minimum amounts of data needed. Collection of cost and revenue data, which are essential to evaluate market power questions and to assess efficiency implications of structural changes, also is difficult and requires follow-up.

Research Methods

The study indicates that monitoring and research need to focus on the process of competition, that is, the rivalrous interaction among firms, and on firms' competitive strategies for responding to technological and other market forces. The researchers found that models that focus on measuring the effects of concentration have not answered questions about market power. Concentration may not be the most relevant factor. Time-series analysis of procurement activities is needed to learn how to model packers' operations, and detailed case studies to learn how firms react to market forces in order to better estimate the effects of future industry change. New conceptual frameworks are needed to test hypotheses relating to pricing policies. For example, is observed pricing behavior consistent with basing-point pricing, price leadership, or price discrimination?

The study has helped identify research methods that need improvement. The study offered researchers an opportunity to analyze types of data they have not been able to examine before. Some models typically used to analyze published aggregate data were not adequate to analyze individual firm behavior. The researchers found that the data contain useful details that they could only begin to examine in the time available.

Conclusions

The study found that pricing and procurement arrangements (including captive supplies) and structural characteristics affect conduct and performance in the meatpacking industry. Researchers on the separate projects used different models and research methods, but produced essentially consistent findings when they addressed comparable issues or questions. Indications are that concentration in the beef and pork industries is likely to remain high, or even increase. Likewise, use of contracting arrangements will increase, especially in pork. There is potential for both adverse and beneficial effects from these trends. Given the persistence and importance of these issues, there is a continuing need to monitor and analyze behavior and structural changes in the industry, and to take corrective action when necessary under existing authority and to request additional authority if needed.

Areas identified as having promise for future surveillance and analysis include:

* procurement and pricing practices of individual firms;

* rivalry and cooperation among firms;

* contracting arrangements and other forms of coordination;

* improvement in methodological capabilities; and

* continued assessment of the effects of concentration.

This study provides initial steps toward a better understanding of the workings of the cattle and pork industries. It provides critical information needed to better understand and more effectively monitor competition in the meatpacking industry. The study has shown that quick answers to these complex market structure and behavior issues are not available. Sustained monitoring and analysis provide the best opportunity to obtain timely, meaningful information as the industry evolves and market conditions change.

Text Boxes

Chapter 1

Volume-Response-to-Price Model

The volume-response-to-price model can be expressed as:

qi,t = f (pi,t,t-s; pj,t,t-s;...; pk,t,t-s; xt)

where qi and pi are the quantity procured by the ith plant (firm) and its procurement price, pj, ... , pk are procurement prices for competing plants (firms) j through k. Subscripts t and t-s represent same-day and previous-day (lagged) values. The variable x, representing total procurement by all the plants (firms) on each day, was incorporated into the model to account for noncompetitive behavior affecting the aggregate q and p relationship. In this formulation, the estimated coefficients are elasticities that represent the plant's (firm's) percent change in procurement volume for a 1-percent change in the plant's (firm's) own price and competitors' price. The larger the price elasticity, the more sensitive a plant's (firm's) cattle procurement volume is to price changes.

An alternative version was also estimated in which a plant's volume share in a particular geographic region is hypothesized to be a function of relative prices. This share-response-to-relative-price model can be specified as follows:

qir/qr = f [(pir/pjr) . . . (pir/pkr)]

where the subscript r represents cattle procurement region. Negative and significant cross-price or relative price relationships indicate plants with statistically significant competitive interaction on a daily basis.

Characteristics of Data Observations Used in the Analysis

The analysis included:

* Lots containing steers, heifers, Holsteins, or mixed sexes.
* Lots that recorded kill and purchase dates. (Transactions with dates outside the period of data collection were deleted.)
* Lots that indicated the number of head contained in the lot and that had 35 or more head.
* Lots that were purchased in the cash (spot) market.
* Lots that had a recorded carcass weight (hot or cold). (All carcass weights were converted to hot

weight.)

* Lots that had an average carcass yield recorded of 50-70 percent.
* Lots that had a yield grade separated into at least yield grade 1-3 and greater than 3.
* Lots that separated Choice and above from Select and below quality grades.
* Lots that were purchased within 14 days of slaughter (except at 3 plants where cattle purchased 30 days in advance were in their normal cash market procurement).

Vector Autoregression Model

The simple bivariate VAR can be expressed as:

Pricei = f (lagged pricei, lagged pricej)

where price at plant i is a function of its own lagged price (price at a prior time) and lagged price at plant j. Granger F-tests assessed the statistical relationship (causality) between prices at plants i and j.

Cointegration Model

Nonstationary series have time-varying means and/or variances. If a linear combination of the two series is stationary, however, then the series are said to be cointegrated. Two series, I and j, are cointegrated if I and j do not statistically diverge from each other. For cointegrated series, error correction models were estimated. The simplified error correction model is:

e Pricei = f(lagged cointegration error term I, e lagged pricei, e lagged pricej)

where e represents a change in the series. Coefficients for the lagged cointegration error terms are the speed-of-adjustment estimates.

Models to Explain Cointegration Statistics

The models were:

DOCij, LOCij, and SPDij = f (distance, procurement overlap, cash purchases, slaughter, price data, same firm)

where DOC is the degree of cointegration; LOC is level of causality; SPD is speed of price adjustment; i refers to the dependent variable plant; j refers to the independent variable plant; distance is the mileage between plant i and plant j; procurement overlap is the percentage of plant i's cattle purchased from a region overlapping with plant j's procurement area; cash purchases is the percentage of cattle purchased in the cash market by the plant over the estimation time period; slaughter is the total number of cattle slaughtered by the plant during the period; price data is the percentage of days over the time period that daily price data were available; and same firm is when plants i and j were owned by the same firm.

Chapter 2

Definitions

Definitions of terms related to livestock procurement vary according to custom and usage. The following definitions were applied in the collection of slaughter cattle transactions data for purposes of the study.

Procurement Methods
Forward Contract - packer enters into contract with seller to purchase a specific lot of cattle at a future date, with the contract established at any time from placement of cattle on feed up to 2 weeks prior to kill date

Packer Fed/Owned - lot of cattle owned by packer while being fed (at either a custom feedlot or a feedlot owned or controlled by the packer) for slaughter

Marketing Agreement - lot of cattle procured under a long-term arrangement between a packer and a seller in which the packer agrees to purchase a specified number of cattle per specified time period such as a week, month, or year

Spot Market - lot of cattle purchased directly from feedlot, public market, or other seller within 2 weeks of kill date (by definition, excludes forward-contract, packer-fed/owned, and marketing agreement lots)

Pricing Methods
Liveweight - payment based on liveweight of lot prior to slaughter, excluding formula-priced lots

Carcass Weight - payment based on dressed weight of lot after slaughter, excluding formula-priced lots

Formula - price based on a formula such as the packer's weekly average prices paid or an average of two or more public price reports; payment can be based on liveweight or carcass weight of lot

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Chapter 3

Model 1: Captive Supply Delivery-Price Impacts

The model consisted of five equations:

$$UTILN_t = [(NFC_t + NPF_t + NMA_t + NSP_t) / CAP_t] \quad (1)$$

$$PQFC_t = f(BSS_t, TRPRC_t, UTILN_t, DDOW_{i,t}, DMON_{i,t}) \quad (2)$$

$$PQPF_t = f(LCFMP_{t-1}, TRPRC_t, UTILN_t, , DDOW_{i,t}, DMON_{i,t}) \quad (3)$$

$$PQMA_t = f(LCFMP_{t-1}, TRPRC_t, UTILN_t, DDOW_{i,t}, DMON_{i,t}) \quad (4)$$

$$TRPRC_t = f(ABBCV_{t-1}, LCFMP_{t-1}, DTYP_{i,t}, AHotWt_t, AHotWtt2, NoHdt, NoHdt2, PYG1\text{-}3_t, FWD_t, DDOW_{i,t}, UTILN_t, TRND_i, TRND_i2, TRND_i3, DPLT_{it}, PQFC_t, PQPF_t, PQMA_t) \quad (5)$$

The subscript t in the model refers to the date that cattle are purchased in the cash market. The dependent variables, or items being explained by these five equations, are:

UTILNt = Each plant's total purchases on a given day expressed as a percentage of the plant's total capacity on the day the cattle were purchased in the cash market.

