THE FUNDAMENTAL ECONOMIC ROLES OF THE U.S. STOCKER CATTLE INDUSTRY

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CHAPTER 1

Introduction

1.1 The U.S. Beef Cattle Industry

The U.S. beef cattle industry is an extremely complex sector in which many production and marketing functions must be completed before fresh meat is available to be purchased by consumers at the retail level. The beef industry's sole purpose is to produce beef calves and transform them into a constant, steady supply of meat available for consumption. The beef industry does a remarkable job of accomplishing this task considering several obstacles which must be overcome. Two of the most important obstacles are: (1) the biological production lags of cattle, grain, and forage; and (2) informational lags between consumers and producers. These two obstacles, together, cause the production of cattle to be very cyclical over time (Peel).

Before the consumer can go to the supermarket and purchase fresh beef, several different ownership and production phases must be completed. The transformation of beef calves into fresh beef can be grouped into four separate phases. These four phases are: (1) commercial cow-calf operations; (2) stocker cattle operations; (3) feedlot finishing operations; and (4) meat-packing, or slaughter and processing operations.

The first, and largest phase (in terms of participants), is the commercial cow-calf phase. These operations maintain breeding herds for the purpose of producing weaned calves which normally weigh between 300 and 600 pounds. These weaned calves are traditionally sold immediately after weaning, however, due to low calf prices recently, many cow-calf producers have searched for alternative marketing methods. These methods include, but are not limited to, retaining ownership of calves into the stocker or finishing phases and forward contracting (Neumann and Lusby).

The second phase in the live beef production process is the stocker phase. Stocker operations can be broadly defined as growing operations. Typically, stocker operators will purchase the 300-600 pound weaned calves and grow them on some type of forage pasture to typical feedlot placement weights between 700-900 pounds. Most stocker operations usually consist of either: (1) spring and summer grazing of native or improved pastures; (2) winter grazing of cereal pastures, wheat primarily; or (3) fall and winter grazing of residue stalkfields, for example, corn stalks (Price). These 700-900 pound yearlings are traditionally sold to feedlot finishing operations.

The third phase in the beef production process is the feedlot finishing phase. Feedlots purchase 700-900 pound feeder calves from the stocker operations and place these calves in confined feeding areas. The purpose behind the finishing programs is to get the cattle to gain weight as efficiently as possible. To do this, high-energy rations are fed until the cattle reach their maximum muscle growth plus a certain amount of fat. These cattle are then sold to meat packers when they reach a slaughter weight between 1100 and 1175 pounds (Price).

The fourth phase of the beef production process is the meat-packing, or slaughter and processing stage. These operations purchase the fed cattle directly from feedlot finishing operations. The cattle are then shipped to packing plants where they are slaughtered and processed into different cuts of meat. These different cuts are packaged into boxed beef units and sold to wholesale and retail grocery companies.

1.2 Problem Statement

It usually takes two and a half years for an animal to ascend through beef production system from the commercial cow-calf phase to the slaughter and processing phase. During these two and a half years, cattle are moved extensively throughout the United States. Also, as cattle move within each of these four production and marketing phases, the industry becomes more concentrated, both geographically and economically (Peel). Cow-calf production occurs virtually in all parts of the United States, while feedlot finishing and packing are concentrated in the Central and Southern Great Plains. This increased geographic concentration, which began in the 1950s and 1960s, gave rise to the stocker phase of production as we know it today (Neumann and Lusby).

Although the stocker phase is one of the largest phases (in terms of participants) of the beef cattle industry, it is the least understood. This lack of understanding occurs for several reasons. One reason is that the stocker phase of production is very diverse and not strictly defined, when compared to the cow-calf, feedlot finishing, or meat-packing phases. As noted previously, stocker production can be broadly defined as growing programs where weaned cattle are purchased by producers and grown to typical feedyard placement weights. However, there are many different terms used around the country to describe such a growing program. In the north, the term 'backgrounding' is often used, while in the south, the term 'stocker' operation is more typical. The term backgrounding, however, can be used to describe completely different types of operations. It is often used to describe a calf preconditioning program, which is different from a growing program. Many stocker operations have an initial receiving program where the calves are prepared for grazing. This initial phase, concentrating on medical and nutritional management, is often referred to as "backgrounding" the cattle before grazing (Peel).

Another reason for this lack of understanding of the stocker phase is that there are several different types of stocker operations, depending on the different types of forage used and the time of year grazing takes place. Some producers may utilize native or improved pastures while others use cereal pastures such as wheat. Often, stocker operations are separated into two groups consisting of summer stocker operations and winter stocker operations. Adding to the confusion, many stocker cattle producers use a combination of both types of pastures and can be considered both summer and winter stocker operations. Also, these different types of stocker operations are not restricted to particular regions of the U.S. Although some regions of the U.S. may be better suited for native summer forage, several regions in the U.S. are capable of producing both summer and winter forages. The southern Great Plains is an excellent example. In this region, producers are capable of grazing both winter wheat and spring and summer native grasses.

Because the stocker phase is so diverse and not strictly defined, it receives little attention from academic researchers. The agricultural economics profession typically overlooks the stocker phase of production, focusing primarily on the feedlot and meat-packer phases. The previously mentioned increasing concentration within these industries is probably the main reason for research being focused mainly on the feedlot and meat-packing phases. Much of the research that is conducted by agricultural economists concerning the beef industry examines the pricing efficiency of both cash fed cattle and live cattle futures markets. Of course there are exceptions, but generally the stocker phase of production has been ignored by agricultural economics research.

Most of the stocker cattle research that is conducted is done by the animal science profession. In fact, the animal science community is one of the few that even acknowledges that the stocker phase of production can be, and often is, independent from the other production stages. Animal science stocker cattle research, however, focuses primarily on production and nutritional efficiency, sometimes neglecting basic economic concepts.

When done, the majority of research which does concern the stocker phase of production by either group of researchers tends to be primarily firm-level research. The agricultural economics research typically examines either the optimal number of head to buy and sell, or the optimal time to buy and sell stocker calves for individual stocker operations. Animal science research typically studies forage to gain efficiency and stocking rate densities for individual stocker operations. Neither group of researchers has examined the stocker phase of production as a separate, viable industry. The stocker cattle industry consists of all the individual stocker operations, or firms, throughout the country, just as the meat-packing industry consists of all the individual meat-packing firms (Rhodes).

Because individual stocker operations are not understood and receive little attention from academic researchers, the role of the stocker industry in relation to the entire beef cattle industry is understood and researched even less. The U.S. stocker industry, as a whole, performs two important, fundamental economic roles within the beef cattle production system. The first, and most recognizable, role the stocker industry performs in relation to the beef cattle production system is to add time, place and form utility to beef calves before they enter the feedlot finishing phase of production.

However, because stocker operations are the only major production alternative to cow-calf operations in the utilization of forage resources, the stocker industry also performs a crucial, although more subtle, resource allocation role by maintaining the economic balance between forage, grain, and livestock markets.

1.3 Objectives

Overall Objective

The overall objective of this research is to determine the fundamental economic roles performed by the U.S. stocker industry in relation to the entire beef cattle production system.

Specific Objectives

The specific objectives of this research project are:

1. To define and describe the different types of stocker cattle operations which make up the U.S. stocker industry.
2. To determine the fundamental role the U.S. stocker industry has in performing the physical marketing functions of adding time, place, and form utility, and to illustrate this role with appropriate economic theory.

3. To determine the fundamental role the U.S. stocker industry has in maintaining the balance between cattle, grain, and forage markets, and to illustrate this role with appropriate economic theory.
4. To suggest a new research interest in the stocker cattle phase of production, as well as the U.S. stocker cattle industry.

1.4 Outline of Remainder of Thesis

The remaining chapters in this thesis are as follows. Chapter 2 is the literature review and justification for research. Chapter 3 defines and describes the different types of stocker operations typical in the United States which combine to form the U.S. stocker industry. Chapter 4 discusses the fundamental marketing role performed by the U.S. stocker industry in relation to the entire beef cattle production system. Chapter 5 discusses the fundamental production, or resource allocation, role performed by the U.S. stocker industry in relation to the entire beef cattle production system; and Chapter 6 contains the conclusions and implications of this research.

CHAPTER 2

Literature Review and Justification for Research

2.1 Overview of Chapter 2

This chapter reviews previously published literature concerning the beef cattle industry, with special attention being given to research conducted on the stocker phase of production. The two main groups of researchers who have studied the cattle industry are the agricultural economics and animal science professions. The research conducted by each profession will be reviewed separately, beginning with agricultural economics research and followed by the animal science research. In addition, the literature that focuses primarily on the stocker phase of production by each group will be reviewed in separate sections.

2.2 Agricultural Economics Beef Cattle Industry Research

The previously published research concerning the beef cattle industry conducted by the agricultural economics profession is fairly extensive. As noted in Chapter 1 (Section 1.2), however, most of the research conducted by agricultural economics profession concentrates on the feedlot or meat-packer industries, and pricing efficiency issues related to these segments of the beef cattle industry. Examples of studies on fed cattle market efficiency include ones by Bailey and Brorsen, Bessler and Covey, Goodwin and Schroeder, and Koontz et al.

Bailey and Brorsen analyzed the speed of fed cattle price adjustments over space, and indirectly, the level of efficiency in spatial fed cattle markets. They believed that the speed of price adjustments between different regions may have important implications about the structure and behavior of the markets. If regional markets function in relative isolation from each other, packers may be able to exert market power on producers. If the markets are interdependent, then the packers' ability to set prices may be diminished because they would have to respond to what is happening in the other regional markets. Using weekly quoted prices for fed cattle graded choice (yield grade 2-4) for four separate markets between Jan. 1, 1978 to June 4, 1983, causality tests between the four price series were performed using a method proposed by Granger.

Bailey and Brorsen found that none of the markets were totally efficient in the strict sense that price adjustments were instantaneous. All significant price adjustments were found to occur in a week or less, which the authors concluded was fairly efficient. They also found that all cross correlations were significant at the one percent level, which demonstrates that a large amount of the price adjustment between regions takes place in the current time period. Beyond a week, the two largest markets seemed to dominate the price discovery process.

In the article by Bessler and Covey, the authors attempted to determine if a statistical relationship, known as cointegration, existed between the futures market for live cattle and a major regional slaughter cattle cash market. Two price series were analyzed for this study: (1) the daily settlement price for the nearby live cattle futures contract from August 21, 1985 to August 20, 1986; and (2) the daily average cash price ($/cwt.) for direct sale of choice 900-1300 pound slaughter cattle steers for the Texas-Oklahoma market over the same time period.

Overall, the results from this research study were mixed. First, the within-sample fits indicated that both cash and futures prices are generated by processes not statistically different from a random walk. Tests for cointegration show some support for the cointegration hypothesis between cash prices and nearby futures, however, no cointegration was found to exist between cash prices and distant futures contract prices. Bessler and Covey concluded that this suggests a Granger mean-causal relation running from today's settlement price for the nearby futures contract to tomorrow's average spot price for Texas-Oklahoma cattle.

Goodwin and Schroeder also conducted cointegration tests on regional fed cattle markets. Cointegration tests were developed and applied to spatial price relationships among eleven regional slaughter cattle markets. Bootstrapping regressions were then used to evaluate the influences of several variables on cointegration. Weekly price series for Choice, yield grade 2-4, 900-1,100 pound slaughter steers were gathered for eleven U.S. regional markets. The time period being studied covered Jan. 1980 through Sept. 1987 for a total of 400 weekly observations.

The results from this study were also mixed. There were some markets which were found to be highly cointegrated while others exhibited low levels of cointegration. Distance seemed to be the main factor affecting cointegration levels. The farther away the other market, the lower the level of cointegration. Goodwin and Schroeder also found that the amount of cointegration had increased over the time period being studied. They claimed that the increase in cointegration coincided with the increase in packer concentration. This could mean greater spatial efficiency or increased non-competitive basing-point pricing by packers.

The study by Koontz et al. examined how the nature of the price discovery process had changed in the U.S. slaughter cattle market over time. The study identified lead/lag relationships between major cash markets and between cash markets and the live cattle futures market. Dominant markets were revealed using lead/lag relationships, strength of causality measure, and tests for symmetry of feedback between markets. The Granger causality method was used to determine which markets were dominant markets and which ones were satellite markets. The data were weekly prices for fed cattle from Jan. 1973 to Dec. 1984. Four terminal markets and four direct markets were used, as well as two truncated CME live cattle futures prices. One was a weekly average and the other was an early week average price. The early week futures was added because of the relatively low trading volume in the cash markets during the end of the week (Thursday and Friday). The early week futures was a three-day average of Monday-Wednesday. The time series was divided into 3 subsets to account for changing industry possibilities.

The conclusions arrived at by this article are similar to those found in related studies. Direct selling has become more important so direct selling prices have become more important. This corresponds to a decline in the importance of terminal markets. A different conclusion reached by the authors was that the cash markets have decreased their reliance on the futures market as an overall price discovery mechanism. The main finding of this study was that the price discovery process is dynamic and is dependent upon the structure of the underlying markets.

Two articles, one by Ward and another by Fuez et al. examined the meat-packing industry in a different manner than the above articles. Ward examined fed cattle price differences among buyers and buyer groups following the packing plant mergers of 1987. Ward's models were estimated with specific focus on the transaction price differences among individual meatpacker buyers and between the "Big Three (IBP, Excel, and ConAgra)" packers and rival firms. The major difference with Ward's study compared to others reviewed here is that primary data were collected from cattle feedlots and supplemented with secondary data from USDA and other reporting agencies. Over one hundred commercial feedlot managers in the southern plains were asked to provide information. A pooled cross-section time-series model was specified to explain the variation in transaction prices for fed cattle. Several dummy variables were included to capture information related to quality differences, day of the week, number of buyers present, and other factors.

Ward discovered that meatpackers in the southern plains differed significantly from one another in prices paid for fed cattle; some paid higher prices and some lower prices than did one of the Big Three firms. As a group, Big Three firms paid lower prices than did their competitors in each subregion.

In an attempt to determine if consumers' demands are being transmitted through the marketing system efficiently, Feuz et al. analyzed the pricing efficiency of four marketing methods currently being used, or that are being proposed in the beef industry.

The four marketing methods examined were: (1) selling slaughter cattle on a live-weight basis, where the price is based upon the live weight of the animal; (2) selling slaughter cattle on a carcass or dressed-weight basis (in the beef), where the price is based upon a hot carcass weight obtained in the slaughter house; (3) selling slaughter cattle on a dressed-weight and grade basis (also known as grade and yield), where the price is based upon the hot carcass weight and discounts are applied if the carcass does not grade USDA Choice or the USDA yield grade is 4 or greater; and (4) selling slaughter cattle under a value-based marketing approach (the Excel Corp. Muscle Scoring System).

The data used for this study came from 69 groups of 5 steer calves representing 53 different producers. The cattle were marketed on a grade and yield basis when three steers of a group of five were estimated to have sufficient fat cover to grade low choice or when continuing to feed the group of steers would result in excess fat cover and a yield grade of 4. Market price and discounts were negotiated with a commercial cattle buyer in a competitive environment. The differences in mean profit levels were tested using a null hypothesis of increased information about quality has no effect on producers' mean profits. The alternative was that increased information about product quality increases producers' mean profit levels. The same test was used for the variance of producers' profits. Regression analysis was used to analyze the variation in profit per head under each of the four marketing methods.

The authors discovered that the live-weight marketing method was the least profitable. The range in profit increased going from marketing system to marketing system. The authors concluded that the current practice of live-weight marketing does not efficiently transmit consumers preferences to the producers.

The above agricultural economics research articles are examples of studies that focus on the fed cattle or meatpacking segment. The following section will detail the research by agricultural economists which focuses on the stocker phase of production.

2.3 Agricultural Economics Stocker Cattle Research

This section will review the previous literature by the agricultural economics profession which focuses on the stocker phase of production. Some of this research pertains *indirectly* to the stocker phase of production, focusing on the pricing efficiency of feeder cattle markets. There are a few studies which are directly related to the stocker phase, but these are essentially marketing strategy papers.

Articles by Schroeder and Featherstone and Bailey et al. are examples of studies which pertain indirectly to the stocker phase of production. Schroeder and Featherstone examined optimal calf retention and marketing strategies for cow-calf producers. Calf retention decisions were examined in a dynamic framework at the weaning, yearling, and finishing cattle stages. A discrete stochastic programming model was formulated to determine the optimal retention and marketing decisions for the cow-calf producers. Steer and heifer calf retention and marketing alternatives were examined for a representative mid-western cow-calf producer under alternative risk aversion levels.

The overall results showed that calf retention depended upon current profit, expected future profit distributions, pricing alternatives available, and the cow-calf producer's aversion to risk. This study was indirectly related to the stocker phase of production because it focused on cow-calf producers who are retaining ownership into the stocker, or according to the authors, backgrounding phase of production. Using the term "backgrounding" instead of "stocker" demonstrates the fact that the stocker phase of production is not strictly defined, adding to the confusion surrounding stocker cattle research.

Bailey et al. developed a spatial statistical test to determine the effect on feeder cattle prices when locations are dominated either by buyers from only one market area or by buyers located where market areas overlap. The authors also attempted to define major market areas for feeder cattle buyers through mapping techniques. The authors suggest that structural changes such as number, size, location of firms, and growth in contracting may allow feeder cattle buyers to pay different prices for cattle depending on the cattle's location and degree of competition, or, spatial price discrimination.

The conclusions found by this study are somewhat interesting. The authors discovered that the market areas were not hexagons as assumed in the traditional spatial models. Instead, market areas for feeder cattle are large, irregularly shaped and tend to overlap greatly. Transportation costs influence the market area for feeder cattle significantly. Because of the transportation costs, buyers purchase more cattle than expected in the areas where they have a transportation cost advantage. As for concentration, the study found that regional concentration appeared to have a greater impact on local prices than had been found in previous studies. Feeder cattle producers (which may include stocker enterprises) located where two or more market areas overlap receive substantial premiums compared to producers in counties dominated by buyers from one feeding area who received lower prices.