PQFCt = Current day's deliveries of forward-contracted cattle as a percentage of total forward-contracted cattle delivered during the 28-day period beginning that day.

PQPFt = Current day's deliveries of packer-fed cattle as a percentage of total packer-fed cattle delivered during the 28-day period beginning that day.

PQMAt = Current day's deliveries of marketing agreement cattle as a percentage of total marketing agreement cattle delivered during the 28-day period beginning that day.

TRPRCt = Cash market (dressed weight) price on the day cash-market cattle were purchased.

The variables PQFC, PQPF, and PQMA represent the rate of deliveries from current inventories of captive supply of each type. The researchers used actual deliveries during the 28-day period as a measure of inventory available on day t. The researchers also estimated the relationships in the model using an alternative definition of inventories based on 14 days rather than 28 days. The explanatory variables used in equations 1-5 are:

NFCt = Number of forward-contracted cattle purchased by each plant; NPFt = Number of packer-fed cattle purchased by each plant; NMAt = Number of marketing agreement cattle purchased by each plant; NSPt = Number of cash-market cattle purchased by each plant; CAPt = Maximum daily plant capacity for each plant during the data period; BSSt = Basis on the day cash market cattle were purchased, that is, dressed-weight cash-market price converted to a live-weight price, minus the preceding day's closing live cattle futures market price for the nearby futures contract; DDOWi,t = Day of the week cattle were purchased; DMONi,t =

Month of the year cattle were purchased; LCFMPt-1 = Preceding day's closing price of nearby live cattle futures contract; ABBCVt-1 = Preceding day's boxed-beef cutout value on the day cattle were purchased, adjusted for percentage of the lot grading USDA Choice or above or Select or below; DTYPi,t = Variable for the type of cattle--steers, heifers, mixed sex, Holstein, and dairy cattle; AHotWtt = Average dressed weight of the sale lot; AHotWtt2 = Square of the average dressed weight of the sale lot; NoHdt = Number of head in the sale lot; NoHdt2 = Square of the number of head in the sale lot; PYG1-3t = percentage of USDA yield grade 1-3 cattle in the sale lot; FWDt = Number of days between purchase and delivery for cash-market cattle; TRNDi = Month cattle were purchased, i = l-n; TRNDi2 = Square of the month cattle were purchased; TRNDi3 = Cube of the month cattle were purchased; DPLTit = Variable for packing plant that purchased cash-market cattle.

The first equation defines a measure of each plant's total daily purchases relative to slaughter capacity on the day of purchase. The measure is the sum of cattle purchased by the three forms of captive supply plus cattle purchased in the cash market, divided by the maximum daily slaughter for the plant where cattle are slaughtered. Maximum daily slaughter was based on the largest number of cattle slaughtered any 1 day during the period covered by the study.

Equations 2-4 show how the daily rates of deliveries of captive supplies by type are determined, including the effect of cash-market prices on those deliveries. Basis was calculated by taking the dressed-weight price times 63 percent estimated average dressing percentage to convert the dressed-weight price to a live-weight price, then subtracting the preceding day's closing live cattle futures market price for the nearby contract. The relative volume of contracted, packer-fed, and marketing agreement cattle delivered varied by day of the week and month, so variables were added to distinguish the effects of day of the week and month of the year. Expected market prices were assumed to be measured by the nearby futures market price.

Equation 5 expresses the simultaneous variation in cash-market transaction prices for fed cattle. Explanatory variables in addition to the captive-supply variables include boxed-beef cutout value adjusted for the percentage of the sale lot grading USDA Choice and above or Select and below, live cattle futures market price, type of cattle, weight of the cattle, number of head in the sale lot, percentage of cattle that yield grade 1-3, number of days between purchase and delivery, day of the week, and the plant purchasing the cattle. Cash-market prices are also expected to be influenced by percentage plant utilization because of its relation to slaughter and processing costs. Cubic time-trend variables were included to deal with the trend in fed-cattle prices.

Model 2: Captive Supply Inventory-Price Impacts

TRPRCt = f (ABBCVt-1 , LCFMPt-1 , DTYP i,t , AHotWtt , AHotWtt2, NoHdt , NoHdt2 , PYG1-3t , FWDt, DDOWi,t , TRNDi , TRNDi2 ,TRNDi3 , DPLTi,t, QFCt , QPFt , QMAt)

The last three variables represent the current inventory of captive supply by type:

QFCt = Current inventory of forward-contracted cattle, measured as number of forward-contracted cattle purchased by each plant during the 28-day period beginning with the current day (t);

QPFt = Current inventory of packer-fed cattle, measured as number of head of packer-fed cattle purchased by

each plant during the 28-day period beginning with the current day (t);

QMAt = Current inventory of marketing agreement cattle, measured as number of marketing agreement cattle purchased by each plant during the 28-day period beginning with the current day (t).

This model is similar to equation 5 (model 1) with two important differences. First, it is a single-equation model rather than a system of equations. Second, this equation uses variables for the inventory of captive supplies instead of the percentage delivery from captive-supply inventory used in equation 5.

Model 3: Captive Supply-Cash Price Difference

PPRCt = f (ABBCVt-1 , LCFMPt-1 , DTYPi,t , AHotWtt , AHotWtt2, NoHdt, NoHdt2, PYG1-3t , FWDALLt , DDOWi,t , UTILNt , TRNDi , TRNDi2 , TRNDi3 , DPLTi,t, DMETHit)

The dependent variable in this equation, PPRCt, represents the price for any transaction regardless of type. The explanatory variables included in this equation are the same as in models 1-2, with two exceptions. The time between purchase date and slaughter date was hypothesized to affect transaction prices for all transactions, not just cash-market transactions. Thus, the variable FWDALLt replaced FWDt used in the earlier model, to measure the difference between purchase and slaughter date for all purchases regardless of type. Second, DMETHit was added to identify purchases from captive supply by type, and thus measure the effect of procurement method on cattle prices.

Model of Longrun Captive-Supply Determinants

Captivesit = f (Casht-4, Basist-4, Cashvart-4, Killt-12, Utilizeit-12 , Capacityit , Capsqit)

Where

Captivesit = Quantity of captive supplies used by plant i in the current month t

Casht-4 = Cash-market price 4 months prior

Basist-4 = Basis 4 months prior

Cashvart-4 = Variance in cash price 4 months prior

Killt-12 = Total U.S. slaughter 12 months prior
Utilizeit-12 = Total slaughter at plant i 12 months prior, divided by plant's capacity

Capacityit = Capacity of plant i in current month t

Capsqit = Square of capacity

Packers' allocations between cash-market and captive supply were hypothesized to be based on relative prices, so cash-market and futures prices at the time of contracting (that is, 4 months prior) should influence the decisions that determined current level of captive supply. Cash-market price variability at the time of contracting was also hypothesized to influence the decisions on use of captive supply. Variables for prior-year U.S. slaughter levels and plant utilization rates represent information about the current stage of the cattle cycle that would influence packers' expectations of cattle availability. Finally, the two current capacity variables accounted for the effects of plant size on captive-supply use.

Chapter 4

Model of Packer Conduct in Fed-Cattle Markets

The model assumes that plants strive to maximize shortrun profits (in the short run, capital is fixed and cannot be altered) by producing the profit-maximizing level of output at minimum variable cost, given fixed captial. Formally the objective of the plant can be written as

maximize Pij = Pyj yij - woj g yij - VC(w1j , . . . wnj ; yij , zi)

wherePij = profit of plant i in period jPyj = output priceyij =output quantitywoj = price or cost per unit of fed cattleg = inverse of the fixed proportion of slaughter converted to beef productsVC = variable processing cost as a function of output quantity and prices of non-cattle inputsw1j , . . . wnj = prices of the non-cattle inputs (x1j, . . . xnj) used for processingzi = capital stock of firm i.

The first-order condition for maximizing profit, assuming each plant may influence prices in fed cattle markets but acts as a price-taker in output markets, is met when

P/y = Py -wo g - [(wog)/y]y - VC(w1 , . . . wn ; y , z)/y = 0

The profit-maximizing relationship in this equation includes the term [(wog)/y]y which specifies the effect of changes in output by a plant on changes in the price of fed cattle. In a market where firms have no market power, behavior of an individual plant does not affect fed cattle prices and the value of this term is zero. A test for the exercise of market power thus is a test of whether this term is greater than zero.

The test is performed by estimating the value of the term simultaneously with the other parameters in a system of equations that includes a shortrun variable cost function and input demand equations, as well as the profit-maximizing condition (rewritten in the first equation below)

Profit max: Pyj = wojg + [(wog)/y]yij + VC(w1 , . . . wn ; y , z)y + vj

Variable cost: VCj = VC(wij , . . . wnj ; yij , zi) + eoj

Demand for input xkj: xkj = VC(w1j , . . . wnj ; yij , zij)/wkj + ekj for all k = 1 through n-1

where vj, eoj, and ekj are prediction errors. The input demand equations restrict the parameters to be consistent with the economic theory of production.

Chapter 6

The Price Surface Model

In simplified form, Bressler and King predict that an informed packing plant operating in an efficient market will necessarily pay prices for (identical) hogs in a given time period such that prices over the entire procurement area follow the relationship:

> Price at the plant = price at the farm + transaction costs

Transaction costs include both freight costs and other costs associated with procurement. The freight portion of transaction costs leads to a geographic price surface resembling a cone; net prices to the producers decline with distance from the plant. Prices of hogs delivered to the plant (that is, the price at the source plus cost of transporting to the plant and all other transactions costs) will be equal regardless of purchase location. If freight costs are linear with distance, the procurement area will approximate a circle.

The first equation does not portray a causal relationship, but rather the characteristics of an efficient pattern of prices across the procurement area. The simplified Bressler-King equation estimated to test spatial price patterns is:

> Prices paid = f (kill date, plant, transfer point, seller type, lot size, average liveweight, distance, total number of hogs from a county, PCTALL, PCTOWN, and number of competing plants per county)

where variables are as defined in the introduction. This equation replaces both the transaction-cost and source-price components of the first equation with variables hypothesized to influence transaction costs and variation in prices paid by source.

Data Issues for the Price Surface Model

Survey hogs were not necessarily all of equal quality. Average weight was the only available measure of hog quality and may be nonlinear with price. Average weight was used as a proxy for quality, and the square of average weight was included to allow for nonlinearity. This could bias results if some plants purchased hogs differing in other quality attributes. Any such differences should be identified in the separate plant estimations.

Transactions were not all simple direct sales from farm to packer. Variables provided information about the transaction type and location to account for the differences statistically.

In the large number of cases for which no freight and/or commission costs were reported, the model estimation assumed that reported plant costs accurately represented the delivered plant prices.

Transaction observations were associated with the kill date, not necessarily the date when the transaction price was agreed upon.

The distance variable was not actual road miles from the hog source to the plant. It was calculated as the direct-line distance based on the approximate longitude and latitude of the plant's city and a centroid point within the source county, whether the source be a farm, auction, terminal, etc. This method of estimating distance was likely to understate the true relationship between distance and price, making one more likely to conclude (falsely) that distance was not related to price. As noted below, the analysis actually found a small positive relationship.

Researchers did not know a priori if transportation costs were a linear function of distance, so nonlinearities were considered by including a variable measure, the square of distance.

Endnotes

1 GAO, "Packers and Stockyards Administration, Oversight of Livestock Market Competitiveness Needs To Be Enhanced," Oct. 1991. GAO/RCED-92-36.

2 Stephen R. Koontz. Arbitrage Costs Between Regional Fed Cattle Markets: Estimates Using Public Price Data. Report to Packers & Stockyards Programs, Grain Inspection, Packers & Stockyards Administration, USDA, 1995.

3 Marvin L. Hayenga, Ronald, D. Hook, and Bingrong Jiang. Fed Cattle Geographic Market Delineation: Slaughter Plant Procurement Area and Supply Response Analysis. Report to Packers & Stockyards Programs, Grain Inspection, Packers and Stockyards Administration, USDA, 1995.

4 Ted C. Schroeder. Spatial Fed Cattle Transaction Price Relationships. Report to Packers & Stockyards Programs, Grain Inspection, Packers and Stockyards Administration, USDA, 1995.

5 The Guidelines outline the enforcement policy of the DOJ and FTC concerning horizontal merger acquisitions and mergers subject to section 7 of the Clayton Act, section 1 of the Sherman Act, and section 5 of the FTC Act. They are written in terms of the exercise of market power by sellers, but also state that an analogous analytical framework applies to the assessment of potential exercise of market power by buyers. In that case, the Guidelines would seek to identify a geographic area such that a hypothetical firm that was the only present or future buyer of the relevant product in that area could profitably impose a "small but significant and nontransitory" decrease in price. In most contexts, the Guideline's "small but significant and nontransitory" price decrease is a price decrease of 5 percent.

6 Eleven of the 120 arbitrage costs were not estimable. These market pairs were: Illinois and Iowa; Illinois and W. Kansas; Omaha and E. Kansas; Sioux City and E. Kansas; W. Nebraska and W. Kansas; W. Nebraska and Texas; Colorado and W. Kansas; Colorado and Texas; E. Kansas and W. Kansas; E. Kansas and Texas; and Arizona and Idaho. With the exception of Arizona and Idaho, all of the pairs are neighboring markets or are relatively important national marketplaces. For these market pairings, it may be that the arbitrage costs were very small or that binding arbitrage never occurred, and thus, arbitrage cost distributions were not estimable. This also suggests that these geographic market pairs are in the same economic market or are completely separate markets.

7 See appendix A for additional information on the data collected for the study.

8 Granger, C.W.J. ©Investigating Causal Relationships by Econometric Models and Cross-Spectral Methods.ª Econometrica 37(1969): 424-38.

9 SoftKey International Inc. Key Travel Map. Computer Software, 1994.

10 Slaughter Cattle Procurement and Pricing Team, Texas Agricultural Market Research Center, Price Determination in Slaughter Cattle Procurement, Report to Packers and Stockyards Programs, Grain Inspection, Packers and Stockyards Administration, USDA, November 1995.

11 Descriptive statistics in this section are simple group averages, not adjusted for other variables. For example, the comparison of average prices does not consider possible differences in quality of cattle purchased.

12 North Atlantic = Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Vermont; South Atlantic = Delaware, Maryland, North Carolina, South Carolina, Virginia, West Virginia; East North Central = Illinois, Indiana, Michigan, Ohio, Wisconsin; West North Central = Iowa, Kansas, Minnesota, Missouri, North Dakota, Nebraska, South Dakota; South Central = Alabama, Arkansas, Kentucky, Mississippi, Tennessee; South Plains = Oklahoma, Texas; Mountain = Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, Wyoming; Pacific = California, Oregon, Washington; Canada = all provinces.

13 This does not necessarily imply slaughter practices of larger plants result in higher yields; the higher yields likely are due to differences in type of cattle purchased, or may be attributable to differences in use of pencil shrink (packers' adjustment for loss in weight during transportation to the packing plant).

14 Typically, formula price is the packer's weekly average prices paid or the average of two or more public price reports.

15 There are no standards or tests for substantive significance. Results must be judged in the context of the analysis being reported.

16 Herfindahl index equals the sum of the squared market shares of all firms in the market. The regions used here were much smaller than those defined in the project specifically focusing on market areas (chapter 1).

17 Clement E. Ward, Stephen R. Koontz, and Ted C. Schroeder, Short-Run Captive Supply Relationships with Fed Cattle Transaction Prices, and Andrew P. Barkley and Ted C. Schroeder, The Role of Captive Supplies in Beef Packing: Long-Run Impacts of Captive Supplies. Reports to Packers & Stockyards Programs, Grain Inspection, Packers and Stockyards Administration, USDA, 1995.