These two articles are representative of the studies which pertain indirectly to the stocker phase of production. Both articles have implications for stocker operations but do not study the stocker phase as being independent from the other beef cattle production phases. The following studies do consider the stocker phase as a separate enterprise, but are basically marketing strategy studies. Marketing strategy papers generally attempt to develop strategies for when to buy or sell a commodity, and how much of the commodity to buy or sell. These studies usually rely on some type of optimization technique using firm-level data. Recently, however, the value of marketing strategy papers has come under scrutiny by some academic researchers (Brorsen and Irwin).

Two studies conducted by Ethridge et al. attempted to identify alternative purchase and sale dates for stocker cattle enterprises in the Southern High Plains/Rolling Plains, and to determine the combinations of enterprises which maximize profits for ranches in the region. The authors point out that most producers in this region purchase cattle or produce spring calves when native range grasses become most productive and cattle prices are highest, and they sell the cattle in October or November when the grasses are dormant and cattle prices are lowest. They claim that while this may indeed be the most efficient production method, from a weight gain viewpoint, it may not be economically efficient.

The first study conducted by Ethridge et al. (1987) examined forty-eight stocker cattle enterprises on tobosagrass, bluestem, and lovegrass pastures consisting of stocker steers and stocker heifers. The various enterprises differed in the purchase weights, purchase and sale dates of the cattle, and in types of the forage used. The different stocker cattle enterprises were evaluated using a linear programming model.

The overall conclusion from this study was that use of improved pastures in ranch production systems, combined with unconventional marketing techniques of seasonal buying and selling activities, may increase the profitability of stocker cattle operations. The study also found that larger ranch profits can be made with both high and low cattle prices than with average cattle prices if: (1) price levels are predictable; and (2) ranch production is modified to take advantage of the price movements. One thing that is important to note is that although this study did take into account price risk through variations in cattle prices, production risk was not recognized because weather was assumed normal throughout the study.

The second study by Ethridge et al. (1988) allowed for production risk as well as cow-calf production. This study used identical data and modeling procedures as did the previous article. The enterprise budgets were constructed at three levels of cattle prices and fifty-four enterprises were selected to be used in nine separate linear programming models representing nine combinations of cattle price and forage production levels. After the LP models were run, risk strategies were developed using Bayesian decision analysis.

The linear programming results indicated that stocking rate is affected more by variations in forage production than price level changes, while ranch net returns are more sensitive to variations in cattle price levels. The Bayesian decision analysis found four risk efficient strategies which included both very conservative strategies (based on assumptions of low prices and forage production) and strategies based on optimistic assumptions (high prices and forage production).

Overall, the conclusion was that the optimal ranch organization called for diversified cattle enterprise combinations under all three levels of cattle prices. Non-traditional marketing tactics (as shown in the previous article) dominated those marketing strategies under high, normal, and low cattle prices.

Another study which considered stocker production as an independent enterprise was conducted by Rodriquez and Taylor. The objectives of this research article were threefold: (1) to develop a model of forage/livestock dynamics; (2) to evaluate the effect of price fluctuations on cattle and forage management policies (especially stocking density); and (3) to incorporate risk into a sequential decision-making process (what the authors call a yearling operation) to test the certainty equivalence (CE) property. Dynamic programming (DP) was used to test the certainty equivalence property of the intertemporal decisions to allocate scarce resources under fluctuating conditions involved in cattle production. A 720 acre pasture in the shortgrass prairie of northeast Colorado was used for the DP model formulation. According to the authors, yearling grazing was chosen instead of cow-calf production in order to allow short-run decision making and profit maximization in response to stochastic forage and market conditions.

The deterministic DP results showed that net present value increased with high stocking density, supplementation, and partial sales of yearlings toward the end of the grazing season to ensure adequate animal growth under decreasing forage quality, as would be expected. In contrast to long-term range management studies, this study showed that adjusted stocking rates traced seasonal trends in forage production. On the production side, with stochastic rainfall, CE failed at high stocking densities. The CE property held for all the cases when cattle price was stochastic. This implied that short-term price variations with a simple price prediction model were irrelevant for management decision. Overall, risk in marketing was increased as sales were postponed or as larger numbers of steers were retained.

The research reviewed in the previous sections demonstrates the fact that much of the work conducted by the agricultural economics profession concerning the beef industry pertains to the fed cattle or meatpacking phase of production. This literature, however, is only one-half of the research concerning the beef cattle industry; the other half being conducted by the animal science community. The following sections will review the literature on the beef cattle industry conducted by the animal science profession.

2.4 Animal Science Beef Cattle Industry Research

This section will review the previously published literature concerning the beef cattle industry which has been conducted by the animal science profession. The animal science community has probably researched the beef cattle industry more than any other academic field. This research covers all phases of the beef industry from cow-calf production to slaughter, but focuses primarily on production and nutrition efficiency (i.e., increasing average daily gain and gain to feed ratios). Much of the literature contains few economic concepts, focusing instead on growth and nutritional performance of cattle under certain circumstances. The animal science profession does, however, consider the stocker phase of production as being a separate and independent enterprise.

Two books, one by Neumann and Lusby and another by Price, are both excellent introductory sources concerning the beef cattle industry. These books present a basic, non-technical overview of the entire beef cattle production process beginning with the cow-calf phase and ending with the slaughter phase of production. The text book by Neumann and Lusby is probably the premier, basic beef cattle production and nutrition book used in beginning animal science classes in agricultural colleges around the country. This book does include a chapter on the stocker phase and even treats it as a separate enterprise. The chapter is relatively small, however, compared to the chapters on cow-calf and feedyard segments.

The book by Price also treats the stocker phase as a separate, economically viable enterprise. Price includes a separate chapter for the stocker segment that is very good at explaining the different types of stocker operations, including operations which use native pasture, improved pasture, small grain pasture, and residual grain pasture (corn stalks). The stocker chapter in Price's book, like the one by Neumann and Lusby, is relatively small compared to the chapters concerning cow-calf and feedlot production.

As noted previously, much of the research conducted by the animal science profession concerns growth and nutritional performance of beef cattle under certain circumstances. This research includes both feeder and stocker cattle performance. Examples of the feeder cattle performance literature include studies by Krehbiel et al., Stock et al., and Hussein and Berger.

Krehbiel et al. studied the effect of feeding supplemental fat in order to increase the dietary energy of finishing diets on yearling steers. Adding energy in the form of fat to increase energy intake may increase average daily gain and gain to feed ratios. The objectives of this research were: (1) to determine whether time of tallow addition in relation to grain adaptation influenced performance of yearling steers; (2) to determine the effects of adding fat to grains on yearling steer performance; and (3) to determine the effects of feeding tallow to large-framed steer calves. Two experiments were conducted to evaluate the effects of grain type, tallow level, and tallow feeding system on finishing steer performance. Experiment 1 used 256 yearling steers which were assigned randomly to four different tallow feeding systems. Experiment 2 used 120 large-framed steer calves and were assigned to one of three tallow feeding systems.

The authors discovered that adding supplemental fat during or after grain adaptation to dry-rolled corn or high-moisture corn based diets fed to yearling steers will result in an improvement in feed efficiency. They also found that greater responses may be observed in large-framed calves supplemented with fat than in yearlings supplemented with the same level of fat.

In the article by Stock et al., the effects of monensin on intake variation and incidence of deaths from digestive disorders in commercial feedlots were studied. Monensin is used to increase efficiency of beef production in the feedlot by altering ruminal fermentation which increases dietary energy utilization. However, as dietary energy concentration increases, the potential for acidosis increases. In a feedlot, acidosis is characterized by reduced and erratic feeding patterns, or by a decrease in feed intake with a subsequent decrease in gain and efficiency. Four commercial feedlots and an individual feeding trial evaluated the effect of monensin and monensin/tylosin on intake variation and deaths from digestive disorders. The steers were allotted randomly to one of three monensin/tylosin levels: (1) no monensin or tylosin (control); (2) 22 mg/kg of monensin and 11 mg/kg of tylosin; or (3) 33 mg/kg of monensin and 11 mg/kg of tylosin.

The authors concluded that monensin and monensin/tylosin reduce feed intake variation among individual steers within a pen of steers, and, although monensin does not prevent acidosis, it may reduce the severity. They also stated that commercial feedlots may not be able to observe a reduction in intake variation due to the pen average masking individual animal variation. Therefore, studies that measure intake variation must use individually fed animals.

Hussein and Berger compared the relative energy value of wet corn gluten feed to that of corn when fed to feeder cattle in a feedlot situation. Wet corn gluten feed is a major byproduct of the corn wet-milling industry. Including wet corn gluten feed in dairy or beef cattle diets may improve feedlot performance. One hundred forty-four medium-framed Angus-cross beef heifers were used for this study. Six treatments of various levels of wet corn gluten feed in corn silage-based diets or high-moisture corn-based diets during the growing phase (127 days) were studied. During the finishing phase (84 days), all diets were offered free-choice and contained 5% corn silage by replacing corn silage with high-moisture corn.

Hussein and Berger concluded that, in growing-finishing diets for beef cattle, wet corn gluten feed can be substituted for up to 25 or 50% of corn without negative effects on feedlot performance, digestibility of nutrients, or carcass characteristics. In addition, restricting feed intake during growing may be a strategy that improves the utilization of wet corn gluten feed. Because feed costs account for approximately 70% of the total costs in beef production systems, feeding wet corn gluten feed also may be one means of reducing feed costs for many beef producers in areas where corn is produced and processed.

The previous articles focused primarily on the growth and nutritional performance of feedlot cattle, and ways to increase this performance. The following section will review the research conducted by the animal science profession concerning the stocker cattle phase of production.

2.5 Animal Science Stocker Cattle Research

Because of the diversity of the stocker phase of production, much of the research conducted by the animal science profession on the stocker phase is also very diverse. Like the feedlot research, stocker cattle research conducted by the animal science community focuses primarily on stocker cattle performance and ways to increase production efficiency. This research, however, does seem to be more concerned with costs and returns than the feedlot cattle research. The diversity in the animal science stocker cattle research can be seen in the following three articles by Allen et al., Phillips and Coleman, and Horn et al.

In the article by Allen et al., alternative forage systems for stocker operations in the eastern United States were evaluated. The objectives of this study were: (1) to develop all-forage systems for stocker cattle, from weaning in October to entry into finishing systems in April; (2) to compare harvested, barn-fed forages with grazed forage supplemented with hay as needed; (3) to determine the influence of grass-legume combinations versus nitrogen-fertilized fescue in barn-fed and grazed systems on performance of stocker cattle; (4) to determine productivity and longevity of fescue grown with either alfalfa or red clover versus nitrogen-fertilized fescue, when managed as stockpiled forage; and (5) to determine the influence of cow-calf systems on subsequent performance of calves during the stocker phase of production. The authors state that, "Beef production in the eastern U.S. is primarily a cow-calf enterprise, and calves are sold at weaning. To improve profitability, however, increasing numbers of calves are now retained in stocker systems after weaning" (p. 588). The experiment was conducted over a 7-year period with Angus beef cows and their calves at the Virginia Agricultural Experiment Station. Many different forage systems were experimented with on both steers and heifers.

The authors concluded that nitrogen-fertilized, stockpiled tall fescue minimized the need for stored forage from November to April, which could reduce labor and equipment requirements. Overall, they found that the nitrogen-fertilized tall fescue could be used efficiently with stocker cattle retained from a cow-calf herd.

Phillips and Coleman studied the individual animal productivity, production per land unit, and input costs of summer stocker systems based on three forage pastures used in the southern Great Plains. Production per animal and per acre along with input costs and returns were determined on three different types of forage pasture during the summers of 1987 through 1989: (1) native range; (2) bermudagrass; and (3) Old World Bluestem. The authors state that producers must balance the costs of production and returns for the product if they are to survive and remain environmental stewards of the forage resources. The calves used for this study were obtained from commercial sources in May and were randomly assigned to each of the forage systems. All pastures were burned each year, but only the bermudagrass and Old World Bluestem pastures were fertilized with nitrogen (70 to 150 lb./acre). The data were analyzed across years as a randomized block using a model containing years, forage, and year × forage. Costs for each stocker system, including fencing and forage were also included. Forage and fencing costs represented only one third of the total costs of production, which also included interest, labor, marketing, and other fixed costs.

The overall conclusions from this experiment were that the native range system had the lowest forage production costs and was profitable all three years. The Old World Bluestem system was profitable two out of three years, while the bermudagrass system was profitable in only one year. The stocker systems based on native range had less variability in both returns per acre and costs per acre than the systems based on the other two forage pastures. The potential for large economic returns, however, were greater for systems based on introduced warm season grasses.

The study by Horn et al. evaluated the effects of two different types of monensin-containing energy supplements on the performance of stocker cattle grazing winter wheat pasture, and their subsequent performance in the feedyard. Adding moderate amounts of energy supplements to cattle on wheat pasture may be necessary because of the large fluctuations in amounts of available forage. A three year study was conducted to determine the effects of high-starch or high-fiber energy supplements on the performance of fall-weaned steer calves grazing winter wheat pasture. The steers received: (1) no supplement other than free-choice access to a commercial mineral mixture; or (2) were hand-fed either a corn-based high-starch supplement; or (3) a soybean hull/wheat middling-based high-fiber supplement.

The authors concluded that the energy supplementation program used in this study allowed stocking density to be increased by approximately one-third, which also increased the daily gain by .15kg. The type of energy supplement did not influence daily gain or supplement conversion. Cattle consumed the high-fiber supplement much more readily than the high-starch supplement. The authors state that this should be considered, along with costs, in selecting an energy supplement for stocker cattle grazing winter wheat pasture.

A different type of stocker cattle research conducted by the animal science profession was one by Turner et al. This study investigated the price impact of cattle and market characteristics and how they may have changed from the late 1970s to the late 1980s. The emphasis focused on cattle breeds and characteristics, health treatments, and market conditions. The sample was divided into two time periods, 1977-82 and 1983-88, in order to determine if there was a change in the factors that influenced sale price. Data on 1,369 lots (95,930 cattle) from 1977 to 1988, obtained from Georgia teleauctions, were used for this study. Information on price, breed, cattle condition (e.g., sex, weight, frame, muscle, flesh), health treatment, time of sale (season and order in auction), lot size, delivery conditions (shrink and cutback), and feeder cattle futures contract price were collected for each lot of cattle sold. An analytical price model was estimated using OLS to determine the impact on price from each of the above mentioned factors. A Chow test was used to test equality over the two separate time periods.

The conclusion from this study was that feeder cattle producers (which could include stocker operations) should take note of the market changes that occurred in the 1980s. Hereford breeds became a significantly discounted breed while other breeds had no impact on price in the latter time period. Health treatments for specific diseases and preconditioning seemed to have a positive impact on price, whereas treating cattle for external parasites switched from a positive impact to a negative impact. The authors concluded that producers should not report that the cattle have been treated for external parasites, but should report that they have received proper medical treatments. The market was also paying premiums for larger lots of cattle. It is important to note that all of these conclusions and implications are appropriate only for teleauctions in the southeastern U.S. The authors encouraged more studies in other areas and at other times in order to confirm their results.

2.6 Justification for Research

This chapter reviewed the previously published literature concerning the beef cattle industry and, in particular, the stocker phase of production. The purpose of this chapter was not to detract value from the research which has been done, but merely to demonstrate that an important phase of the beef cattle production system has received little attention from academic researchers, especially the agricultural economics profession. The stocker phase has been virtually overlooked by agricultural economists who tend to focus more on the feedlot and meatpacking phases for a variety of reasons. The animal science community, which does conduct a fair amount of research on stocker operations, concentrates primarily on stocker cattle performance and ways to increase production efficiency, sometimes omitting economic concepts. Neither group has examined the role of the stocker industry, as a whole, in relation to the entire beef cattle production system. Completely missing from the previously published literature is any study on the stocker industry's role in maintaining the balance between cattle, grain, and forage markets. In fact there is very little literature concerning forage markets at all.

Stocker cattle operations are the major, if not sole, source of income for many producers across the country. States like Oklahoma, Kansas, and Texas are major stocker cattle producing areas, yet little research has been conducted on the stocker phase of production. This lack of research, caused primarily by the lack of understanding of stocker cattle operations, demonstrates the need for a comprehensive study of the stocker phase of production.

This thesis will address this need by providing a comprehensive discussion of the U.S. stocker industry. First, this discussion will define and describe the different types of stocker operations which combined to form the U.S. stocker industry. Second, and most importantly, this discussion will determine the fundamental economic roles performed by the U.S. stocker industry in relation to the entire beef cattle production system.

CHAPTER 3

Definition and Description of the U.S. Stocker Industry

3.1 Overview of Chapter 3

Chapter 3 begins the discussion of the U.S. stocker industry in relation to the entire beef cattle production system. This chapter provides a definition of the stocker industry that will be used throughout the remainder of this thesis. First, a description of the different types of stocker cattle operations and the different types of forage systems utilized by stocker cattle producers in the U.S. is included. An overview of the U.S. stocker industry follows which describes the historical growth of the stocker industry and the geographical distribution of stocker cattle operations throughout the U.S. Finally, a brief overview of the roles performed by the stocker industry within the entire beef production system is presented.

3.2 Definition of the U.S. Stocker Industry

The U.S. stocker industry, as a whole, consists of all the individual stocker operations that are found in the United States. Therefore, the best way to define the U.S. stocker industry is to provide a definition and description of the different types of stocker operations typically found in the Untied States.

As noted in Chapter 1 (Section 1.1), the typical U.S. stocker operation can be broadly defined as the growing phase between the cow-calf and the feedlot finishing phases. Typical stocker operations take weaned calves weighing 300-600 pounds and grow them to feedlot placement weights of 700-900 pounds. Following the definition used by Peel, the terms stocker, stocker phase of production, and stocker operation used in the remainder of this study describe a variety of growing programs which generally share the following characteristics.

First, stocker operations focus on growing the animal rather than finishing. Stocker production emphasizes frame and muscle production rather than fat. Medium-framed and smaller calves will become too fat before reaching an acceptable finishing weight. The growing phase allows calves to develop more frame before they are placed on high-energy finishing rations (Neumann and Lusby). This means that the cattle will usually gain less weight than is genetically possible during the stocker phase of production.

Second, stocker operations rely on forage, both grazing and harvested, as the primary source of feed. The use of concentrates is limited to a supplementary role only. The typical forages used are native and improved pastures, small grain crops, and residual crops. These crops are usually too high in quality for full-time grazing by cows (Neumann and Lusby). Because breeding cows merely need to maintain their weight, stocker cattle can utilize these types of forage relatively more productively than cows (Price). The different forage systems utilized by stocker operations are discussed in more detail in Section 3.4.

Third, stocker operations are viable economic enterprises. While stocker operations are often associated with other production enterprises, it is not required that another enterprise be associated with the stocker phase of production. For example, cow-calf producers may retain ownership of their calves into the stocker phase of production, while grain producers may purchase stocker cattle to graze winter wheat, giving them a "double crop" alternative. In addition, there are large numbers of cattle producers in the United States who participate solely in the stocker phase of production. These different types of stocker cattle enterprises are discussed in the following section.

3.3 Types of Stocker Cattle Operations

Because of the diversity of stocker production alternatives throughout the United States, there are equally diverse stocker cattle operations, each with different ownership and marketing characteristics. However, there are three broad categories of stocker cattle ownership which can be used to classify the majority of stocker cattle enterprises. These categories are cow-calf retained ownership, commercial stocker operations, and backward integration by cattle feeders. While most stocker operations in the U.S. can be grouped into one of the three categories, several producers may opt for a combination of the different ownership alternatives, depending on their resource endowment and management expertise. The distinction between these categories is made primarily for convenience of characterizing different types of stocker cattle enterprises found in the United States, whether they are the sole ownership alternative or a combination of alternatives.

(1) Cow-Calf Retained Ownership - Cow-calf producers in many parts of the country may participate in the stocker phase of production for a wide variety of reasons. As a result, this group represents one of the most fluid components of the stocker industry (Peel). Cow-calf producers with good breeding and selection programs may find it difficult to receive the maximum price at weaning time that their highly productive calves deserve. By retaining ownership into the stocker and possibly the feeding phases, cow-calf producers may be able to fully reap the benefits of their excellent breeding programs (Neumann and Lusby). Typically in these cases, the stocker enterprise is so integrated with the cow-calf phase that it is often not considered a separate economic enterprise.

In other cases, the stocker enterprise is merely an opportunistic activity determined on an annual or seasonal basis. Factors affecting the decision are cattle prices; grain price, quality and availability; and forage price, quality and availability. These factors tend to be highly variable and may be grain or forage marketing strategies as much as cattle marketing strategies. The decision to produce or not produce stocker cattle is often the result of unexpectedly good or bad forage production, unexpectedly abundant or deficit grain production, unexpectedly good or poor quality grain or forage stocks, etc.

(2) Commercial Stocker Operations - The commercial stocker producer is used here to refer to operations where stocker production, if not the sole economic enterprise, at least represents a major source of income for the producer.

Included in this group are winter small grain pasture grazing operations, the majority of which is winter wheat grazing in the Southern Plains. Also included are summer grazing operations which are typically found in concentrated regions such as the Flint Hills region of Kansas, and shortgrass stocker grazing operations found in the southern High Plains. These stocker operations can be grain producers who purchase stocker cattle as a "double crop" alternative or strictly stocker cattle producers who may lease the small grain and/or native pastures from other land owners.

These types of operations, although often seasonal in nature, are a very consistent component of the stocker industry. Stocker production is a continuous activity and these operations are a steady component of stocker demand year to year. As a result, the winter grazing operations, in particular, play an important role in stabilizing cattle prices. Demand for stocker cattle matches the seasonal increase in supply as weaned calves are marketed (Peel).

(3) Backward Integration by Cattle Feeders - Two different and distinct types of backward integration by cattle feeders into the stocker phase of production can be characterized. One type is the seasonal cattle feeder of the Northern Plains and Midwest. These operations purchase stocker cattle to utilize pasture, crop aftermath, or harvested forages prior to finishing. For these operations, the stocker and feeding enterprises naturally complement each other and the associated farming operations.

A less common but growing type of backward integration is contract stocker production by large commercial feedlots. In recent years, an increasing number of large commercial feedlots will purchase stocker cattle and maintain ownership through the stocker cattle phase. Often, the feedlot will contract with a commercial stocker operator to produce the stocker calves into feeder cattle. This is becoming more common with winter wheat stocker production. Although contract production is still a relatively small component of stocker production, for some wheat pasture stocker producers it provides an opportunity to reduce the risk of cattle ownership and a way to better market their stocker cattle management skills. There are advantages of contract stocker production for the commercial feedlots as well. The feedlots can control the stability of incoming feeder supplies, manage purchase costs by pricing out of calf markets in addition to feeder markets, and maintain quality control of incoming feeder supplies.

3.4 Types of Forage Systems Utilized by Stocker Operations

The three broad categories of stocker cattle operations, discussed in the previous section, utilize a wide variety of forage systems for the production of stocker cattle. These forage systems will usually consist of either: (1) spring and summer grazing of native pastures; (2) spring and summer grazing of improved pastures; (3) winter grazing of small grain pastures (typically wheat); or (4) fall and winter grazing of residual stalkfields (e.g., corn or milo stalks). Like the three categories of stocker operations, the types of forage systems may be the sole system utilized or may be a combination of several of the types, depending on the producer's resource endowment and management expertise.

(1) Stocker Operations Utilizing Native Pastures - This type of forage system is normally limited to spring and summer grazing because this is the only time when native pastures are of good enough quality to support weight gain. During the peak grazing months, these forages will often support gains of up to two pounds per day. However, once the heat or drought of summer appears, or in some areas the first frost of fall arrives, the forage quality declines very rapidly. As forage quality declines, weight gain can drop off just as rapidly (Price). Forage conditions, as well as price, determine the extent that producers utilize native pastures. There are four types of stocker programs which utilize native pastures. These are shortgrass, tallgrass, early intensive grazing, and winter annual grass programs.

The shortgrass native pasture program involves summer grazing of shortgrass perennials commonly found in the southern and central great plains. The calves are usually purchased during the spring and preconditioned for several weeks prior to being released onto the warm season pasture. Protein supplements are often provided when the quantity and quality of the forage begins to decline during the summer. The stocker cattle are usually sold after five months when they achieve a weight of approximately 700 pounds.

The tallgrass native pasture program involves summer grazing of native tallgrass perennials. This type of native pasture program is usually located in the Flint Hills of Kansas, extending south into parts of northern Oklahoma. As with the shortgrass program, the stocker cattle are typically sold after five months of ownership. Supplemental protein may be provided, but only if pasture conditions are of extremely poor quality.

The early intensive grazing native pasture program is a variation on the previous two native pasture programs. This stocker program is intended to enhance animal performance with higher stocking rates per acre. The shorter grazing season requires an increased utilization of available forages with flash grazing and/or an increased use of pasture rotations during spring growth.

The annual winter native grass pasture program is the only native grass stocker program that is conducted during the winter months. These programs are found predominately in the southeastern United States where winters are less severe and late season moisture is usually adequate. This stocker program involves purchasing stocker cattle during the fall and grazing warm season perennials such as bermudagrass during the remainder of the growing season. As winter progresses and forage quality declines, the focus shifts towards winter annual grasses such as hairy vetch or rye. Supplemental hay and grain are necessary when either type of forage grass is in short supply. The stocker calves are typically sold in the spring during March or April. Winter annuals generally offer a longer growing season and excellent pasture gains at relatively low costs (Peel).

(2) Stocker Operations Utilizing Improved Pastures - Improved pastures, both irrigated and dry land, are utilized all over the U.S. for stocker cattle production. Their use stems from the fact that they are of marginal value for crop farming, but can support more productive cover crops than native grasses. This land may be too hilly, rocky, have too shallow a soil profile, etc., but when planted to improved pasture grasses and legumes, its value is enhanced compared to its value when only native grasses are utilized (Price).

Stocker operations which utilize improved pastures typically purchase the cattle around the first of May, when forage growth begins in earnest. The cattle are run on pasture for about five months and are sold in the fall. Protein supplementation is usually necessary to increase the utilization of the forage as its quality decreases throughout the summer.

This type of stocker program may be found in the southeastern states and the southern great plains region (Peel). Recently, the southeastern states have chosen to utilize the improved pasture in that region for cow-calf production more than stocker production. This practice stems from the fact that in sub-tropical and tropical areas, the pasture grasses adapted to these climates are usually of relatively low nutritional value. In more temperate climates, improved pastures usually produce forage that is too high of quality for efficient utilization by cow herds. Because cow herds need only to maintain rather than gain weight, stocker cattle are relatively more productive because they are able to gain between one and two pounds per day on improved pastures (Price).

(3) Stocker Operations Utilizing Small Grain Pastures - Winter small grain pastures such as wheat, barley, oats and rye make exceptionally good grazing and are used extensively for stocker cattle production. Many small grain fields are used specifically for grazing, but the majority are used for both grazing and grain production. With proper management grazing does not reduce grain yield. In fact, proper grazing may actually enhance grain yields (Price).

Several factors (primarily past farm programs) have made wheat the principal small grain forage utilized for winter stocker cattle production. The winter wheat stocker program is a very unique agricultural activity for producers in the Southern Plains, being confined mostly to central and western Oklahoma, southwestern Kansas, the Texas panhandle, and the southeastern corner of Colorado. Winter wheat stocker operations in these areas are also very important to the entire beef production system. While calves may be purchased from cow-calf producers within the region, many stocker cattle are imported into the winter wheat stocker region from other parts of the country for winter grazing. This is because other forage production systems in other regions around the U.S. have seasonally poor forage quality and quantity when wheat reaches its peak forage season.

The grazing period usually begins during late fall when the wheat reaches at least six inches of growth. Forage production will decline from December through early

February when cold temperatures support little, if any, plant growth. When the production goals are forage and grain, grazing must be terminated at the beginning of the joint stage of growth in order to maximize potential grain yield. This generally occurs in March in the southern great plains. Grain yields will be reduced when grazing is extended past this stage.

Many winter stocker operations use rotational grazing. Rotating the cattle among different pastures allows for more efficient forage and beef production because it helps prevent overgrazing, increases the carrying capacity in the spring, and prolongs forage production.

Wheat pasture stocker operations also have the option to "graze out" the wheat, meaning that they allow the stocker cattle to remain on wheat past March and into May. Projected wheat yields and prices, the government wheat program, and stocker prices are all factors which determine whether wheat graze out is a valid option or not (Peel).

(4) Stocker Operations Utilizing Residual Stalkfields - The residual stalkfield stocker program typically involves cattle grazing corn or milo stalkfields during the fall and winter after harvest has been completed. For many stocker operations, grazing crop residue pastures can yield extremely inconsistent results. Some producers will get excellent gains of up to two pounds per day while others will actually see weight loss on the same type of residue pasture (Price). The difference stems from the fact that cattle do not gain weight on the actual crop residue of stalks, straw, leaves, etc. The cattle gain weight by eating the wasted grain left in the field during harvest.

Corn stalkfields usually support the greatest weight gains. Typically, 3 to 8% of the corn grain is lost during harvest, and it is the grain, *not the stalks*, that the cattle gain weight on. Cattle are very good at rooting through the stalks and leaves to sort out the ears lost during harvest. Other grain crop residues such as wheat, milo, etc. do not allow as much weight gain as corn stalkfields because cattle cannot chew whole wheat and the other small grains compared to corn (Price).

This type of grazing system is traditionally found in the western corn belt states of southern Nebraska, northern Kansas, and part of Iowa and Missouri . Recently, however, this type of grazing system can be found in the Texas panhandle due to the large increase in the amounts of irrigated corn being grown there. Depending on market and weather conditions, many producers in the Texas panhandle may move their cattle from winter wheat to corn or milo stalkfields. In addition, these residue pastures offer excellent forage for use in a winter wheat-corn stalkfield rotational system.

3.5 Historical Growth of the U.S. Stocker Industry

The U.S. stocker industry as it exists today is a fairly new industry dating from the 1950s and 1960s, when large-scale cattle feeding began. Before that time, weaned calves were simply raised on forage for an additional year or two and were slaughtered with little or no grain finishing (Neumann and Lusby). This is essentially the same beef production system that is used today in virtually every beef producing country other than the United States and Canada. Therefore, the modern U.S. stocker industry, which grew out of the large-scale feedlot finishing phase of production, is unique to the United States and has strongly influenced cattle production in Canada. Because the modern stocker cattle phase of production grew out of the feedlot phase, a brief history of the U.S. feedlot industry is necessary.

Although cattle have been fattened on farms in grain-producing areas for many years, large-scale grain finishing of cattle is a relatively new industry and is unique to the United States. Cattle feeding became a major industry in the U.S. for three reasons. First, extremely large grain surpluses developed in the 1950s and 1960s, making grain available for animal use at low costs. Second, the U.S. consumer developed a taste for grain-fed beef; and third, the United States had large amounts of pasture available for feeder cattle production.

Until the 1950s, cattle feeding was usually conducted with small numbers of cattle as a secondary enterprise on grain farms. The large-scale feedlot industry as we know it today began in the 1950s in California and Arizona and rapidly moved into the Plains states of Colorado, Texas, Oklahoma, Kansas, and Nebraska in the early 1960s. The dry climates in these states made them natural areas for cattle feeding on a large scale. Although California and Arizona did not produce enough feeder calves or feed grains to support large-scale feedlots, low grain prices and cheap transportation costs during the 1950s through the 1970s made it possible to move cattle and grain to areas with favorable feeding climates. The years between 1959 and 1973 saw a tremendous increase in the numbers of cattle fed (Neumann and Lusby).

The stocker cattle industry developed out of the large-scale feedlot industry for several reasons. First, the commercial feedlot industry was developed primarily for yearling steers. Feedlots were designed for the 700-pound steer, which meant that the size of the physical structures at many commercial feedlots were be too large or too high for calves (Gill). The stocker phase of production allowed calves to be grown to roughly 700 pounds before entering the feedyard.

Second, large commercial feedlots were built solely to be in the business of feeding cattle, not doctoring them. Most feedlots want cattle which will have less than five percent sick cattle per pen, and any sickness that does occur be encountered within the first few days of arrival (Lusby). The stocker industry became the primary phase where the calves received much of their medical treatments. Stocker operators became required to provide the necessary medical treatments, including all vaccinations and implants which were necessary.

Third, because most feedlots were located primarily in the Plains states, calves born in all regions of the U.S. needed to be transported to these primary feeding locations. The stocker industry became the preliminary receiving operations for these calves. Stocker operations would purchase the calves, ship them to the feeding locations, and assemble the cattle into uniform groups with respect to weight, breed, and age. The movement of cattle throughout the U.S. in conjunction with the stocker industry is discussed in more detail in the following section.

3.6 Geographical Distribution of the Stocker Operations

The general pattern of feeder cattle movement within the United States is well known (Figure 3-1). However, it is difficult to quantify the movement of cattle through stocker operations because of the diversity of the stocker industry. More importantly, the traditional cattle inventory data that are currently collected does not lend itself to measuring stocker cattle numbers. Especially difficult to measure is the number of cattle that move through summer stocker programs. These cattle can move through the summer stocker programs and never be counted in any inventory (Peel).

It is possible, however, to estimate the movement of cattle through winter stocker operations. Because the majority of beef calves in the U.S. go through some type of stocker operation, and approximately 70 percent of beef calves are born in the spring and weaned in the fall, it is logical to assume that cattle too small for feedlot placement will be in some type of winter stocker program. The differences between winter and summer stocker operations, and the principle forages utilized for each program, were discussed in Section 3.4.

Figure 3-2 attempts to measure the movement of feeder cattle through winter stocker operations around the country. The supply of feeder cattle outside of feedlots was estimated using January 1 inventory data obtained from the *Cattle Report* published by the National Agricultural Statistical Service. The estimated feeder supply was calculated by summing the number of steers over 500 pounds, the number of calves less than 500 pounds, and the number of other heifers not considered replacement heifers. The number of cattle and calves on feed were then subtracted from this total, yielding a total estimated feeder supply for each state. This estimated feeder supply was then compared to the previous year's calf crop for each state as a ratio. This ratio shows the percentage of each state's calf crop that is not in feedyards or being used for replacements, implying that the cattle are part of the available feeder supply. States with a ratio greater than one means that the supply of feeder cattle on January 1 is greater than that state's total calf production. These states are net importers of feeder cattle, whereas states with low ratios are net exporters of feeder cattle. Because the estimated feeder supply is net of cattle on feed, Figure 3-2 suggests that much of the cattle movement within the U.S. occurs in conjunction with winter stocker operations.

Figure 3-2 illustrates this estimated feeder supply and the movement of cattle around the U.S. using the January 1, 1996 inventory data compared to the 1995 calf crop for each state. The average ratio for all states was .83. This implies that, on average, about 17 percent of the 1995 calf crop was either already in feedlots or were replacement heifers being retained for breeding purposes on January 1, 1996. Of the remaining 83 percent, calves which were born in the fall would presumably still be suckling on January 1. If roughly 25 percent of the total calf crop is born in the fall, approximately 60 percent of the U.S. calf crop is in some type of winter stocker program. There is some proportion of the fall-born calves that will be in some type of summer stocker program the following summer, but this proportion is extremely difficult to estimate.

Figure 3-2 shows the average ratio for several regions of the U.S. as well as the ratios for selected states within each region. Again, states with the highest ratios are net importers of stocker cattle and states with the lowest ratios are net exporters of stocker cattle. Although this figure is based on 1995-1996 data only, there is little variation in the regional ratios from year-to-year. By studying the ratios of the separate regions, the generally perceived movement of cattle around the U.S. is confirmed. The Northern

Plains, Southern Plains, and Corn Belt regions all have ratios greater than the national average of .83. The Northeast, Southeast, Delta, and Mountain regions all have ratios which are substantially lower than the national average. These regional ratios show that cattle from the east tend to move west, and cattle from the north tend to move in a southerly direction. In total, cattle tend to move toward the states in the central region of the United States.