18 Contract No. 53-6395-2-124, Technical Proposal, p. 22.

19 The model developed here explicitly focuses on packers' decisions about drawing from captive supply inventories. It does not address decisionmaking by feeders who also exercise some control over the timing of deliveries of cattle sold under captive supply arrangements.

20 The researchers estimated the model with inventories measured alternatively at the plant and firm level, and also based on a 14-day period as well as a 28-day period. The range in the reported effects is due to the level of aggregation and period used.

21 The effect of captive supply on prices in the long run was not examined.

22 The hypothesized determinants of packer-fed supply included the volume of forward-contracted and

marketing agreement cattle, and conversely, the determinants of other forward-contracted and marketing agreement cattle included volume of packer-fed cattle.

23 S. Murthy Kambhampaty, Paul J. Driscoll, Wayne D. Purcell, and Everett D. Peterson, Effects of Concentration on Prices Paid for Cattle. Report to Packers & Stockyards Programs, Grain Inspection, Packers and Stockyards Administration, USDA, December 1995.

24 Appendix B provides a description of data items requested from individual plants.

25 Chain speed does not necessarily represent the desired variable, which is capital. Plants were also asked to estimate the replacement cost of the facility as an alternative measurement of size, but were generally unable to provide useful estimates.

26 See Appendix B for complete detail on these categories as well as byproduct categories.

27 Although every plant paid overtime in every week, overtime hours never exceeded 22 percent of total hours worked and usually varied between 5 and 10 percent of total hours worked.

28 Marvin L. Hayenga, V.J. Rhodes, Glenn A. Grimes, and John D. Lawrence. Vertical Coordination in Hog Production. Report to Packers & Stockyards Programs, Grain Inspection, Packers and Stockyards Administration, USDA, 1995.

29 The term "market hogs" is generally understood to include young (5-7 month) hogs that have been fed to live weights of 220-270 pounds. The term "spot markets" refers to the type of sale where prices are negotiated between buyer and seller and delivery is made within a relatively short period (usually within a day or two in the hog industry). An alternative to spot markets is some form of contractual pricing arrangement, wherein the buyer and seller agree in advance to a transaction with delivery, the actual transfer of title, and final settlement of terms deferred until some later date.

30 Marketing contracts include contracts where producers own the hogs until they are delivered to the packing plant. With production in the packers' own or jointly owned (with producers) facilities, and with production contracts, the packers have some ownership interest in the hogs during the feeding operation. Under production contracts, the hogs are fed in facilities owned by the contract producers.

31 The North Central region includes Illinois, Minnesota, Kansas, Indiana, Missouri, Nebraska, South Dakota, Iowa, and Kentucky.

32 Commodity Economics Division, Economic Research Service, USDA. Economic and Statistical Assessment of Hog Assembly, Shipping, and Prices in the Eastern Corn Belt - Final Report. Report to Packers and Stockyards Programs, Grain Inspection, Packers and Stockyards Administration, USDA, 1995.

33 Bressler, Raymond G., and Richard A. King. Markets, Prices, and Interregional Trade. Norman-Weathers Printing Co.: Raleigh, NC, 1978.

34 Hoover, Edgar M. An Introduction to Regional Economics, Second Edition. Alfred A. Knopf: New York, NY, 1975.

35 When averaged over all plants and the counties where they actually purchased, the average plant's

total 2-week purchases from the average individual county represented 4.3 percent and 2.8 percent of that plant's total 2-week purchases in 1990 and 1991.

36 The interpretation, on average, is that a given plant purchased just over 50 percent of reported sales reported from a given county in 1991, versus 58 percent in 1991.

37 These conditions for economic efficiency are not strictly identical to a test for perfect competition in the procurement area.

38 Azzeddine Azzam and Dale Anderson. Assessing Competition in Meatpacking: Economic History, Theory and Evidence. Report to Packers & Stockyards Programs, Grain Inspection, Packers and Stockyards Administration, USDA, 1995.

39 The specific examples and incidents traced throughout the historical review emphasize changes in beef production and slaughter. Changes in pork followed the same general patterns, although the westward relocation of feeding was not as pronounced as that of cattle.

40 Names in parentheses refer to full citations listed in the bibliography (Appendix C).

41 Competitive price is the price that theory predicts would result if price is determined in a competitive market.

42 "Seller" refers to the name and location information of the individual/business that sold cattle to the packer and reported by the packer.

43 The term "Firm" or "Firm Name" refers to sellers operating at more than one location and/or that are owned by the firm.

Appendix A—Overview of Transactions Data

Transactions data for the packer concentration study were collected from the top 43 steer/heifer packing plants. Packer transactions data included seller information, cattle weight, cost, and quality information. Appendix table A-1 lists and describes the specific variables obtained. For each plant, data were collected for individual transactions with 35 or more head for the time period April 5, 1992, to April 3, 1993. The remainder of this appendix describes data collection and processing objectives and provides an assessment of limitations of the data set.

Packers in the sample were requested to provide transactions data for the specified time period. Each packer was given the opportunity to either (1) allow GIPSA personnel access to their records for data collection purposes or (2) provide to GIPSA the requested data electronically. A number of packers provided all or a portion of the requested transaction data electronically, with GIPSA personnel collecting the missing variables or observations in a supplemental collection from packers' records at corporate headquarters or plant site. Using protocols established for this collection, data collected by GIPSA personnel were recorded as maintained in packers' records. Data provided electronically by the packers did not necessarily conform exactly to GIPSA protocols.

Data Collection and Processing Objectives

* Economic variables (weights, number of head, cost, quality characteristics, etc.) should accurately reflect information as recorded in packers' records.

* Each seller (unique combination of name, city, county, and State information) should be identified and assigned a unique seller ID code.[42] The seller code was used to link seller information back to original data and allow the summation of each seller's cattle marketings to all packers.

* *Seller Name*. Data collected from packers should reflect the entities that sold cattle to packers (feedlots, auctions/terminals, or dealers). The primary source of cattle was feedlots/feeders. If cattle were sold at a public market (auction or terminal) the market's name should be listed. If cattle were custom fed by a feedlot for absentee owners, then feedlot's name should be listed.

* *Seller Location*. Data collected from packers for seller's location (city, county, and State) should reflect the address of the feedlot or auction/terminal. If cattle were custom fed, location should *not* reflect absentee owners' address but that of the feedlot's.

* City-county, city-State, and county-State locations should correspond to known locations from external sources.

* *Firm Name*.[43] Sellers that: (a) operated at more than one location and/or (b) were controlled or owned by a single entity, should be assigned the same Firm Name ID (Control) code. This allowed the summation of cattle marketings by a single firm for all of its operations.

* Each seller should be assigned a seller-type code indicating whether it was a feedlot/feeder, auction/terminal, or dealer.

Assessment and Limitations

Economic Variables. Price, weights, number of head, quality characteristics, and all other information about the terms of sale other than seller name, location, and type were reviewed to ensure that they accurately reflected lot transaction information as recorded in packers' records. No further auditing of packers' records was done. These data were deemed suitable for all economic analyses consistent with appropriate statistical practices, including treatment of missing values and measurement error.

Location Information. City, county, and State information was assessed to validate city-county-state combinations. Approximately 3 percent of all locations were either missing or had Canadian addresses.

Location information for all sellers was as accurate as possible given the information recorded in packers' records. When feasible, location corrections were made in cases where an invalid location was provided for a large seller (at least 1,000 head) and location could be inferred unequivocally.

Analyses and inferences requiring location information for dealers (a small minority of all transactions in the database) should be treated with caution. Packers' records may have recorded a dealer's mailing address, the location where cattle were bought by the dealer, or the location where the dealer negotiated the sale. Sensitivity analysis may be appropriate for cases in which measurement error in location information is important and the seller type is dealer.

Seller Identity Information. Information on seller identity was supplied only to the contractor for the project examining price determination in slaughter cattle procurement. Seller information (names, controlling firm, and type) was not closely reviewed for sellers marketing fewer than 1,000 head in the sample. Caution should be exercised in interpreting analyses concerning differences among the smaller sellers.