By studying the individual state ratios, it is possible to determine which states are heavily involved in stocker cattle production. Kansas, with a ratio of 1.60 leads all states followed by Iowa, Oklahoma, and Illinois which have ratios of 1.34, 1.32, and 1.22, respectively. Montana, with a ratio of .41 is the state with the lowest ratio, followed by Florida (.45), Wyoming (.50), and Louisiana (.50). Kansas and Oklahoma have high ratios due in a large part to the winter wheat stocker programs which are prevalent in these states, whereas Iowa and Illinois have high ratios due in a large part to the stocker programs which utilize the grazing of corn stalks during the winter months.

Figure 3-2 measures only net inflow or outflow of cattle from a state. For this reason, it is likely some of the cattle movement, especially cattle movement within a state, is not taken into account. For example, Texas, which is considered a major cattle producing state has a ratio of .85, only slightly higher than the national average. Texas and Oklahoma, together, make up the Southern Plains region which has a ratio of .97. These two states, combined, account for roughly 18 percent of the total U.S. calf crop. Texas, however, accounts for almost 14 percent of this total. Cow-calf production is heavily concentrated in the central and eastern areas of Texas. It is likely that much of the cattle movement occurs within the boundaries of Texas, with calves born in central and east Texas being moved north to the Texas Panhandle for winter wheat grazing.

3.7 Overview of the Role of the Stocker Industry

As can be seen in the above sections, the stocker phase of production is a very diverse and complex sector within the beef production system. There are different types of stocker cattle operations and different types of forage systems used throughout various regions in the United States.

The stocker operation has many different roles and can vary from year to year for individual stocker producers. Depending on the individual producer's goals, the stocker operation may be a unique commercial enterprise, a way to manage and market forage, an addition to a good breeding program, or a means of feedlot supply and quality control (Peel).

Combined, these individual stocker operations, with their different applications and variations, form the U.S. stocker industry. The stocker industry, as a whole, performs three important roles within the entire beef cattle production sector.

(1) The stocker industry increases the weight, age, and quality of feeder cattle. This was the traditional motivation for the stocker industry which developed out of the large-scale feedlot finishing industry. As noted earlier in this chapter, many calves are too small or too young to be placed directly on high-energy feeding rations. Small calves will become too fat before reaching the acceptable finishing weight. In addition, most calves will not grade Choice consistently at ages less than 14 or 15 months. The stocker phase of

production allows calves to reach this age before they can be efficiently finished on high-energy grain rations.

Many people see this role not only as the primary production role of the stocker industry, but as the only role of the U.S. stocker cattle industry. Chapter 4 provides a comprehensive study of this role illustrated with the appropriate economic theory.

(2) The stocker industry helps to balance the seasonal production of livestock, forage, and grain. Weaning dates are seasonal which results in a large number of calves available in late summer to late fall and small numbers during the winter and spring. The stocker industry helps to maintain an even supply of feeder cattle year around (Neumann and Lusby).

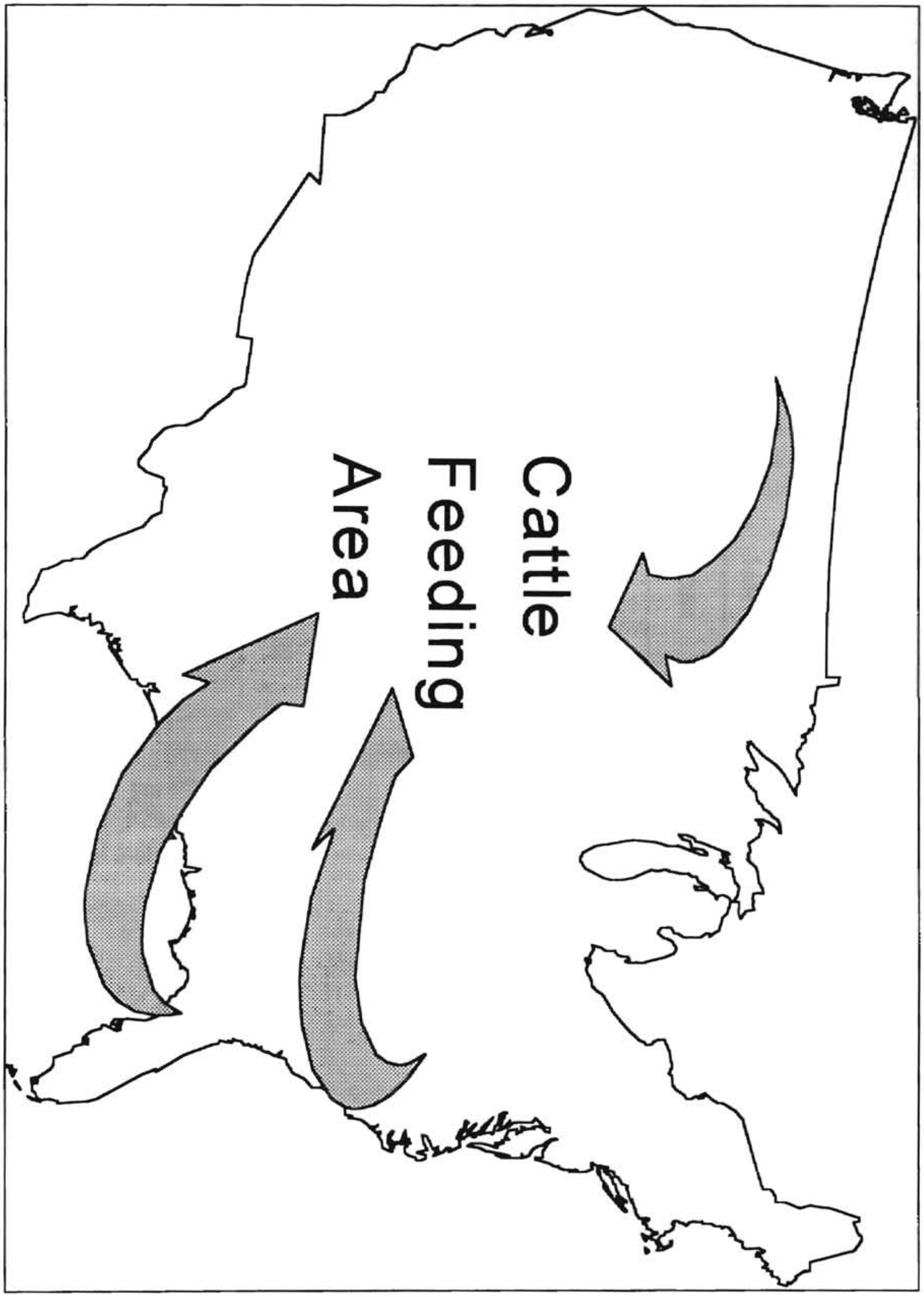
The stocker industry acts as a shock absorber in order to manage the short term variability in livestock and feed production. In doing so, the stocker industry is able to distribute seasonally produced cattle through time (Peel). This role, along with the appropriate economic theory, is also be discussed fully in Chapter 4.

(3) The stocker industry serves to maintain both the short-run and long-run balance between cattle, grain, and forage markets. Cattle, grain, and forage markets are economically intertwined, which implies that any change in the relative price of these commodities changes their allocation to alternative uses.

Because cattle can be produced with either more grain intensity or forage intensity, changes in the relative price of grain and forage imply a need to change the way cattle are produced. Also, cattle are competing against alternative enterprises for the use of grain, primarily pork and poultry. Any change in the value of cattle relative to grain implies an alternative allocation of resources (Peel).

Of all the beef cattle production phases, explained in Chapter 1 (Section 1.1), the stocker industry is the primary sector which serves to maintain the balance between these competing resources. This is the most important role the stocker industry performs within the entire beef cattle industry, and it is also the least understood. This fundamental resource allocation role, illustrated with the appropriate economic theory, is the topic of Chapter 5.

FIGURE 3-1. General Pattern of Feeder Cattle Movement Throughout the U.S.



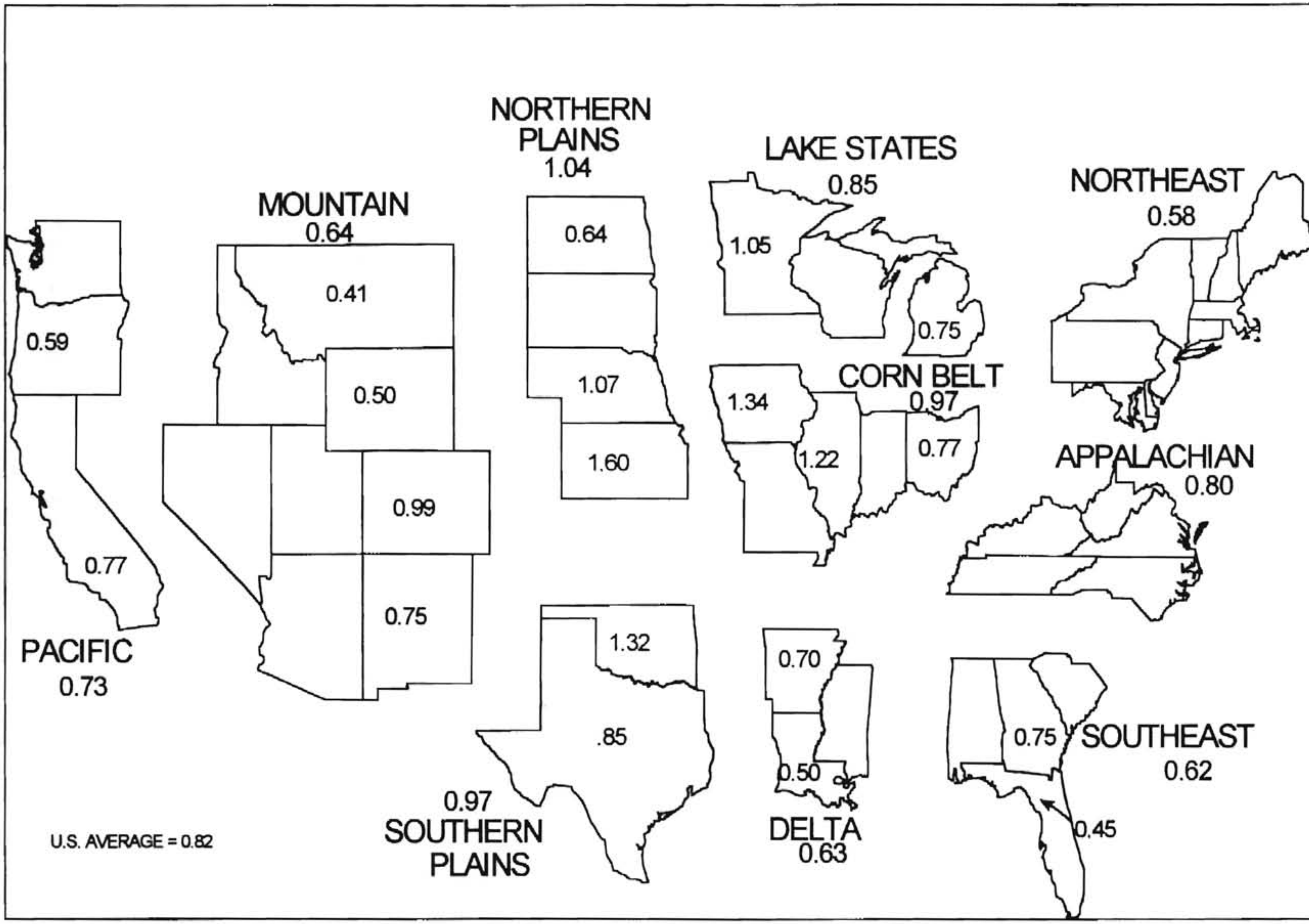


FIGURE 3-2. Jan. 1, 1996 Estimated Feeder Supply / 1995 Calf Crop

CHAPTER 4

The Fundamental Marketing Role of the U.S. Stocker Industry

4.1 Overview of Chapter 4

The previous chapters have described the beef cattle industry and the stocker cattle industry in general terms. Except for the brief overview in Chapter 3 (Section 3.7), there has been no attempt to discuss the role of the stocker industry in relation to the entire beef cattle industry. Chapter 4 will begin the discussion of the fundamental economic roles of the U.S. stocker industry in relation to the entire beef cattle production system.

Specifically, this chapter will describe the fundamental marketing role the U.S. stocker industry performs within the beef production process. This marketing role will then be illustrated with the appropriate economic theory, where applicable.

4.2 Viewing The Stocker Industry in a Marketing Framework

Many people, producers and academic researchers alike, tend to view the stocker industry in a production framework. This is understandable considering the biological need to grow the calves to acceptable feedlot placement weights. When studying stocker operations, researchers typically use firm-level data and sophisticated optimization procedures in order to determine the profit-maximizing number of stocker calves to buy and sell. Stocker operators typically use simple budgeting and break-even analysis as their decision-making tools.

There are many different stocker operations throughout the country, each with their own objectives for participating in the stocker phase of production (see Chapter 3). Taken together, these individual stocker operations, or firms, combine to form the U.S. stocker industry (Rhodes). The distinction between firm and industry, or system, is an important one. While traditional production economics may be appropriate for firm-level analysis, it may not be the best methodology with which to study the stocker industry as it relates to the entire beef production system. The stocker industry, as a whole, may be better viewed within a marketing framework.

The term *marketing* has many different definitions depending on the viewpoint of the market participants. To some, marketing is simply buying and selling commodities. To others, marketing consists of storing and processing a commodity. Formally, the American Marketing Association has defined marketing as the performance of business activities that direct the flow of goods and services from producers to consumers or final user. Agricultural marketing begins at the farm or ranch, the basic source of supply, and continues until a consumer purchases the retail product or until it is purchased as a raw material for another phase of production. In general, marketing consists of any efforts that bring about transfer of ownership and that create time, place, and form utility to commodities (Cramer and Jensen).

Although the stocker industry is not traditionally viewed within a marketing framework, it does conform to the general definition of marketing by bringing about a transfer of ownership and by creating time, place, and form utility to a commodity, in this case, beef calves. One of the stocker industry's most visible roles within the beef production process is to perform the physical marketing functions of adding form, place, and time utility to beef calves before they enter the feedlot phase of production.

4.3 The Stocker Industry's Role in Adding Form Utility

Form utility is added to commodities by processing. In many marketing textbooks, processing is usually described as being a technologically, sophisticated manufacturing phase where raw commodities are transformed into the final goods that consumers purchase. For example, milk processors purchase fluid milk from dairies, pasteurize it, and package it in convenient containers for consumers (Rhodes). In relation to the beef cattle industry, processing is usually thought to occur only in the meat-packing phase of production where the cattle are slaughtered and processed into different cuts of meat. While both of these are definitely examples of transforming a raw commodity into a form that consumers want, the form utility function does not always require such a drastic, technological transformation. In the most simple case, adding form utility to commodities adds value, and any process which increases the value of a commodity for the customers at the next marketing level can be considered adding form utility.

In the case of the stocker industry, form utility is added to beef calves before they enter the feedlot phase of production. The stocker industry transforms beef calves into feeder cattle, a form that the feedlot operations (the customers at the next marketing level) desire. By doing so, the stocker industry increases the value of feeder cattle to the participants in the feedlot industry. The stocker industry adds form utility to beef calves in two ways: (1) the stocker industry increases the quality of individual calves; and (2) the stocker industry increases the quality of a group of calves.

The stocker industry serves to increase the quality of individual calves in several ways. The first way is, of course, to increase the size, weight and age of younger calves before they enter the feedlot phase of production. The traditional role of the stocker operation has been to upgrade beef calves that are not ready to be placed into a feedlot. Often, weaned calves are too small and too young to be placed directly on a high-energy finishing ration. Medium-framed and smaller calves will become too fat before reaching ideal slaughter weights, and most cattle will not consistently grade Choice at ages less than 14 or 15 months. As a whole, the stocker industry provides a valuable service to the feeding industry by making these younger, lighter-weight calves more acceptable to feeding companies. Given average grain and cattle prices, feedlot operations typically prefer cattle that weigh approximately 600 pounds and are relatively fleshy. Most of the high plains feedlot operations are designed around the 700 pound steer, which means that their facilities are simply not designed for smaller, light-weight calves.

Another way the stocker industry increases the quality of beef calves before they enter the feedlot phase of production is to increase the health of the individual calves. As mentioned in Chapter 3, beef calves are produced in virtually all regions of the United States, while large-scale feeding operations are located primarily in the central U.S. As a result, many calves will usually be shipped long distances, often passing through several auction barns and being grouped with different calves from around the country. Shipping calves, often freshly weaned, and grouping them with different calves creates substantial stress on the cattle and exposes them to many diseases. This stress and exposure to different diseases may lead to severe death loss problems. The term "shipping fever" has been used to describe both the stress and the respiratory diseases which are associated with moving cattle large distances.

Because feedlots are in the business to feed cattle as efficiently as possible, they tend to demand feeder cattle which are healthy. Sick cattle simply do not gain weight as efficiently as possible due to reduced feed intake and feed to energy conversion. The typical feedlot operation in the U.S. does not have the resources to handle the shipping fever problems associated with the transportation of cattle very long distances. Therefore, the stocker industry has become the primary phase responsible for treating these health problems. Stocker operations have developed "receiving programs" where the cattle are treated for various health problems before being placed on forage pastures. By treating the health problems associated with the transportation of calves, the stocker industry increases the value of feeder cattle by improving the health of the individual animals.

The stocker industry also increases the value of feeder cattle to feeding operations by increasing the quality of an entire group of calves. The stocker industry increases the quality of groups of cattle by assembling calves, which are purchased all over the U.S., into uniform groups of similar breed, sex, age, and size. Additional value is added when these uniform groups consist of larger numbers of cattle. Feedlots tend to prefer cattle which are receivable in multiples of 60 to 70 head per truck load and 100 to 200 head per pen. This may partially explain the increase in direct sales of feeder cattle and the corresponding decrease in the number of cattle sold through public auctions. The number of cattle sold through public auctions has decreased by roughly 50 percent since 1978, while the confirmed direct sales of feeder cattle have nearly doubled during that same time period (Peel and Ward). Feeder cattle buyers are able to purchase the cattle directly from the stocker operations which have already sorted the cattle into groups of similar sex, breed, age, and size. The feeder cattle buyers no longer have to attend the public auctions and attempt to sort the cattle into similar groups while competing with other buyers. Also, the stocker operations typically have enough cattle to make up a half or whole pen of cattle. This may limit the feeder cattle buyer's need to travel to several auctions in order to purchase a pen load of cattle.

Theoretically, because feedlot operations are demanding the above mentioned characteristics in feeder cattle, this implies that there is a demand for certain marketing services provided by the stocker industry. These marketing services can be illustrated with a traditional marketing margin model. Figure 4-1 illustrates the traditional marketing margin model common in most marketing textbooks.

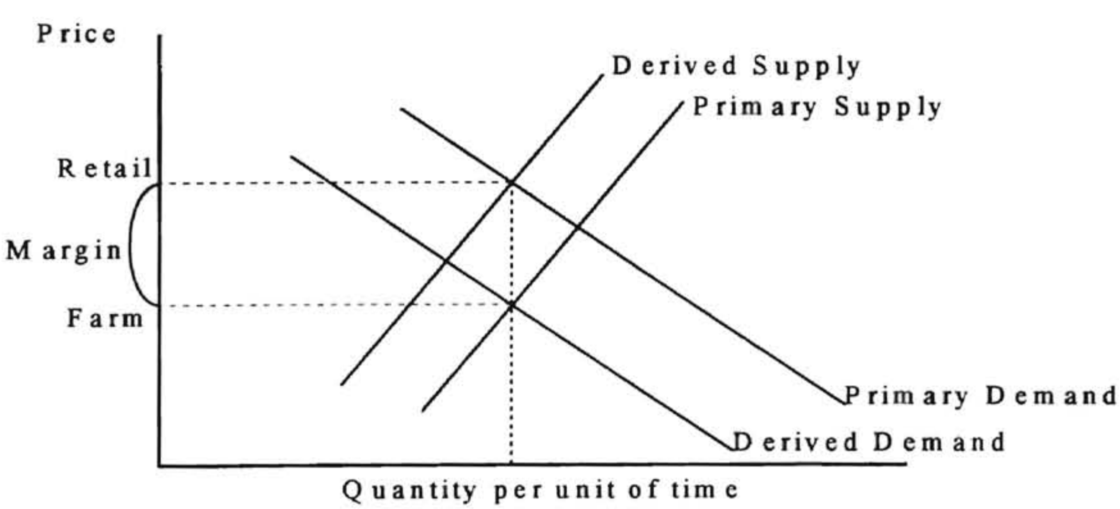


FIGURE 4-1. Traditional Marketing Margin Model

A marketing margin is usually defined as the difference between the price paid by consumers and the price received by producers (Tomek and Robinson). The marketing margin occurs from the interaction between primary supply and demand, and derived supply and demand. Primary supply refers to the supply response at the producer level and primary demand refers to the demand response at the ultimate consumer level. Derived demand is usually defined as the price-quantity relationship that exists at the producer level, while derived supply is defined as the supply response at the ultimate consumer level. The retail price is established at the point where the primary demand response and derived supply relation intersect. The farm-level price is discovered where derived demand and primary supply intersect. The difference between the retail and farm price is the marketing margin.

The concept of derived and primary demand and supply, and the associated marketing margin, can be used to illustrate the theoretical marketing margin associated with the stocker industry's role in adding form utility to beef calves before they enter the feedlot phase of production. Although the marketing margin is usually defined as the difference between retail and producer prices, the concept can be used to describe the difference between prices at two market levels (Tomek and Robinson). Figure 4-2 illustrates the theoretical marketing margin associated with the stocker industry's role in increasing the quality of beef calves before they enter the feedlot phase of production.

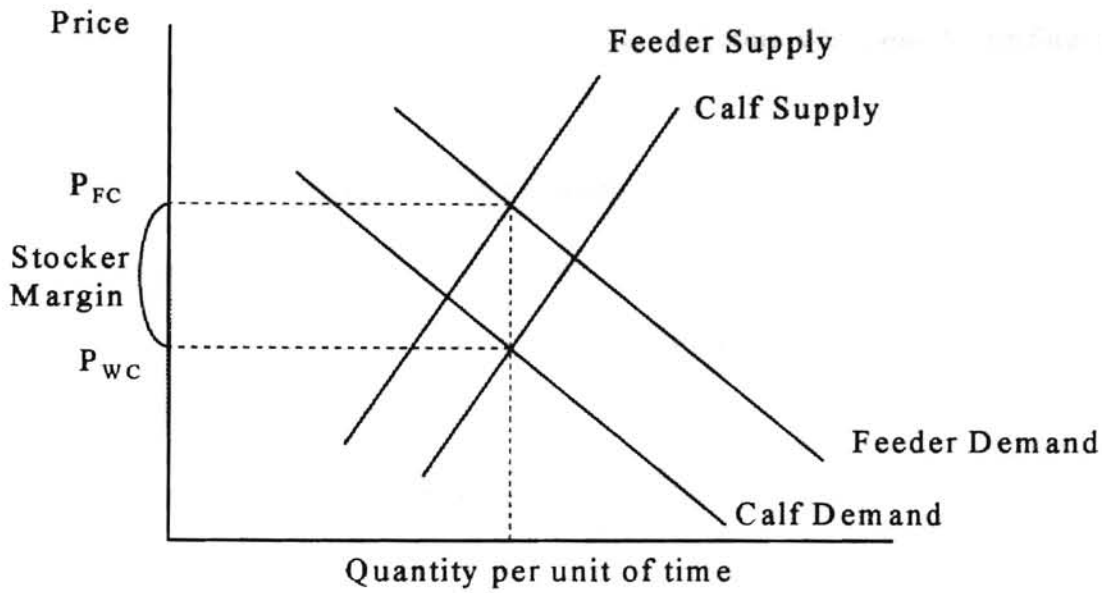


FIGURE 4-2. The Theoretical Marketing Margin for the Stocker Industry

There are several simplifying assumptions which must be made in order to understand the marketing margin for the stocker industry. The first is that the primary supply is assumed to be the supply of weaned calves and the primary demand is the demand for feeder cattle. Of course in reality, the demand for beef from the ultimate consumer is the primary demand, and a whole family of derived demand curves representing each beef production phase would follow. For simplicity and clarity, the primary demand is considered to be the demand for feeder cattle and the derived demand is the demand for weaned calves. The second assumption is that the term feeder cattle is used here to represent cattle which are ready to be placed into feedyards. This leads to the third assumption that some firm is performing these form utility functions, whether it is a commercial stocker operator or a cow-cow operator who is retaining ownership into the stocker phase. In other words, whether there is some vertical integration, or none at all, these form utility functions are being performed by some firm within the beef production system. Traditionally, however, it is the stocker operators who typically perform these functions.

The point where the demand for and supply of weaned calves intersect is the price paid for the weaned calves (P_{WC}). Similarly, where the demand for and supply of feeder cattle intersect is the price paid for feeder cattle (P_{FC}). The price of feeder cattle is a function of the physical characteristics of the cattle and the fundamental market forces reflecting aggregate feeder cattle supply and demand (Schroeder et al.). The same is assumed to be true for the weaned calves. Like the traditional model shown in Figure 4-1, the difference between the price of weaned calves and the price of feeder calves is the marketing margin. The marketing margin is the price received for providing certain marketing services, such as processing and assembly (Tomek and Robinson). By assuming the stocker industry is providing these marketing services, the marketing margin in Figure 4-2 is labeled as the "Stocker Margin."

Holding the supply and demand for both calves and feeder cattle constant, the marketing margin should reflect the difference in the physical attributes between weaned calves and feeder cattle. Several research studies have confirmed that the stocker industry does increase the value of both individual and groups of beef calves before they enter the feedlot phase of production. For example, a study by Kansas State University researchers examined the impact of several physical characteristics on Kansas feeder cattle prices. In respect to individual calves, the study discovered that cattle which were considered fleshy received a \$0.36/cwt premium and cattle which were thin received a \$1.55/cwt discount when compared to the average. Cattle which were considered very thin received discounts of almost $5.00/cwt. The study also found large and significant discounts for cattle which were considered to be in poor health. Cattle with dead hair, appeared sick, had bad eyes, and/or had lumps or were crippled, received discounts of $1.22, $19.32, $8.35, and $14.65 per hundredweight, respectively, when compared to cattle which were considered healthy. In respect to groups (or lots) of calves, lots which were not uniform with respect size and age received a $.43/cwt discount. The effect of lot size had a significant impact on price. Larger numbers of head in each lot received premiums when compared to single-head lots. Lots which consisted of 55 to 65 head received premiums $5.23 per hundredweight.

Holding demand and supply constant, these premiums and discounts received for feeder cattle indicate that feeder cattle buyers demand certain aspects in the cattle they purchase. This illustrates the fact that the stocker industry does add form utility to beef calves before they enter the feedlot phase of production, and that there is a marketing margin associated with the stocker industry.

4.4 The Stocker Industry's Role in Adding Place Utility

Place utility is added to commodities through transportation. Consumers in one area find little value in a commodity that is not available in their region unless that commodity is transported and made available in the consuming region. Generally, transportation includes moving commodities from the farm to processing facilities and from these facilities to the final destination (Cramer and Jensen).

The stocker industry adds place utility to beef calves by arranging for the transportation of calves from the major cow-calf producing areas to the primary feedlot finishing areas of the United States. The actual transportation of the calves is generally done by an outside transportation firm, usually a livestock trucking company. Although stocker operations do not generally provide the actual transportation of the calves, they do add place utility by purchasing the transportation services, and more importantly, by providing an incoming destination for the calves.

The stocker industry adds place utility by providing a destination for the beef calves which is relatively close to the feedlot finishing operations. By providing the destination for the calves, the stocker industry adds value to the beef calves before they enter the feedlot phase of production. The fact that feeder cattle are located relatively closer to the feedlot operations is of great value to the feeding industry. Feedlot cattle buyers are able to purchase the feeder cattle either through local auctions, or directly from the stocker operations, which are located relatively short distances from the feedlot operation. This saves feedlot operations considerable time and money, two resources which are of great value in the feedlot finishing industry.

The movement of feeder cattle throughout the U.S., in conjunction with the stocker industry, was discussed in Chapter 3. Figure 3-2 indicates that many of the beef calves produced in the U.S. are imported into the central region, and that this movement occurs in conjunction with the stocker phase of production, in particular winter stocker operations. This is due to the fact that there is an abundant amount of high quality forage available in the central portion of the U.S. during the winter, when other forage pastures are diminishing in quality.

The stocker industry's role in adding place utility can be illustrated using a traditional spatial equilibrium model, with certain differences in the assumptions. Figure 4-3 illustrates the theoretical spatial equilibrium model associated with the stocker industry.

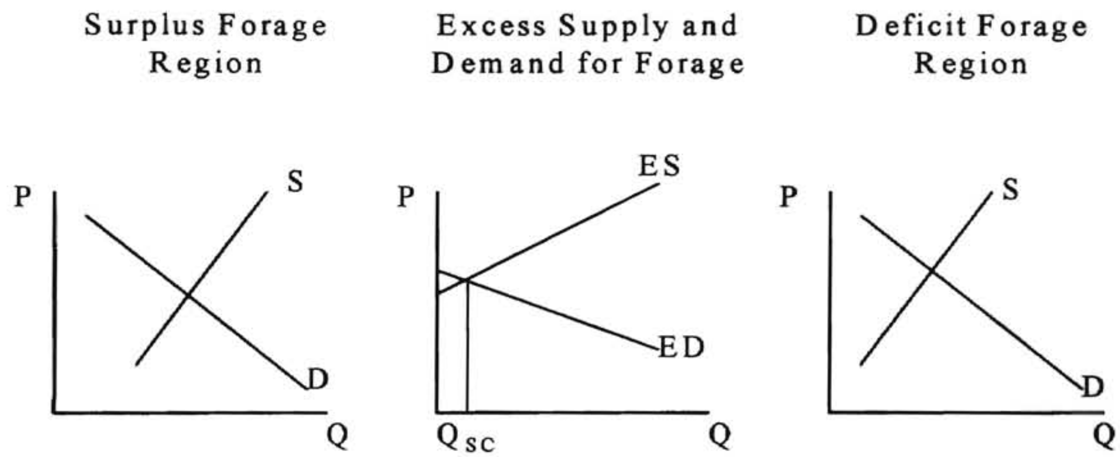


FIGURE 4-3. Theoretical Spatial Equilibrium Model for the Stocker Industry

In Figure 4-3, it is assumed that the surplus forage region is the central region of the United States, which is where the majority of stocker operations are located. The deficit forage region is assumed to be the major cow-calf producing regions of the U.S., such as the Southeast. The terms surplus and deficit are used to describe either the quantity or quality of the forage. In all cases, the cost of transportation is assumed to be constant and is already reflected in the excess supply (ES) curve.

The major difference in the stocker industry spatial model and traditional models is in the definition of exporter and importer. In traditional models, the surplus regions are the exporters and the deficit regions are the importers. In the stocker industry spatial model, it is assumed that forage is not exported and imported, but that the stocker cattle which graze the forage are. This is due to the fact that it is simply easier and cheaper to move the cattle to forage than it is to move forage to cattle. This implies that the demand curves for forage in both the deficit and surplus forage regions are derived demand curves. The demand for forage is derived from the demand for stocker cattle because forage is a major input to stocker cattle production. The supply curves are assumed to be the primary supply of forage in both regions. Thus, the excess supply (ES) and the excess demand (ED) curves can be considered the supply and demand curves for stocker cattle. Here, the term stocker cattle is used to define cattle which have been weaned but which have not been placed in a feeding operation. The quantity of stocker cattle shipped from the deficit region to the surplus region is expressed as Q_{SC}. Figure 4-3 illustrates the case where a small quantity of stocker cattle is being shipped from the forage deficit region to the forage surplus region. Theoretically, if both regions have an abundant supply of high-quality forage, there would be no movement of stocker cattle, assuming all other relevant factors are held constant.

Figure 4-4 illustrates the theoretical basis for the movement of cattle throughout the United States in conjunction with winter stocker operations. This implies that Figure 4-4 illustrates the theoretical concepts about the movement of stocker cattle which was estimated in Figure 3-2.

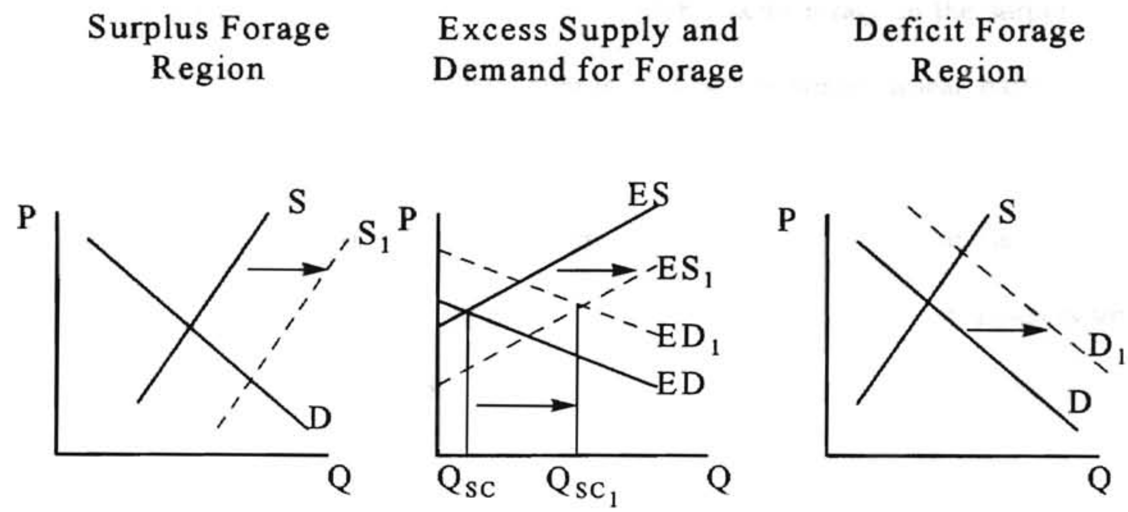


FIGURE 4-4. Theoretical Basis for the Movement of Stocker Cattle

The same assumptions underlying the relationships in Figure 4-3 apply to Figure 4-4. The forage deficit region is the major cow-calf producing regions of the U.S. and the forage surplus region is the central portion of the U.S. Similarly, the excess supply and demand curves are the demand and supply curves for stocker cattle. It is also assumed that the type of forage pasture found in the forage deficit region is of lower quality than the forages found in the surplus region.

It is estimated that approximately 70 percent of the U.S. beef calf crop is born in the spring and weaned in the fall (Peel and Ward). By assuming that the forage deficit region is the major calf producing region, the demand for forage in the fall increases. The demand for forage in the deficit region is illustrated by the demand curve shifting from D to D_1. This increase in forage demand is due to the calves needing to graze the forage as well as the cows. In addition, the quality of the forage during the fall declines rapidly. At roughly the same time, however, the supply of high-quality forage in the surplus region increases from S to S_1. This is due in large part to the winter wheat pasture that is available for grazing in several states in the central region of the United States. The increase in forage demand in the deficit region increases the excess demand (ED) for forage, shown by the shift in excess demand from ED to ED_1. Similarly, the excess supply (ES) of forage increases from ES to ES_1. Because the excess supply and demand curves can be assumed to be the supply and demand curves for stocker cattle, the quantity of stocker cattle imported from the deficit forage region to the surplus forage region increases from Q_{SC} to Q_{SC1}, all other factors held constant.

Thus, Figure 4-4 illustrates the theoretical basis of the stocker industry's role in adding place utility to beef calves. This is particularly true for the winter stocker operations participating in the stocker industry. Many of the commercial stocker operations, which were defined in Chapter 3, utilize this excess forage in the winter for stocker cattle grazing. Therefore, the commercial stocker operator is a major contributor to the place utility function.

4.5 The Stocker Industry's Role in Adding Time Utility

The time utility function is traditionally described as the storage of commodities. Most agricultural commodities are produced once a year, but need to be distributed for consumption throughout the year. Typically, the storage of agricultural commodities is conducted by large agribusiness firms, such as grain elevator owners, who specialize in storing commodities (Rhodes). It is not necessary, however, for storage to be conducted solely by these large firms. The storage function can occur at all levels in the marketing channel, and any segment that holds a commodity from harvest or production and distributes it over time as needed, adds time utility to that commodity (Cramer and Jensen).