Additional review procedures were followed for sellers tentatively identified in the database with sales of at least 1,000 head. To identify these sellers, additional review was conducted (1) to correctly combine unique name-location combinations under a single seller code, (2) to assign a common control code to entities under common ownership or control, and (3) to identify seller type (auction/terminal market, dealer, or other).

Potential bias in seller code identification is essentially unidirectional. Seller codes identify unique seller name-location combinations, with locations defined by city, county, and State. Transactions having the same seller code or control code should have been correctly identified as belonging to the same seller or controlling firm. However, some transactions may have been incorrectly identified under a separate seller code or control code. Packers' own records constituted the limiting factor in determining seller name and location. For example, packers were requested to provide the name of the entity from which the cattle were bought or fed. In some cases, seller names reported by packers may actually be the absentee owners of custom-fed cattle, resulting in additional unique seller codes. Particularly in the case of data provided electronically by packers, it was not possible to track and correct such errors. Missing information for individual sellers may also have resulted in additional unique seller codes due to multiple financial interests in a given feedlot. For instance, one firm may have operated two feedlots in separate cities, but in the same county in the same State. Packers' records may have recorded transactions under the firm name both with and without city locations identified. Thus, three unique seller codes could have been assigned for three different name-location combinations, although only two actual locations exist. Generally, the effects of such errors would be to overstate the total number of sellers and of smaller sellers particularly, understate the total marketings of individual feedlots, and perhaps misrepresent the location from which cattle were sold or fed.

Sellers with at least 1,000 head were reviewed to assign seller type. The default value for seller type was "other" (not an auction/terminal market or dealer). Sellers identified as an auction/terminal market or dealers were correctly identified, but there might be cases of sellers identified as "other" that should be coded as markets or dealers.

Appendix table 1-- Description of transaction data variables

Field Name	Description
Trans No	Index key field - uniquely identifies transaction record
Packer ID	Plant code identifier
Kill Date	Date cattle recorded as slaughtered. If a lot was killed on two separate days and the packer did not break out information separately for portion killed each day, the entire lot was recorded as killed on a single day, usually the first day
Seller Type	Code to identify whether the seller was an auction/terminal, dealer, or other
Seller ID	Code to distinguish unique seller
Seller City	Requested city location of the feedlot where the cattle were fed, not the address or location of the owner of the cattle, but in some cases entry may be owner's address.
Seller State	Requested State location of the feedlot where the cattle were fed, not the address or location of the owner of the cattle, but in some cases entry may be owner's address.
Seller County	Requested county location of the feedlot where the cattle were fed, not the address or location of the owner of the cattle, but in some cases entry may be owner's address.
Seller Zip	Requested zip code of the feedlot where the cattle were fed, not the address or location of the owner of the cattle, but in some cases entry may be owner's address.
No Hd	Number of head in this kill lot. May include dead and condemned cattle not paid for by the packer.
Cattle Type	Code indicating type of cattle in this kill lot, as classified by the packer. Values include codes for steers, heifers, mixed, fed Holsteins, other, unknown, and five additional variations.
Pro Meth	Code indicating the method by which this lot of cattle was purchased. Values are: forward contract (packer contracts with seller to purchase lot of cattle at either a fixed or basis price; contract is entered into at any time between placement of cattle on feed and 2 weeks prior to kill date), packer fed/owned (packer owned cattle fed for slaughter at either custom feedlot or packer owned or controlled feedlot), marketing agreement (a long-term arrangement where packer agrees to purchase specified number of cattle per specified time period such as week, month, or year), spot market (cattle purchased directly from feedlot, other seller, or at public markets within 2 weeks of kill date), other (any cattle purchases not captured in other categories), or unknown.
Price Meth	Code indicating the pricing method used to set the price for this lot of cattle. Categories include carcass weight (hot or dressed weight) including carcass grade and yield or fixed price, formula (e.g., price is based on packer's weekly average prices paid or an average of two or more price reports, etc.), liveweight, custom kill and railers, and unknown.
Purch Code	Code indicating any special interpretation of the indicated purchase date.
Purch Date	Date lot was purchased by the packer.

Net Code	Code indicating any special interpretation of the value entered in the following liveweight field.
Live Wt	Net live or actual purchase weight for the lot. Generally equal to gross live weight minus pencil shrink, unless indicated otherwise by Net Code.
Hot Code	Code indicating any special interpretation of the value entered in the Hot Wt field.
Hot Wt	Total hot weight of the lot; same as carcass weight or dressed weight.
Yld Code	Code indicating any special interpretation of the value entered in the Yield field, including pencil shrink factors or other special yield calculations factors used by particular packers.
Yld	Lot yield (=total hot wt. divided by total net liveweight unless indicated otherwise by the Yld Code).
Deliv Code	Code indicating whether total cost includes transportation (shipping) and commissions, which must be added to the amount in Cost field to obtain total cost when not already included.
Cost	Total delivered cost of this lot unless indicated otherwise by the Deliv Code. This value should include only the cost of the cattle, transportation, commission, and feed costs charged to the packer by the seller. In some cases, indicated by the Deliv Code, it may be necessary to adjust this cost by the amount recorded in the other cost fields.
AvgD Code	Code indicating any special interpretation of the value entered in the Cost/cwt field, such as shrink factors or other particular methods used by packers to compute Cost/cwt.
Cost/cwt	Average rail cost = (Cost/Hot Wt) * 100 unless indicated otherwise by the AvgD Code.
QG Code	Code indicating manner in which the following quality grade fields show number of carcasses in this lot in each quality grade, including whether the lot was ungraded, not reported or unknown, or one of eight different combinations the quality grades.
QG Type	Code indicating whether values in following quality grade fields represent total weight, number of head, or percent of lot total head in each of the quality grades.
Prime, Choice, Select, Other	Generally, portion of lot graded as prime, choice, select or other. Exact interpretation depends on codes in the QG Code and QG Type fields.
YG Code	Code indicating manner in which the following yield grade fields show number of animals in this lot in each yield grade, including not recorded or 1 of 11 different combinations of the yield grade fields.
YG Type	Code indicating whether values in following yield grade fields represent number of head or percent of lot total head in each of the yield grades.
YG1-5	Generally, portion of lot graded as yield grade 1, 2, 3, 4, or 5. Exact interpretation depends on codes in the YG Code and YG Type fields.
Ship	Total transportation cost for the lot of cattle.
Comm	Total Commissions paid for the lot of cattle.

Appendix B
Cost and Revenue Survey

Data were obtained on the operating costs and revenues of the 43 largest steer and heifer slaughtering plants for the period April 5, 1992 through April 3, 1993. The data collected through a mail survey. Attached are the instructions for the survey instruments.

BEEF PACKER COSTS AND REVENUE SURVEY
ESTABLISHMENT REPORT

INSTRUCTIONS

O.M.B. APPROVAL NO. 0590-0005: EXPIRES 4/30/96

NOTICE -- Response to this inquiry is required by law (Section 6 of the Federal Trade Commission Act, as made applicable to the authority of the Secretary of Agriculture by Section 402 of the Packers and Stockyards Act, 1921, as amended (7 U.S.C 222)). Your report to the Packers and Stockyards Administration is confidential.

Public reporting for this collection of information is estimated to average 160 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Agriculture, Clearance Officer, OIRM, AGBOX 7630, Washington, DC 20250-7630, and to the Office of Management and Budget, Paperwork Reduction Project (OMB #0590-0005), Washington, DC 20503.

▶ **GENERAL INSTRUCTIONS**

Unless otherwise instructed, report on all activities at this establishment for the period **April 5, 1992 through April 3, 1993**.

An establishment is defined as a single physical location where slaughter, fabrication, and other processing activities are performed. This is a consolidated report for **all beef operations conducted at this location**.

Use these instructions to complete the Beef Packer Costs and Revenue Survey Establishment Report. Responses should be recorded on a separate Response Form (enclosed). Information should be recorded on the Response Form where this symbol ☞ appears in these instructions. The unit of information requested is noted in parentheses. For example, ☞ ($) indicates that a dollar amount should be entered for this item on the Response Form.

Be sure to complete every item unless otherwise instructed. Enter "0" in items where appropriate.

Please contact the Industry Analysis Staff, Packers and Stockyards Administration at (202) 720-7455 if you have questions about completing this report.

Please complete this report within 60 days of receipt and return to:

Industry Analysis Staff
Packers & Stockyards Administration
Ag Box 2840
Washington, D.C. 20250-2840.

▶ PART A - GENERAL ESTABLISHMENT CHARACTERISTICS

▶ Item 1 - Beef Slaughter and Fabrication Hourly Rates

a. **Food Safety and Inspection Service (FSIS) approved** combined slaughter rate for **all beef slaughter lines** at this establishment as of:

April 5, 1992 ..... ☞ (Number of head per hour)

April 3, 1993 ..... ☞ (Number of head per hour)

b. Maximum combined slaughter rate as **designed and engineered** for **all beef slaughter lines** at this establishment as of:

April 5, 1992 ..... ☞ (Number of head per hour)

April 3, 1993 ..... ☞ (Number of head per hour)

c. Maximum combined **fabricating rate** as designed and engineered for **all beef fabricating lines** at this establishment as of:

April 5, 1992 ..... ☞ (Carcass-equivalents per hour)

April 3, 1993 ..... ☞ (Carcass-equivalents per hour)

▶ Item 2 - Estimated Replacement Cost for this Establishment as of April 5, 1993 ..... ☞ ($)

INCLUDE
- Replacement cost of buildings and structures
- Replacement cost of machinery and equipment
- Replacement cost of depreciable assets obtained through capital leases

EXCLUDE
- Value of land
- Current assets (inventories, cash, accounts receivable, etc.) and intangible assets (goodwill, patents, copyrights, etc.)
- Value of depreciable assets at other locations for which this establishment maintains records

▶ PART B - MONTHLY OR EQUIVALENT ACCOUNTING PERIOD OPERATING INFORMATION

▶ REPORTING INSTRUCTIONS FOR PART B

Complete each item in this part for each monthly or equivalent accounting period that is wholly or partially included in the period April 5, 1992 through April 3, 1993. Write the word "None" in the first column on the Response Form to indicate items for which the amount is 0 (zero) for *all* periods. Equivalents to monthly accounting periods are four-week and combination four/five-week accounting periods.

ENSURING COMPLETENESS - Be sure to report for all monthly or equivalent accounting periods that include April 5, 1992 through April 3, 1993.

- If your fiscal year consists of 12 monthly accounting periods, you may need to report information for 13 periods.
- If your fiscal year consists of a combination of 12 four and five week-long accounting periods, you may need to report information for 13 periods.
- If your fiscal year consists of 13 four week-long accounting periods, you may need to report information for 14 periods.

▶ **Item 3 - Ending Date for Monthly or Equivalent Period**.....☞ (month/day/year)

▶ **Item 4 - TOTAL Expenses for Period** .....☞ ($)

Report consolidated total cost of sales plus all general, overhead, and administrative expenses for all beef operations at this establishment.

INCLUDE

- Total payroll costs for all employees before deductions, including all costs of both voluntary and legally required fringe benefits (supplemental labor costs)
- Delivered cost of cattle and meat purchased, including payments to sellers, shipping costs, commissions, and any other costs of obtaining the cattle and meat
- Cost of materials and services used, including utilities and outside or contract services
- All other operating expenses (See Item 7 below for examples of items included)
- Rental payments
- Charges assessed by any corporate headquarters, home office, other central administrative, or auxiliary support unit for overhead and support activities (including charges reported in Item 5 below)
- Total overhead expense
- Additions made to depreciation reserves
- Allocated periodic expense of unusual or non-recurring one-time costs, or costs that are normally incurred less frequently than a monthly or equivalent period basis
- Allocated periodic expense for purchased services and materials for repair of buildings, machinery, and equipment, including payments to other establishments of the same company and for repair and maintenance of leased property

EXCLUDE

- Capital expenditures
- Expenses of a separate headquarters office or other central unit for services performed in support of other establishments, even if that unit is physically located at this establishment (Include, however, the share of that unit's total expenses allocated to this establishment)

▶ PART B - MONTHLY OR EQUIVALENT ACCOUNTING PERIOD OPERATING INFORMATION

▶ Item 5 - Total Charges From Headquarters:

a. If this is a single-establishment firm, check the box on the response form and then SKIP to Item 7.

b. If this establishment is part of a multi-establishment firm, report the portion of consolidated total establishment expenses reported in Item 4 above that was due to charges assessed against this establishment by corporate headquarters, home office, or other separate administrative or auxiliary establishments for overhead and support activities .....☞ ($)

INCLUDE ● Charges from units performing supporting services, such as research, development, and testing; central warehouses; central garages; receiving stations; sales branches and offices; sales promotion offices; general administration or supervising offices; accounting, purchasing, planning, advertising, legal, and financial planning or administration operations; and cattle procurement operations reported in Item 6 below

▶ Item 6 - Charges for Centralized or Headquarters Cattle Procurement Operations:

a. If a centralized, headquarters, or other separate cattle procurement operation not operated by this establishment buys cattle for this establishment, complete lines b and c. Otherwise, check the box on the response form and SKIP to Item 7.

b. Charge assessed to this establishment for cattle procurement activities.....☞ ($)

c. Total head of cattle purchased for this establishment by a separate procurement operation☞ (number)

▶ Item 7 - Total Operating Expenses of Production Operations.....☞ ($)

Report the portion of consolidated total establishment expenses reported in Item 4 above that was due to current production operations.

INCLUDE ● All expenses of current production operations incurred at this establishment, such as labor; utilities; packaging and other materials and supplies; grading and inspection services; other outside or contract services (such as outside freezers and maintenance services); product loading, merchandising and selling expenses; interest on working capital; cost of all parts, components, containers, supplies (except cattle, meat, and by-products) consumed or put into production; and all other production-related expenses of operating the establishment

EXCLUDE ● Charges for depreciation; charges assessed by or for central headquarters or any other separate establishment for overhead, support, and administrative services reported in Items 5 and 6; payments to sellers for cattle and meat; commissions and other payments to independent buying agents for cattle and meat; cost of freight and transportation on cattle shipped to and products shipped from the establishment; interest expenses other than interest on working capital; and cost of meat and by-products transferred in from other establishments of this firm

▶ PART B - MONTHLY OR EQUIVALENT ACCOUNTING PERIOD OPERATING INFORMATION

▶ **SPECIAL INSTRUCTIONS FOR ITEMS 8 - 11 (Operating Expenses by Type of Activity)**

Items 8 through 11 require you to separate establishment total operating expenses (Item 7) into categories of expense based on the types of production activity being conducted (called "departments," "divisions" or "plants" at some establishments). If this establishment has activities that are not included in Items 8 - 11, such as separate specialized edible by-product processing or specialized hide processing activities, the sum of Items 8 through 11 will be less than the total reported above in Item 7.

▶ **Item 8 - Total Slaughter Operating Expenses** .....☞ ($)

Report the portion of the total reported in Item 7 attributable to cattle slaughter operations at this establishment. *(Slaughter operations are defined as all production activities performed from the time the cattle are received at the establishment until the carcass is weighed prior to transfer to fabrication lines)*

EXCLUDE
- Operating expenses of any activities associated with meat fabrication and specialized further processing of by-products from slaughter, such as rendering or hide processing
- Delivered cost of cattle slaughtered (payment to sellers, shipping costs, and commissions and other payments to independent buying agents)

▶ **Item 9 - Total Fabrication Operating Expenses** .....☞ ($)

Report the portion of the total reported in Item 7 attributable to beef fabrication operations at this establishment. *(Fabrication operations are defined as all production activities to convert carcasses into beef, beef cuts, and meat by-products ready for shipment)*

EXCLUDE
- Operating expenses of any activities associated with further processing of non-meat by-products.
- Operating expenses of any activities prior to removal of the chilled carcass from the cooler for breaking

▶ **Item 10 - Total Distribution, Merchandising and Selling Operating Expenses**.....☞ ($)

Report the portion of the total in Item 7 attributable to sales and distribution activities conducted at THIS ESTABLISHMENT ONLY.