The stocker industry's role in adding time utility to beef calves is the most important and crucial of the marketing functions. It is also the least understood function. The stocker industry adds time utility to beef calves before they enter the feedlot phase of production by distributing the seasonally produced calves over time. Because the stocker industry is able to adjust to short term variations in production easier than the other sectors, it provides a valuable service to the entire beef cattle industry by acting as a shock absorber to manage short term variability in beef calf production.

Although beef calves are produced continuously throughout the year, approximately 70 percent are born in the spring and weaned in the fall. Traditionally, these fall calves are sold immediately after weaning. Therefore, a majority of the calves are placed in the beef cattle marketing system during the fall months. The stocker industry takes these seasonally produced calves and distributes them relatively evenly over time. The stocker industry's role in adding time utility is conceptualized as a temporal equilibrium model in Figure 4-5.

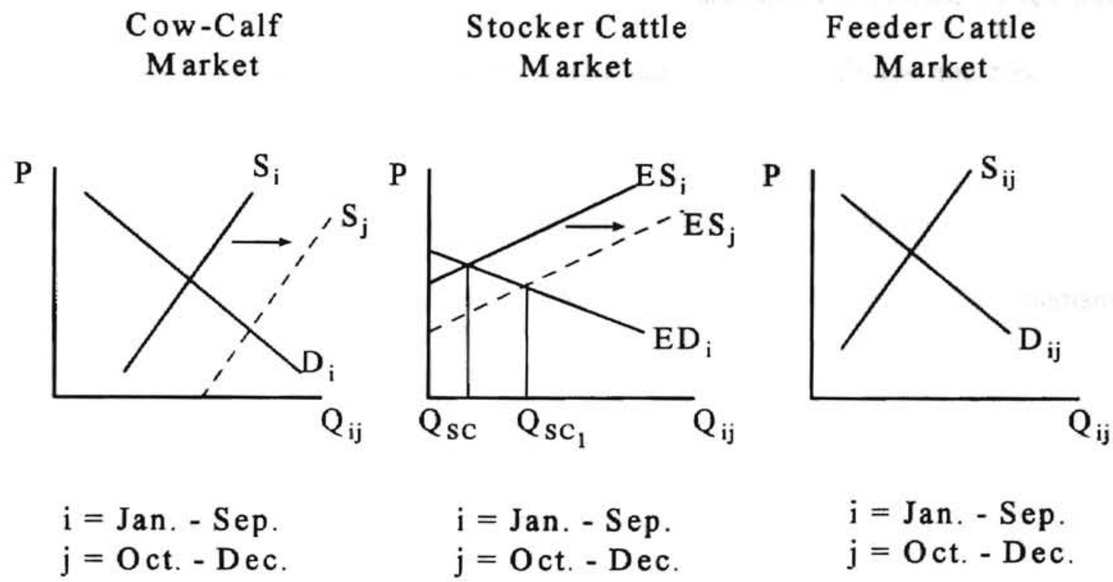


FIGURE 4-5. The Time Utility Function of the Stocker Industry

Figure 4-5 illustrates the stocker industry's role in adding time utility to beef calves before they enter the feedlot phase of production. The stocker industry temporal equilibrium model is different from traditional models. In traditional models, the excess supply (ES) and demand (ED) curves represent the supply and demand for storage. In the stocker industry model, the excess supply and demand curves are assumed to represent the supply and demand for stocker cattle. In a sense, the stocker industry "stores" the excess feeder cattle, if only for a brief period of time.

Also, it is assumed that there is a clear distinction between stocker cattle and feeder cattle. For this model, the term stocker cattle refers to cattle which are suitable only for grazing forage, while the term feeder cattle is used to define those cattle which are suitable for placement into feedyards. In reality, stocker cattle can be considered a subset of the feeder cattle supply when the term feeder cattle is used to describe all cattle which have been weaned and are not in feedyards. The distinction is made here in order to illustrate the stocker industry's role in distributing seasonally produced calves through time. It is also assumed that the demand and supply for both forage and feedgrains are held constant.

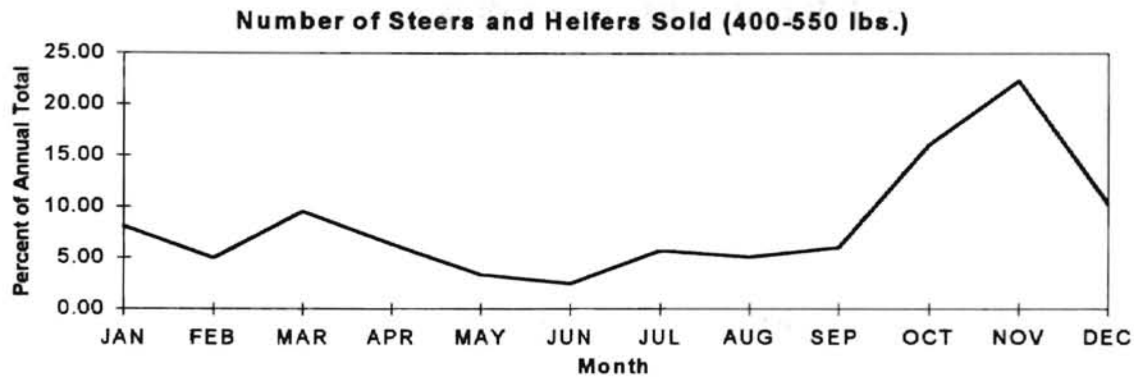
With the distinction between feeder cattle and stocker cattle made, the supply and demand curves illustrated in the Cow-Calf Market represent the supply of and demand for weaned beef calves. Likewise, the supply and demand curves illustrated in the Feeder Cattle market represent the supply of and demand for feeder cattle. The excess supply and demand curves depicted in the Stocker Cattle Market panel have previously been defined. The time period used in this model is one year, beginning with January (Jan) and ending with December (Dec). The subscript, i, refers to the months of January through September, and the subscript, j, refers to the months October through December.

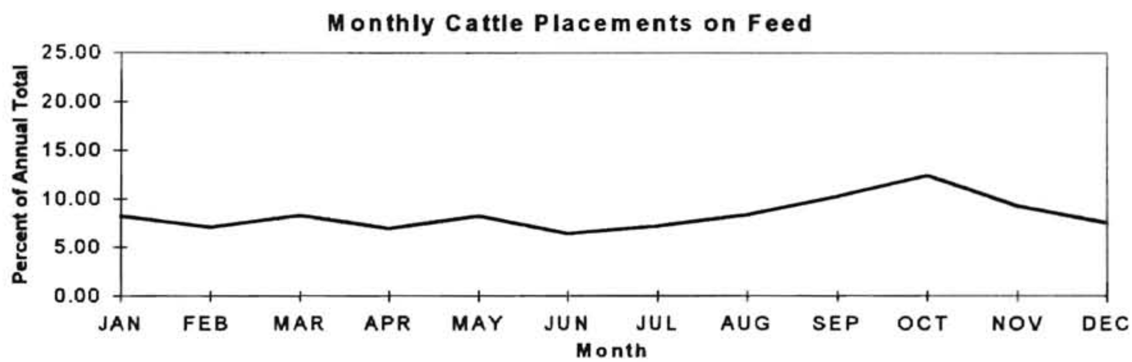
As noted previously, approximately 70 percent of the beef calves in the U.S. are born in the spring and weaned in the fall. The shift in the supply curve in the Cow-Calf Market panel from S_i to S_j illustrates the increase in the number of calves marketed during the fall. This increase in the calf supply causes an excess supply of cattle, which is illustrated by the shift in excess supply from ES_i to ES_j. By assuming that the demand and supply for both forage and feedgrains is held constant, and that feedyards have a limited capacity, there is no change in the supply and demand functions for feeder cattle in the Feeder Cattle Market panel. The result is that the quantity of stocker cattle increases from Q_{SC} to Q_{SC1}. Thus, the stocker industry helps to distribute the seasonally produced calves during the year, implying that the stocker industry adds form utility to beef calves before they enter the feedlot phase of production.

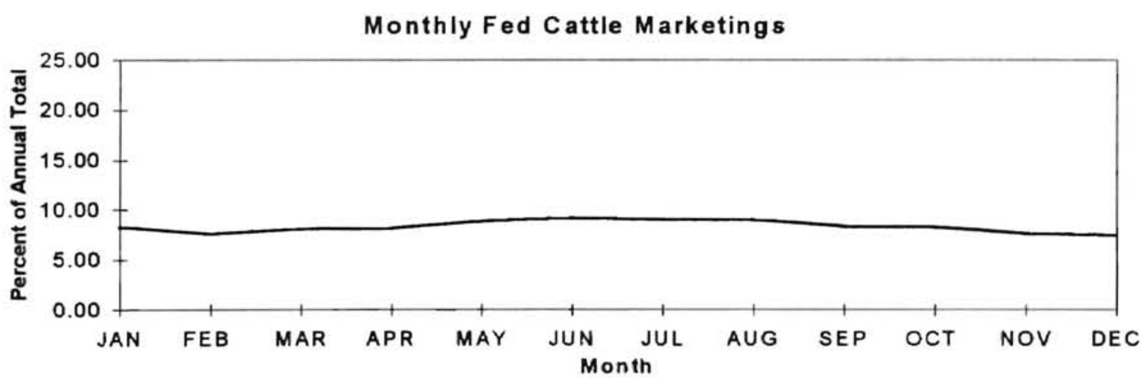
Figure 4-6 confirms the stocker industry's role in distributing the supply of calves evenly throughout the year. The supply of cattle at each beef production sector was estimated as a percentage of the annual total number of head which were marketed during each month of the year. The first panel shows the average percent of steers and heifers weighing 400-550 pounds which were sold at the Oklahoma City public auction during each month. This panel represents the supply of beef calves entering the stocker phase of production. The second panel shows the monthly cattle placements on feed as a percent of the annual total. This panel represents the supply of cattle entering the feedlot phase of production. The third panel shows the monthly fed cattle marketings as a percent of the annual total. This is the supply of fed cattle coming out of the feedlot phase and entering the packing phase. The fourth panel shows the monthly commercial slaughter of steers and heifers as a percent of the annual total. This panel represents the supply of processed meat coming out of the packing phase and entering the wholesale food market.

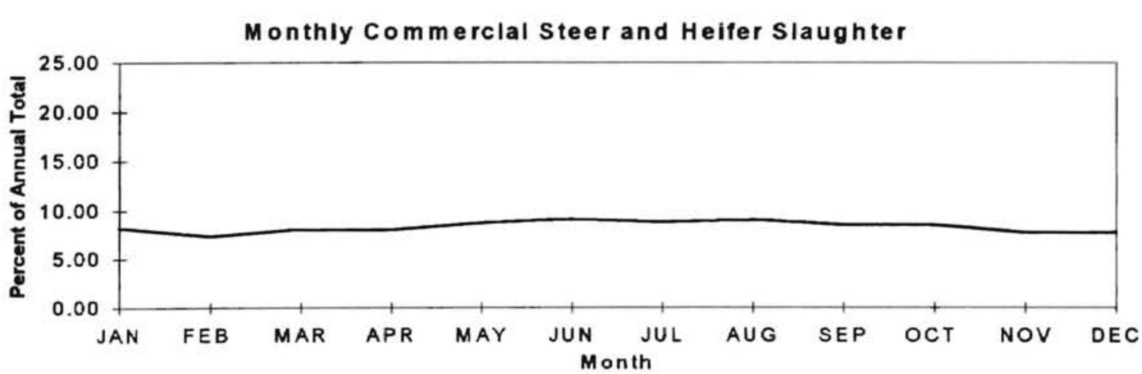
As can be seen in the first panel, the number of 400-550 pound steers and heifers sold increased sharply to roughly 22 percent of the annual total during the fall months, corresponding to the fact that most weaned calves are marketed in the fall. The number of calves sold in June decreases to almost two percent of the annual total. Overall, the number of cattle supplied by the cow-calf sector varies greatly during the span of one year. After the cow-calf sector, the variation in the number of cattle supplied to the remaining sectors is relatively stable throughout the year. In the second panel, the number of cattle placed on feed averages approximately 8 percent of the annual total except for the decrease to about 6 percent in June and an increase to about 12 percent in October. The second panel illustrates the role of the stocker industry in adding time utility to beef calves before they enter the feedlot phase of production. The stocker industry does smooth out the supply of cattle during the year.

FIGURE 4-6. The Supply of Cattle from Each Beef Production Sector









CHAPTER 5

The Fundamental Resource Allocation Role of the U.S. Stocker Industry

5.1 Overview of Chapter 5

Chapter 5 completes the discussion of the fundamental roles performed by the U.S. stocker industry in relation to the entire beef cattle production system. Chapter 4 describes and discusses the fundamental marketing role performed by the U.S. stocker industry. However, the stocker industry also performs a crucial, yet largely ignored, role in allocating fixed resources among competing enterprises. Through this resource allocation role, the U.S. stocker industry functions to maintain the balance between forage, grain, and cattle markets.

Chapter 5 describes this fundamental resource allocation role performed by the stocker industry and is illustrated with the appropriate economic theory.

5.2 Review of Scarcity and Resource Allocation

Economics is traditionally defined as the study of the allocation of scarce resources among competing uses (Nicholson). This definition illustrates two important features concerning the study of economics. The first feature is the concept of scarcity. Scarcity is defined by the relationship between the amounts of things available and the amounts of things desired (Cramer and Jensen). The resources used in the production of goods are scarce. That is, they do not exist in sufficient numbers to satisfy all wants and needs. This scarcity imposes a variety of constraints on both the choices available to a society and the opportunities open to its members. Individuals and societies must make choices on how to best use the scarce resources available to them, which leads to the second feature of the study of economics. Given that there are scarce resources used to produce a good or service, determining how these resources are allocated among competing uses is a major concern for economists (Nicholson).

There are several constraints imposed on the entire beef cattle industry in relation to the production of beef in the United States. In this sense, the beef cattle industry is no different from other industries. The industry must choose how best to allocate the scarce resources used in the production of beef. The manner in which the beef industry responds to allocate these resources, however, is extremely different compared to other industries. Both the constraints faced by the beef industry, and the manner in which it responds to these constraints, combine to make the beef cattle industry one of the most unique and complex industries in the United States. The constraints faced by the beef cattle industry are discussed in the following section. The manner in which the industry responds to these constraints, and in particular the stocker industry's role, is discussed in subsequent sections.

5.3 Constraints Faced by the Beef Cattle Industry

The first constraint faced by the beef cattle industry is a direct result of the way beef is produced in the United States. As noted in Chapter 3, the production of cattle in the United States is very unique. Because grain-fed beef has become the choice of consumers in the U.S., the beef cattle industry, and in particular the feedlot finishing sector, is highly influenced by grain markets.

The beef cattle industry is not the only livestock industry dependent on grain, however. Both the poultry and swine industries are also highly dependent on grain. Therefore, the cattle industry is competing with both poultry and pork for the use of grain. The swine and poultry industries, however, are much more dependent on grain than the cattle industry (Lusby). This implies that any decrease in the value of cattle relative to grain changes the allocation of grain out of cattle production and into pork and poultry production.

If beef cattle production in the United States was similar to that of other countries, this constraint would be irrelevant. However, because consumers have come to demand the quality associated with grain-fed beef, cattle production in the U.S. will always be dependent on grain markets.

The second constraint faced by the beef cattle industry is due to short-run rigidities in overall forage production. Agricultural land used for the production of beef cattle in the U.S. can be broadly grouped into two categories. One category is land used for grain production, and the second is land used for forage production. Theoretically, the relative price between forage and grain determines how many acres of land are allocated between these two alternatives. Holding all other factors constant, if the price of grain increases relative to the price of forage, then more acres of land should be allocated to the production of grain.

The overall amount of land in forage-based acres, however, is relatively fixed. Land which is used for forage production usually consists of rangeland, permanent pasture-based forage, annual pasture-based forage, or crop residues. Switching land from forage production to grain production is typically a multi-year decision. Of the four basic types of forage-based land choices, only the annual pasture-based forage is capable of being produced within a single year, economically. Rangeland will likely never to be switched to grain production, while the permanent pasture-based forage could be switched to grain production, but would take over one year. The crop residue type of forage is not planted for forage, but is planted for grain. By definition, this land is already being utilized for grain production. The term forage, as it is used throughout the remainder of this thesis, refers to a broad spectrum of forage-based acres which are generally always in some type of permanent or semi-permanent forage.

Most of the land that is currently used for forage-based production is of marginal quality. Producers would experience substantial costs in preparing this lower quality land for grain production. It could take several years before the producers recovered these costs. Therefore, there would need to be several years of sustained, relatively high grain prices before the aggregate number of acres used in grain production is increased. This implies that in the short-run, there is a fixed number of acres of forage available to be allocated between competing forage-based production enterprises.

In the United States, there are essentially two industries which compete for these fixed forage-based acres. Although there is some sheep and dairy cattle production on forage-based land, for the most part the cow-calf industry and the stocker industry are the two major industries between which forage is allocated. The sheep industry is a relatively small industry in terms of total numbers of sheep. The dairy cattle industry, although large in terms of participants and total numbers of dairy cattle, primarily utilizes feedgrains and higher quality forages as its primary ration components. In a sense, the dairy cattle industry has a closer resemblance to the feedlot industry than the stocker cattle industry.

Therefore, the cow-calf and the stocker industries are the two primary ones which compete for these fixed forage-based acres. Given that in the short-run there is a fixed forage base, any change in the price of calves relative to the price of stocker cattle implies a change in the allocation of forage between the cow-calf and the stocker industries. This forage allocation between the cow-calf and stocker industries is more of a long-run concept, however, due to the following constraint.

The third constraint faced by the beef cattle industry is a short-run rigidity in feed demand. The short-run feed demand for cattle production is fixed because the number of cattle available to eat the feed is fixed, especially within a one-year time frame. Once a calf crop has been produced and weaned, the calves enter the beef production and marketing system. Although there may be some minor reduction in numbers due to death loss, in general the number of beef calves that enter the system does not change during the short-run.