INCLUDE
- Selling expenses such as brokerage and commissions, and expenses associated with loading products for shipment at this establishment

EXCLUDE
- Any expense or charge of a headquarters or other separate establishment that conducts selling or related distribution services
- Freight for the products shipped from this establishment

▶ **Item 11 -Total Cattle Procurement Operating Expenses** .....☞ ($)

Report the portion of the total in Item 7 attributable to cattle procurement activities conducted by THIS ESTABLISHMENT ONLY.

INCLUDE
- Buyers' vehicle and other travel expenses, for buyers working solely for this establishment
- Total compensation of cattle buyers who work solely for this establishment

▶ **PART B - MONTHLY OR EQUIVALENT ACCOUNTING PERIOD OPERATING INFORMATION**

EXCLUDE
- Delivered cost of cattle purchased (payments to sellers, shipping expenses for cattle purchased, and commissions and other payments to independent buying agents)
- Charge assessed for centralized cattle procurement activities reported in Item 6 (if any)

▶ **SPECIAL INSTRUCTIONS FOR ITEMS 12 - 19 (Operating Expenses by Type of Input)**

Items 12 through 19 require that you provide information on selected individual components of the Total Operating Expenses entered in Item 7. These items represent various types of inputs or services generating total expenses. Most of the costs reported in items 12-19 were reported in different categories in items 8-11. **Note that items 12 through 19 may not sum to Total Operating Expenses as entered in Item 7.**

▶ **Item 12 - Establishment Total Payroll and Fringe Benefits:**

a. Employee Payroll before Deductions ..... ☞ ($)
Report the total of all weekly gross earnings, prior to deductions, for all salaried and hourly employees, including commissions, dismissal pay, bonuses, and vacation pay.

EXCLUDE
- Employer's cost for fringe benefits (see line b below)
- Payments to proprietors and partners if this is a sole proprietorship or partnership operation

b. Employer's Cost for Fringe Benefits (Supplemental Labor Costs)..... ☞ ($)

INCLUDE
- Employer's cost for legally required fringe benefits such as employer's Social Security tax, unemployment tax, workers' compensation insurance, and state disability insurance programs
- Employer's cost for voluntary fringe benefits such as union negotiated benefits, life insurance premiums, pension plans and welfare plans, insurance premiums on medical plans, and stock purchase plans

▶ **Item 13 - Number of Salaried Employees at this Establishment**..... ☞ (number)

INCLUDE
- Both full- and part-time salaried employees as of the last Wednesday of the period
- All production and nonproduction (office, clerical, maintenance, etc.) salaried employees
- Firm officers and executives on the payroll of this establishment

EXCLUDE
- Unsalaried proprietors and partners if this is a sole proprietorship or partnership operation
- Wage (hourly) employees

▶ **Item 14 - Cattle Buyers Employed by This Establishment:**

a. If this establishment is part of a multi-establishment firm AND all cattle procurement during the year was handled by a centralized or other separate buying operation, check the box on the response form

▶ **PART B - MONTHLY OR EQUIVALENT ACCOUNTING PERIOD OPERATING INFORMATION**

and then SKIP to item 15. Otherwise, complete lines b and c.

b. Number of cattle buyers employed by this establishment as of the last Wednesday of this period☞ (nur

c. Total compensation and benefits for cattle buyers employed by this establishment. Include all payments and benefits as defined in Item 12, lines a and b.....☞ ($)

▶ **Item 15 - Total Cost of All Purchased Utilities**.....☞ ($)

INCLUDE
- Electricity
- Fuels used for heat and power, but not fuels for transportation
- Water
- Waste and sewage treatment and disposal
- Telephone and other communications services

▶ **Item 16 - Cost of Selected Utilities Excluding Fuels for Transportation:**

a. Cost of purchased electricity .....☞ ($)

b. Cost of purchased fuels consumed for heat or power.....☞ ($)
EXCLUDE ● Purchased electricity reported on line a above

c. Cost of purchased water .....☞ ($)

d. Cost of sewage treatment and disposal.....☞ ($)

▶ **Item 17 - Quantity of Selected Utilities Excluding Fuels for Transportation:**

a. Quantity of purchased electricity.....☞ (kilowatt hours)

b. Quantity of purchased natural gas .....☞ (thousand cubic feet)

c. Quantity of purchased LP gas (propane, butane, ethane) .....☞ (thousand gallons)

d. Quantity of purchased fuel oil .....☞ (thousand gallons)

e. Quantity of purchased coal.....☞ (tons)

f. Quantity of purchased water.....☞ (thousand gallons)

▶ **Item 18 - Expense of Packaging Materials for Beef and By-products**.....☞ ($)

▶ **PART B - MONTHLY OR EQUIVALENT ACCOUNTING PERIOD OPERATING INFORMATION**

INCLUDE
- Boxes, film, bags, paper, and other items used for product packaging

▶ **Item 19 - Expense of Operating Materials and Supplies other than Packaging**.....☞ ($)

INCLUDE
- Cleaning and maintenance supplies, and non-durable equipment and supplies such as knives, gloves, aprons, etc.

EXCLUDE
- Supplies provided as part of a service contract, such as chemicals included in the cost of an outside sanitation contract
- Expense of packaging material reported in Item 18 above

▶ PART C - WEEKLY OPERATING INFORMATION

▶ REPORTING INSTRUCTIONS FOR PART C

Complete each item in this part for each accounting week at this establishment that includes the dates shown at the top of each column in Part C of the Response Form. The dates shown in the Response Form are the Wednesdays for each week of the period April 5, 1992 through April 3, 1993. Write the word "None" in the first column on the Response Form for any item for which the amount is 0 (zero) for *all* weeks.

▶ Item 20 - Ending Day of Accounting Week at this Establishment☞ (check one box on the response forr

▶ SPECIAL INSTRUCTIONS FOR ITEMS 21-24 (Payroll and Labor Information)

Hours Paid include actual hours worked plus hours paid for as vacation, holiday, or sick leave. Regular Hours include all hours for which employees received pay at their base rate (straight-time hours). Report Overtime Hours as actual hours, not straight-time equivalent hours, for which employees received pay at a higher or premium rate due to working hours exceeding the regular or straight-time working shift. Report totals for all hourly employees as specified.

▶ Item 21 - Total Hourly Payroll:

Report totals for all employees of this establishment who were paid on an hourly basis.

a. Total Regular Hours Paid for All Hourly Employees .....☞ (hours)

b. Total Payroll for Regular Hours Paid to All Hourly Employees.....☞ ($)

INCLUDE
- The total of all weekly gross earnings based on hours worked at regular rates, prior to deductions, including commissions, dismissal pay, bonuses, and vacation pay

c. Total Overtime Hours for All Hourly Employees .....☞ (hours)

d. Total Payroll for Overtime Hours Paid to All Hourly Employees .....☞ ($)

INCLUDE
- The total of all weekly gross earnings based on hours worked at overtime rates, prior to deductions.

e. Employer's Cost for Fringe Benefits (Supplemental Labor Costs).....☞ ($)
Report total payments for fringe benefits for all hourly employees.

INCLUDE
- Employer's cost for legally required fringe benefits (employer's Social Security tax, unemployment tax, workmen's compensation insurance, state disability insurance programs)
- Employer's cost for voluntary fringe benefits (union negotiated benefits, life insurance premiums, pension plans and welfare plans, insurance premiums on medical plans, stock purchase plans)

EXCLUDE
- The cost of fringe benefits that cannot be allocated between hourly and salaried

▶ PART C - WEEKLY OPERATING INFORMATION

employees (such as medical insurance plans)

f. Total Number of Hourly Employees As of Wednesday of Each Weekly Period.....☞ (number)

▶ **Item 22 - Slaughter Operations Total Hourly Payroll**:
Report totals for all employees working in the slaughter operations at this establishment who are paid on an hourly basis. See PART B, Item 8, for the definition of slaughter operations.

a. Total Hours Paid for Slaughter Operations Hourly Employees .....☞ (hours)

INCLUDE
- Regular ("straight-time") hours and overtime hours

b. Total Payroll for All Hours Paid to Hourly Slaughter Operations Employees.....☞ ($)

INCLUDE
- The total of all weekly gross earnings based on hours worked (at regular rates and overtime rates combined), prior to deductions, including commissions, dismissal pay, bonuses, and vacation pay

c. Employer's Cost for Fringe Benefits (Supplemental Labor Costs) for Hourly Slaughter Employees. . . ..☞ ($)
Report total payments for fringe benefits for all hourly slaughter employees. Exclude the cost of fringe benefits that cannot be allocated between hourly and salaried employees (such as medical insurance plans or certain insurance premiums).

INCLUDE
- Employer's cost for legally required fringe benefits (employer's Social Security tax, unemployment tax, workmen's compensation insurance, state disability insurance programs)
- Employer's cost for voluntary fringe benefits (union negotiated benefits, life insurance premiums, pension plans and welfare plans, insurance premiums on medical plans, stock purchase plans)

▶ **Item 23 - Fabrication Operations Total Hourly Payroll:**
Report totals for all employees working in the fabrication operations at this establishment who were paid on an hourly basis. See PART B, Item 9, for the definition of fabrication operations.

a. Total Hours Paid for Fabrication Operations Hourly Employees.....☞ (hours)

INCLUDE both regular ("straight-time") hours and overtime hours.

b. Total Payroll for All Hours Paid to Hourly Fabrication Operations Employees.....☞ ($)

INCLUDE
- The total of all weekly gross earnings based on hours worked (at regular rates and overtime rates combined), prior to deductions, including commissions, dismissal pay, bonuses, and vacation pay

c. Employer's Cost for Fringe Benefits (Supplemental Labor Costs) for Hourly Fabrication Employees☞

▶ PART C - WEEKLY OPERATING INFORMATION

Report total payments for fringe benefits for all hourly fabrication employees. Exclude the cost of fringe benefits that cannot be allocated between hourly and salaried employees (such as medical self-insurance plans.)

INCLUDE
- Employer's cost for legally required fringe benefits (employer's Social Security tax, unemployment tax, workmen's compensation insurance, state disability insurance programs)
- Employer's cost for voluntary fringe benefits (union negotiated benefits, life insurance premiums, pension plans and welfare plans, insurance premiums on medical plans, stock purchase plans)

▶ Item 24 - Production Hours and Shifts Worked:

a. Number of Slaughter Shifts Worked ..... ☞ (number)

b. Total Number of Hours Slaughter Lines Were in Production During Week..... ☞ (hours)

c. Number of Fabrication Shifts Worked ..... ☞ (number)

d. Total Number of Hours Fabrication Lines Were in Production During Week..... ☞ (hours)

▶ Item 25 - Total Cattle Slaughtered at this Establishment, excluding cattle custom slaughtered for other firms:

a. Total Chilled Carcass Weight..... ☞ (pounds)

b. Total Delivered Cost..... ☞ ($)

INCLUDE
- Payments to sellers of cattle, shipping costs, and commissions to independent buying agents

EXCLUDE
- Cost of slaughter

▶ SPECIAL INSTRUCTIONS FOR ITEMS 26 - 30 (All Beef and By-Product Inputs from All Sources EXCLUDING Transfers WITHIN This Establishment)

Report all beef and beef by-product inputs used by the fabrication and processing operations at this establishment that were obtained from sources other than slaughter operations at this establishment. If this establishment is part of a multi-establishment firm, INCLUDE TRANSFERS IN FROM OTHER ESTABLISHMENTS OF THIS FIRM, BUT EXCLUDE TRANSFERS BETWEEN DEPARTMENTS, DIVISIONS, OR PLANTS LOCATED AT THIS ESTABLISHMENT. Value shipments from other establishments of this firm at full market value (that is, at the full delivered price including shipping costs) which would have been charged for equivalent products purchased from other firms.

▶ Item 26 - Carcass Beef Purchased or Transferred in From Other Establishments:

▶ PART C - WEEKLY OPERATING INFORMATION

a. Quantity of Whole carcasses, Halves, and Quarters ..... ☞ (pounds)

b. Total Delivered Cost ..... ☞ ($)

▶ **Item 27 - Fabricated Beef Purchased or Transferred in From Other Establishments:**

a. Quantity ..... ☞ (pounds)

b. Total Delivered Cost ..... ☞ ($)

▶ **Item 28 - Hides Purchased or Transferred in From Other Establishments**:

a. Quantity ..... ☞ (number)

b. Total Delivered Cost ..... ☞ ($)

▶ **Item 29 -Edible Beef By-Products, Variety Meats, and Kill Floor Grinding Material Purchased or Transferred in From Other Establishments**:

a. Quantity ..... ☞ (pounds)

b. Total Delivered Cost ..... ☞ ($)

▶ **Item 30 - All Other In-edible Beef and By-Products Purchased or Transferred in From Other Establishments**:

a. Quantity ..... ☞ (pounds)

b. Total Delivered Cost ..... ☞ ($)

▶ **SPECIAL INSTRUCTIONS FOR ITEMS 31 - 44 (Total Volume and Value of Shipments)**

If this establishment is part of a multi-establishment firm, INCLUDE shipments (transfers) to other establishments of this firm. Include in Total Value the net F.O.B. sales revenue received or receivable for all products shipped for each listed product category, net of returns and other allowances. Value transfers to other establishments of this firm at full market value, that is, at the same price which would have been charged for equivalent products sold to customers.

EXCLUDE
- Non-operating income such as dividends and interest
- Excise and sales taxes

▶ **Item 31 - Fabricated Beef Shipped as Whole Carcass Equivalents**:

a. Quantity ..... ☞ (pounds)

▶ PART C - WEEKLY OPERATING INFORMATION

b. Total Value ..... ☞ ($)

▶ **Item 32 - Fabricated Beef Shipped as Primals**:

a. Quantity ..... ☞ (pounds)

b. Total Value ..... ☞ ($)

▶ **Item 33 - Fabricated Beef Shipped as Sub-Primals**:

a. Quantity ..... ☞ (pounds)

b. Total Value ..... ☞ ($)

▶ **Item 34 - Fabricated Beef Shipped as Other Fabricated Cuts**:

a. Quantity ..... ☞ (pounds)

b. Total Value ..... ☞ ($)

▶ **Item 35 - Fabricated Beef Shipped as Trimmings, Boneless Beef, or Grinding Material from Fabrication Operations**

a. Quantity ..... ☞ (pounds)

b. Total Value ..... ☞ ($)

▶ **Item 36 - Carcass Beef (Whole, Halves, Quarters)**:

a. Quantity ..... ☞ (pounds)

b. Total Value ..... ☞ ($)

▶ **Item 37 - Total shipments of Edible Beef by-products, Variety Meats, and Kill Floor Grinding Material:**

a. Quantity ..... ☞ (pounds)

b. Total Value ..... ☞ ($)

▶ **Item 38 - Green Hides**:

a. Quantity ..... ☞ (number)

b. Total Value ..... ☞ ($)

▶ **Item 39 - Dry-Salted Hides**:

a. Quantity ..... ☞ (number)

b. Total Value ..... ☞ ($)

▶ **Item 40 - Wet-Salted Hides**:

a. Quantity ..... ☞ (number)

▶ PART C - WEEKLY OPERATING INFORMATION

b. Total Value ..... ☞ ($)

▶ **Item 41 - Wet Blue Hides**:

a. Quantity ..... ☞ (number)

b. Total Value ..... ☞ ($)

▶ **Item 42 - All Other Inedible Beef and By-Products:**

a. Total Value ..... ☞ ($)

▶ **Item 43 - Custom Cattle Slaughter:**

a. Cattle Custom Slaughtered at this Establishment for Others ..... ☞ (number)

b. Total Revenue from Custom Cattle Slaughter ..... ☞ ($)

▶ **Item 44 - Miscellaneous Sources of Revenue of this Establishment:** ..... ☞ ($)

Report all other revenue from sources other than shipments of products reported in Items 31-44, or custom cattle slaughter reported in item 43.

Appendix C-Bibliography for Literature Review

(The sources listed here are those that were reviewed for the "Literature Review" chapter only)

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