Any reduction or increase in beef cattle numbers occurs because of a reduction or increase in the overall beef cattle herd size. Reducing or increasing the overall herd size requires a much longer time period. For example, after a cow has been bred it normally takes one and a half years before her heifer calf is weaned. Another year is required before that heifer can be bred. Before that heifer's offspring reaches the packing phase, another two and a half years will have passed. Thus, it takes roughly five years before there is an overall increase in the number beef calves available for market. The reduction or liquidation of the beef herd can occur in a shorter time period, but the overall effect of this short-run rigidity in calf numbers causes the well-known cattle production cycle that has a duration of seven to fourteen years, with an average of about ten years. The fact still remains, however, that in the short-run once a calf crop is produced, the number of cattle entering the beef production system does not change, whether it is a reduced or increased calf crop.

Several important theoretical implications concerning the production of beef cattle in the United States can be seen from the previous discussion. The first is that the U.S. beef cattle industry utilizes both forage and grain resources in the production of beef. The second is that the markets for cattle, grain, and forage are all economically linked together through the production of beef cattle. The third implication is that, because of the constraints faced by the beef cattle industry, the production of beef cattle in the United States differs significantly from the production of any other agricultural commodity. This suggests that the manner in which the beef cattle industry responds in allocating the resources used for the production of cattle is very unique. The following section discusses the theoretical implications for the production of beef cattle in the United States.

5.4 Theoretical Implications for the Production of Beef Cattle in the U.S.

As discussed in the previous section, beef cattle production in the United States utilizes both forage and grain resources as inputs. For this discussion, the short-run is defined as the period of time after a calf crop has been weaned and those calves have entered the beef production system, up until the point where those same calves are slaughtered to be processed into beef. This implies that the production of beef utilizes both forage and grain resources. Therefore, a production function used to represent beef production can be specified in the general terms of:

(1) $q = f(\text{Grain, Forage})$

where: q = the total quantity of beef produced.

This production function states that the total quantity of beef produced is a function of grain and forage, all other factors held constant. The total quantity of beef produced (q) is defined as the total pounds of beef produced, in live weight terms. Therefore, the quantity of beef produced (q) is the product of the number of cattle slaughtered multiplied by the average live weight of the slaughter cattle, in pounds. This definition of q will be used throughout the remainder of this thesis.

Given this production function, a theoretical isoquant map can be graphed to illustrate the different combinations of forage and grain used to produce various quantities of beef. Figure 5-1 illustrates the theoretical isoquant for the production of beef where both forage and grain are variable factors of production. All other factors of production are assumed to be held constant.

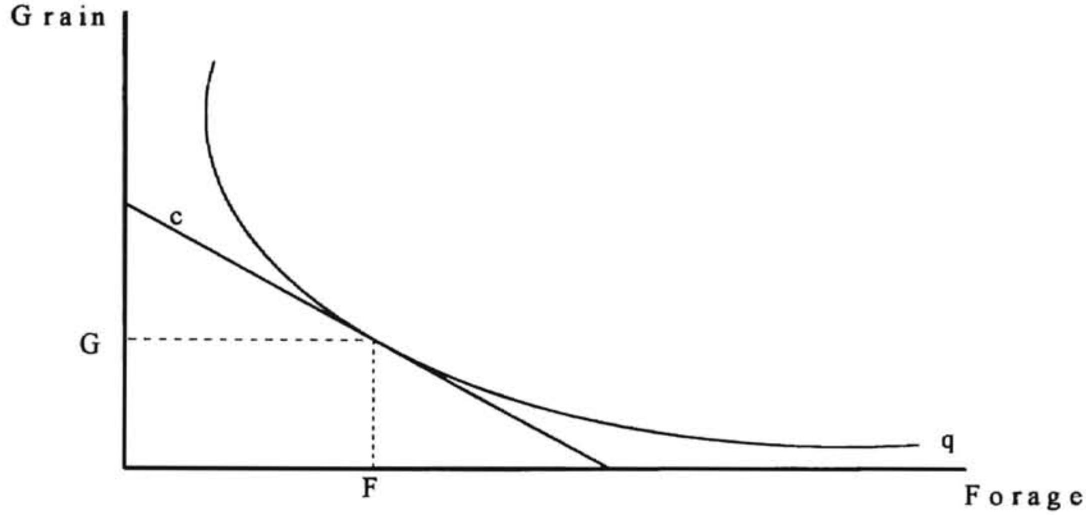


FIGURE 5-1. Theoretical Isoquant for Forage and Grain

The isoquant shown in Figure 5-1 illustrates the different combinations of forage and grain needed to achieve a given quantity of beef production, q. The line labeled, c, is the isocost line associated with the production of beef, using both grain and forage as variable factors of production. The slope of the isocost line is defined as the negative of the ratio of prices. In this case the slope of the isocost line, c, is $-(P_F/P_G)$, where P_F is the price of forage and P_G is the price of grain. In traditional production economic theory, the point where the slope of the isocost line is tangent to the isoquant determines the least-cost combination of the variable factors of production (Beattie and Taylor). Figure 5-1 shows an arbitrary tangency point between the isoquant, q, and the isocost line, c. This tangency point results in the least-cost combination between forage and grain needed to produce a given quantity of beef. The least-cost levels of forage and grain are labeled F and G, respectively.

In traditional production economic theory, when the price of one input changes relative to the other, both the least-cost combination of input levels and the quantity of output produced change, assuming perfect competition in all markets and profit-maximizing behavior by the firms operating in an industry. Typically, a change in the price of one factor causes the isocost line representing the variable factors to rotate, all else held constant. This rotation in the isocost line traditionally causes the total output produced to change.

Figure 5-2 illustrates the effects of an increase in the price of grain relative to forage on the least-cost combination of forage and grain, as well as total beef output. Before the rise in the price of grain, the least-cost combination of forage and grain is at the point where the isoquant, q_0, is tangent to the isocost line, c_0. This initial cost-minimizing levels of forage and grain inputs are labeled F_0 and G_0, respectively.

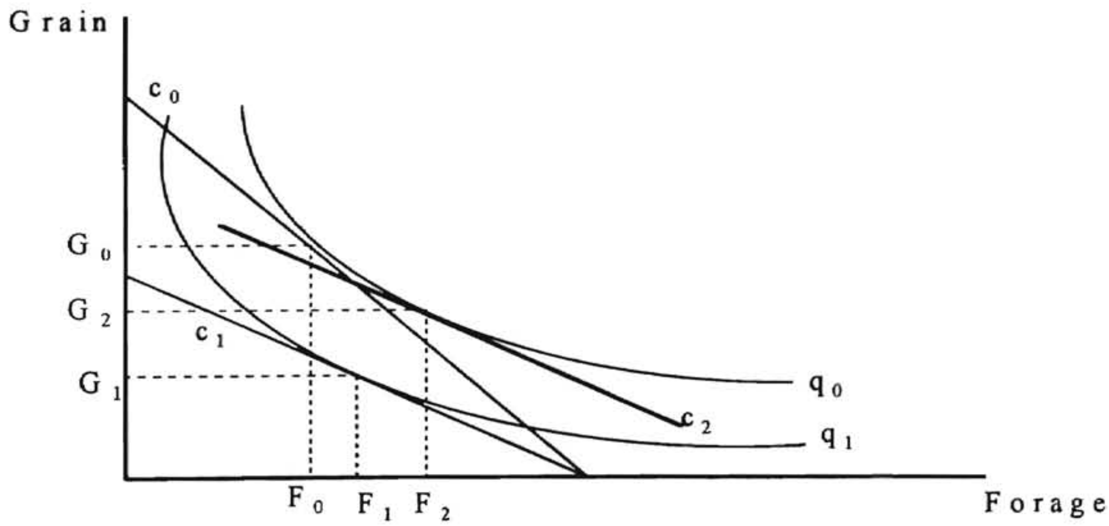


FIGURE 5-2. Effects of an Increase in the Price of Grain

When the price of grain increases relative to the price of forage, the isocost line rotates due to the change in the price ratio between forage price and grain price. The new isocost line is labeled c_1. As is illustrated in Figure 5-2, when the price of grain increases relative to the price of forage, the new least-cost combination of forage and grain input levels also change to F_1 and G_1. As would be expected, less grain is utilized and more forage. However, in order to achieve this least-cost combination, and spend the same amount of money on grain and forage inputs, the industry also must decrease the overall output of beef. This decrease in output results in the tangency point between the new isocost line, c_1, and a lower isoquant, q_1.

This is where the production of beef begins to differ from traditional production theory. Because of the constraints faced by the beef cattle industry, the total quantity of beef produced does not change in the short-run. While it is reasonable to assume that some firms may reduce their individual production of beef cattle, on an industry level, the total pounds of beef produced does not change. As defined earlier, the total quantity of beef in pounds is the number of cattle being slaughtered times the average live weight of the slaughter cattle. The output, or total pounds of beef produced in the industry, can not change because of the third constraint faced by the beef industry discussed in the previous section, the short-run rigidity in animal numbers. Once a calf crop has been weaned, those calves enter the beef production and marketing system. Also, the average live weight of slaughter cattle does not vary by much in the short-run. This is due to the fact that fed cattle must be slaughtered when the cattle reach a certain weight plus a certain amount of fat in order to maintain the quality that U.S. consumers demand in grain-fed beef. Any difference in either slaughter weights or fat will result in feeding companies receiving large price discounts for their slaughter cattle. Therefore, given that both the number of cattle being slaughtered and the average live weight of the cattle are both fixed, the total quantity of beef produced in the short-run (q) must be held constant. Both Figure 5-1 and Figure 5-2 illustrate this short-run production function. This constraint has important implications for both the production of beef in the United States, and the overall profitability of the beef cattle industry.

Given that the short-run total quantity of beef produced must be held constant, the tangency point between isoquant, q_1, and isocost, c_1, illustrated in Figure 5-2 is not a viable option for the beef cattle industry. The quantity of beef produced cannot be any less than that illustrated by isoquant q_0. Therefore, an increase in the price of grain does not result in a least-cost combination of forage and grain input levels at F_1 and G_1. Instead, because output must be considered to be held constant, the isocost line c_1, must shift outward, in a parallel manner, until it becomes tangent with the fixed level of beef production, q_0. This new isocost line is the darker line labeled c_2. The new tangency point between isoquant, q_0, and the new isocost line, c_2, results in a different least-cost combination for forage and grain input levels. The resulting least-cost combination of forage and grain input levels are labeled F_2 and G_2. This implies that when the price of grain increases relative to forage, the isocost line simply rotates along different tangency points on isoquant q_0. The output produced by the beef cattle industry does not change in the short-run. The costs of producing this fixed level of beef would rise, however.

As can be seen from Figure 5-2, by holding output constant, an increase in the price of grain relative to forage causes the amount of grain used in the production of beef to be more than it normally would be if output were allowed to decrease. Although there is a decrease in the grain input level, the decrease is relatively smaller than if output were reduced (G_0 to G_2 versus G_0 to G_1). The amount of forage used in the production of beef increases. Therefore, this implies that when the price of grain increases relative to forage, the amount of grain used in overall beef production decreases, the amount of forage used in overall beef production increases, and the total cost for producing the fixed quantity of beef also increases.

From a production economic standpoint, there are large implications for the production process associated with beef cattle production. One implication is that, given the short-run rigidities in both beef cattle numbers and slaughter cattle weights, the short-run factor demand functions for forage and grain can only be *conditional factor demand functions*. The conditional demand for a factor is a seldom used production economic concept defined as the relationship between the quantity of the factor used and factor prices, *holding output constant* (Beattie and Taylor). Because of the fixed quantity of beef produced constraint, output is held constant (Figure 5-2). Therefore in the short-run, the only demand functions relating to grain and forage inputs are conditional factor demand functions.

The second implication for the production of beef in the U.S. is that, given that the only relevant factor demand functions for grain and forage inputs are conditional factor demand functions, the beef industry is not a profit-maximizing industry in the short-run.

The beef industry can only be a constrained cost-minimizing industry because the total output of beef is held constant in the short-run. This may partially explain the reason why profits are extremely variable in the beef industry. Because the industry cannot reduce output in response to factor price increases, profits fall more drastically than in most other industries. It is simply impossible for the beef cattle industry to maximize profits in the short-run, due to output being fixed. The industry can only minimize costs, subject to the constant output constraint.

Another implication for the production of beef is that, given the need to grow beef cattle with some grain, along with the short-run rigidities in acreage allocation and total beef output, the manner in which the beef cattle industry responds to exogenous factor price changes is extremely unique. The beef cattle industry is unique because beef cattle can be produced with either more grain intensity or forage intensity, with no change in the total pounds beef produced. The difference between grain-intensive and forage-intensive cattle production is discussed in the following section.

5.5 Grain-Intensive versus Forage-Intensive Cattle Production

Because beef cattle can be produced with either more grain intensity or forage intensity, any change in the relative price of grain and forage implies a need to change *how* cattle are produced rather than changing *how many* cattle produced. This suggests that there are two different production technologies associated with the production of beef. One is a grain-intensive production technology and the other is the forage-intensive technology.

As was discussed in the previous section, both the short-run number of feeder cattle entering the beef cattle production system, and the slaughter weight of fed cattle are fixed. When the price of grain increases relative to forage, the level of grain used as an input for beef production decreases, the level of forage used increases, and the total cost of producing the fixed quantity of beef increases as well. Assuming all firms operating in the beef cattle system are attempting to minimize their cost of producing beef cattle, there is a certain critical relative price between grain and forage which signals the participants operating in the beef cattle industry to switch from the grain-intensive production technology to the forage-intensive production technology.

Figure 5-3 illustrates how the cattle industry switches production technologies, while holding the total quantity of beef produced at a fixed level.

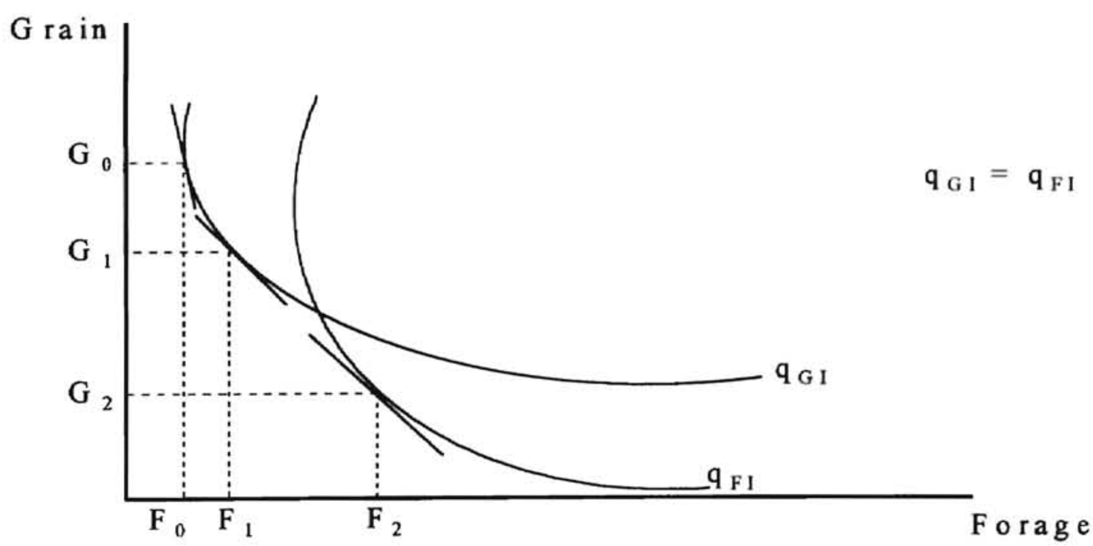


FIGURE 5-3. Theoretical Grain-Intensive and Forage-Intensive Isoquants

Figure 5-3 shows the theoretical grain-intensive isoquant and the forage-intensive isoquant associated with the fixed level beef production. The grain-intensive isoquant is labeled q_{GI} and the forage-intensive isoquant is labeled q_{FI}. Because the number of cattle in the beef production system is fixed in the short-run, the total quantity of beef produced associated with either isoquant is the same. Thus, q_{GI} is equal to q_{FI}. Assume initially, that the price of grain is such that the least-cost combination of forage and grain input levels are at F_0 and G_0, respectively. Holding output constant, an increase in the price of grain relative to forage will cause the isocost line to rotate along the grain-intensive isoquant, q_{GI}, resulting in a new least-cost combination of forage and grain input levels at F_1 and G_1. The total cost of producing the fixed quantity of beef, however, has increased. Assuming the industry is attempting to minimize the costs of producing beef cattle, any additional increase in the price of grain relative to forage signals the need for the industry to switch to the forage-intensive production technology, illustrated by the isoquant labeled q_{FI}.

Switching to the forage-intensive isoquant results in a different least-cost combination of forage and grain input levels. These new input levels are labeled as G_2 and F_2. The industry is prompted to switch to the forage-intensive technology because the new least-cost combination (G_2 and F_2) results in the same total cost of producing beef as the least-cost combination of G_1 and F_1, even though the price of grain has increased relative to forage. Thus, the slope of the isocost line associated with input levels G_1 and F_1 is equal to the slope of the isocost line associated with input levels G_2 and F_2. If the beef cattle industry could not switch production technologies in the short-run, the total cost of producing the fixed quantity of beef would increase tremendously due to exogenous increases in either the price of grain or forage.

This implies that there is some isocost line that is tangent to both the forage-intensive isoquant and the grain-intensive isoquant. Figure 5-4 illustrates the isocost line that is tangent to both production technology isoquants.

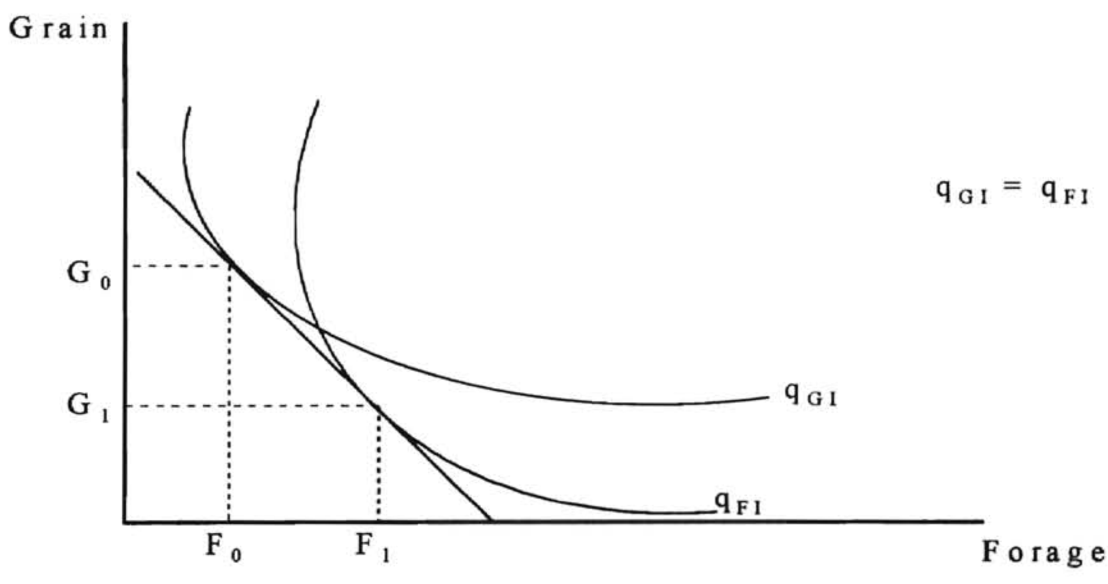


FIGURE 5-4. Isocost Line Tangent to Both Production Technologies

The least-cost combinations of input levels F_0 and G_0 represent the quantities of both forage and grain used in the production of beef when the industry is on the grain-intensive isoquant, q_{GI}. Input levels F_1 and G_1 are the least-cost combination of input quantities when the industry is on the forage-intensive isoquant, q_{FI}. Given that the total quantity of beef produced is fixed (i.e., $q_{GI} = q_{FI}$), Figure 5-4 illustrates that there is one isocost line that is tangent to both production technologies. When the forage/grain price ratio reaches some critical level, the market is signaling the beef cattle industry to switch from the grain-intensive production technology to the forage-intensive technology, and vice versa. As illustrated in Figure 5-4, any grain price less than, or forage price greater than, that implied by the isocost line would signal the beef industry to use the grain-intensive production technology. Likewise, any grain price greater than, or forage price less than, that implied by the isocost line would signal the beef cattle industry to use the forage-intensive technology. In other words, the beef cattle industry will be on the grain-intensive isoquant for any grain or forage price that results in an isocost line steeper than the one that is tangent to both production technology isoquants. Any grain or forage price that results in an isocost line that is flatter than the one tangent to both isoquants implies that the beef cattle industry will be on the forage-intensive isoquant.

The beef cattle industry's ability to switch production technologies allows the industry to produce the same total quantity of beef, using different levels of forage and grain inputs, at the lowest possible total cost, in the short-run. The ability to switch production technologies in the short-run is a direct result of the constraints faced by the beef cattle industry discussed in Section 5.3, and is unique to the beef cattle industry. This ability to switch technologies occurs in the stocker phase of production. The stocker industry's short-run resource allocation role is discussed in the following section.

5.6 The Stocker Industry's Short-run Resource Allocation Role

Given the short-run rigidities in acreage allocation and total beef output, switching from the grain-intensive production technology to the forage-intensive production technology occurs because of the existence of the stocker phase of production. Thus, the stocker industry is the primary sector which functions to maintain the balance between cattle, grain, and forage markets. The stocker industry's role in allowing the beef cattle industry to switch production technologies is the fundamental short-run resource allocation role performed by the stocker industry in relation to the entire beef production system.

As discussed in the previous section, the production of beef can be achieved with either more grain intensity or forage intensity. Thus, any change in the relative price of grain and forage implies a need to switch to the least-cost production technology. Because beef cattle are also competing with other livestock enterprises for the use of grain, any change in the value of cattle relative to grain implies an alternative allocation of the grain resource. When the price of grain increases relative to the price of cattle, this implies the need to produce cattle with relatively more forage.

The stocker industry accomplishes this by allowing the fixed number of beef cattle to be raised on forage to heavier weights before they are placed on high-energy rations in the feedyard. Once cattle have been placed in the feedyard and are being fed high-energy rations, there is a certain weight in which the fed cattle must be marketed to the packers before the feedyard receives discounts for slaughter cattle which are too heavy and fat. This fact was stated earlier in that the average live weight of slaughter cattle does not vary by much in the short-run due to quality issues (Section 5.4). When the price of grain increases, due to either a shortage in the supply of grain or an increase in the demand for grain, this indicates that cattle should be grazed relatively longer on forage to higher feedyard placement weights before being marketed to the feedlot phase of production.

By assuming that the costs of gain are similar between forage-based operations and feedlot operations, higher grain prices would increase the cost of gain for cattle being fed grain relative to stocker cattle grazing forage, increasing the value of gain for stocker cattle (Lusby). Feedyards which are minimizing their cost of gain are willing to purchase more of the heavier weight cattle because these heavier cattle can be fed the higher priced grain rations for a shorter period of time. For example, the feedyards can feed a 900 pound steer to 1150 pounds cheaper than they can feed a 600 pound steer to the same 1150 pounds. This implies that the need to switch between forage-intensive production and grain-intensive production occurs primarily in the stocker industry.

As the price of grain increases relative to forage, the entire beef cattle industry is prompted to switch to a more forage-intensive technology. As noted previously, this is accomplished primarily in the stocker industry by increasing feedyard placement weights of the feeder cattle. While Figure 5-4 illustrated the extreme points of switching production technologies, Figure 5-5 illustrates the stocker industry's role in allowing the beef industry to switch production technologies by increasing the placement weights of cattle entering the feedyard phase of production.

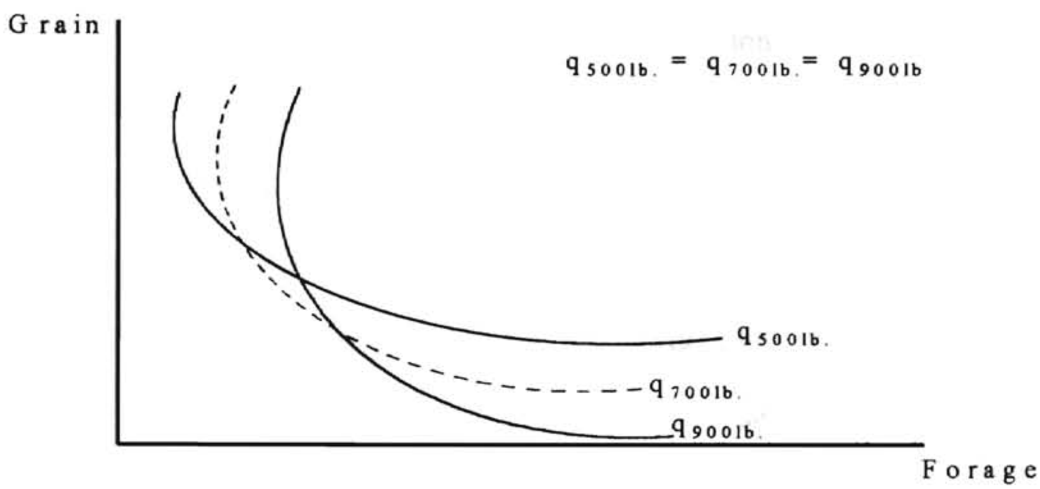


FIGURE 5-5. Switching Technologies by Increasing Feedyard Placement Weights

Figure 5-5 illustrates three different grain and forage intensive isoquants in terms of the different placements weights of beef cattle into the feedyard. The isoquant labeled $q_{500lb.}$ is essentially the same isoquant that was labeled as the grain-intensive isoquant (q_{GI}) in Figure 5-4. Similarly, the isoquant labeled $q_{900lb.}$ in Figure 5-5 is the same as the forage-intensive isoquant, q_{FI}, in Figure 5-4. The isoquant labeled $q_{700lb.}$ illustrates the premise that there is a production technology between the extreme grain-intensive and forage-intensive isoquants. Isoquants $q_{500lb.}$, $q_{700lb.}$, and $q_{900lb.}$ all illustrate the different levels of forage and grain inputs used to produce a given quantity of beef, at the same total cost of production, when the beef industry is utilizing different production technologies. Therefore all three isoquants are equal to each other in terms of total output. Figure 5-5 illustrates only three different levels of forage and grain intensive production, but conceivably, there is a whole family of isoquants used to differentiate between different levels of grain-intensive and forage-intensive production technologies, depending on market signals.

These different isoquants associated with different feedyard placement weights illustrate the reason the stocker industry is the primary sector which allows the entire beef cattle industry to switch between grain-intensive and forage-intensive production technologies. Because the number of beef cattle in the system is fixed in the short-run, along with the small variation in the average live weight of cattle that are slaughtered, the primary industries which are affected by this switch in production technology are the stocker industry and the feeding industry. The feeding industry is affected because cattle coming into the feedyard will be heavier, but these cattle will leave the feedyard weighing relatively the same amount as in any given year. The feeding industry is constrained at the end of their production process, implying that the stocker industry is primarily responsible for allowing the beef industry to switch between the grain-intensive production technology and the forage-intensive technology. Because the feeding industry is operating at a less intensive level, the stocker industry must operate at a more intensive level. Thus, although the entire beef production system is prompted to switch between production technologies, the existence of a viable stocker industry is the primary reason for this switch being able to occur.

Because switching between production technologies is achieved by changing the feedyard placement weights of feeder cattle, the relative prices between the different weight classes of feeder cattle are the market signals concerning what production technology the beef cattle industry should be using. In the United States, the price of lighter-weight cattle is normally higher than that of heavier-weight cattle. This is known in the beef industry as the "price rollback." Thus, the market signal for switching production technologies becomes a question of how much higher or lower the price of light-weight cattle is relative to heavy-weight cattle. This implies that the price spreads between the different weight classes of feeder cattle are the market signals suggesting a need to switch from the forage-intensive production technology to the grain-intensive forage technology, and vice-versa. When the price spreads between different feeder cattle weight classes narrow, the market is signaling the beef cattle industry to produce cattle with more forage and less grain. In a sense, the market is signaling the need to increase overall stocker cattle production relative to feedlot cattle production. As the price spreads widen, the market is signaling to decrease overall stocker cattle production relative to feedlot production. It is important to note that stocker cattle production refers to grazing cattle on forage-based resources (see Section 3.2). Any increase or decrease in stocker cattle production does not necessarily imply an increase or decrease in the total number of cattle grazing on forage. Instead, an increase or decrease in stocker cattle production refers to an increase or decrease in the total pounds of gain the cattle achieve while grazing forage.

For example, when the price of 700-800 pound feeder cattle is relatively high compared to 500-600 pound cattle (a narrow price spread), the market is giving the signal that cattle should be produced with relatively more forage. The value of gain for cattle grazed on forage to heavier weights increases. Although light-weight cattle prices are normally higher than heavier-weight cattle prices, when the price of 700-800 pound cattle decreases relative to the price of 500-600 pound cattle (a wide price spread), the market is signaling that cattle need less forage and need to move through the beef production system quickly. The value of gain for cattle grazed on forage to heavier weights decreases. Thus, a narrowing price spread between the different feeder cattle weight classes signals the need for the beef cattle industry to switch to the forage-intensive technology, while a widening price spread signals the need to switch to the grain-intensive production technology. This occurs because of the increase or decrease in the value of gain for cattle being fed forage relative to the value of gain for cattle being fed grain.

This implies that the stocker industry is the primary sector in the beef production system which has the flexibility to adjust its production practices in response these short-run market signals. Therefore, the stocker industry is also the primary sector within the beef cattle industry which can maintain the balance between cattle, grain, and forage markets, because these markets are all economically linked together through the production of beef cattle.

5.7 The Stocker Industry's Long-run Resource Allocation Role

The previous discussion was concerned primarily with the stocker industry's short-run resource allocation role. However, the stocker industry also performs an important, yet more subtle, long-run resource allocation role. This longer-run resource allocation role is analogous to the previous discussion, but is concerned with changes in the price of forage relative to grain. This change in forage price relative to grain is a direct result of the cattle cycle which results in larger cow-calf numbers or smaller cow-calf numbers over an average of approximately ten years.

Given that the two primary enterprises that compete for fixed permanent and semi-permanent forage resources are cow-calf and stocker enterprises, any change in total cow-calf production implies changes in stocker cattle production in the long-run. When total cow numbers are decreasing, the demand for forage also decreases. This decrease in forage demand causes the price of forage to decrease relative to grain prices. A decrease in the price of forage relative to grain implies a need for the beef industry to switch production technologies from the grain-intensive to the forage-intensive technology. This occurs even though the price of grain is held constant, and over a longer time period than it does in the short-run. Figure 5-6 illustrates this long-run switch in technologies.

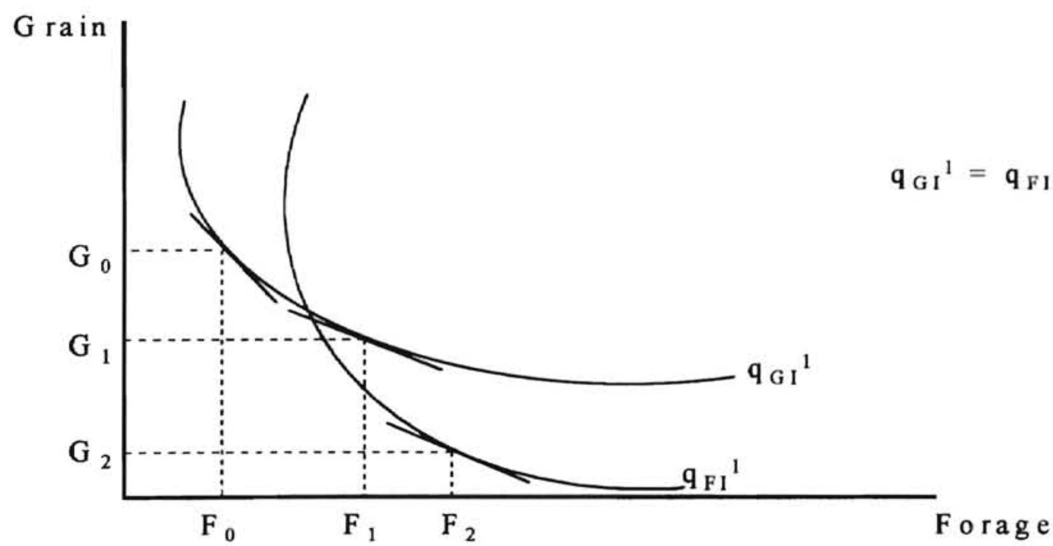


FIGURE 5-6. Long-run Switch in Production Technologies

Figure 5-6 is similar to Figure 5-3. Figure 5-6, however, illustrates the beef cattle industry's ability to switch technologies over the long-run as total calf numbers are decreasing. In Figure 5-6, the grain-intensive production isoquant is labeled q_{GI}^1 and the forage-intensive production isoquant is labeled q_{FI}^1. Both isoquants illustrated in Figure 5-6 represent a fixed level of beef production that is lower than that shown in Figure 5-3. Therefore, q_{GI}^1 is equal to q_{FI}^1 in terms of total beef output, which is a lower output level than the isoquants illustrated in Figure 5-3 (q_{GI} and q_{FI}). It is important to note that even though overall calf numbers are decreased, once that decreased calf crop is weaned and marketed into the beef production system, those calves will be processed into a fixed quantity of beef. This total quantity of beef in pounds does not vary much due to the fixed numbers of beef cattle constraint and the small variation in slaughter weights constraint (see Section 5.4).

Assuming the beef industry is initially operating on the grain-intensive isoquant, q_{GI}^1, the least-cost combination of forage and grain inputs are shown as F_0 and G_0, respectively. As total beef cow and calf numbers decrease, the demand for forage decreases, resulting in a decrease in the price of forage relative to grain. Because output is held constant, the isocost line rotates along the grain-intensive isoquant yielding a new least-cost combination of forage and grain inputs labeled as F_1 and G_1. Any further decrease in total calf numbers will result in a further decrease in forage price relative to grain. In order for the beef industry to produced the fixed quantity of beef, at the lowest total production cost, the industry switches to the forage-intensive production technology.

This results in a new least-cost combination of forage and grain inputs on the forage-intensive production isoquant, q_{FI}^{1}, labeled as F_2 and G_2, respectively.

Therefore, as overall calf numbers decrease, the beef industry is prompted to switch from a grain-intensive production technology to a forage-intensive technology, even though the price of grain is held constant. As in the short-run example, switching technologies occurs primarily in the stocker phase of production. In the long-run example, the decrease in overall cow-calf production implies an increase in stocker cattle production, because the cow-calf and the stocker industries are the two major industries which compete for forage-based acres. Thus, the stocker industry also helps to maintain the long-run balance between cattle, grain, and forage markets.

Although this process takes a considerably longer time to adjust between the grain-intensive and forage-intensive technologies, any decrease in overall calf numbers implies an increase in overall stocker cattle production. Like the short-run, the beef cattle industry is prompted to switch production technologies by the price spreads between the different feeder cattle weight classes. Therefore, holding grain prices constant, if the price spreads between different feeder cattle class weights narrow, the market is signaling the industry to increase stocker cattle production relative to cow-calf production. If the price spreads widen, this indicates a need to decrease stocker cattle production relative to cow-calf production. Again, as in the short-run, the stocker industry is the primary sector in the beef cattle industry which has the flexibility to adjust to these longer-run market signals. The stocker industry maintains the long-run balance between cattle, grain, and forage markets by increasing or decreasing stocker cattle production relative to cow-calf production. This occurs because there is no established forage market. Therefore, as the price of forage changes as a result of a change in total cow-calf numbers, the balance between cattle, grain, and forage markets is maintained by a change in total stocker cattle production which is opposite the change in overall cow-calf production.

In summary, the stocker industry is the primary sector which allows the beef cattle industry to adjust production technologies in both the short-run and long-run. In the short-run, any change in production technologies occurs by increasing or decreasing stocker industry production relative to feedlot industry production. In the long-run, any change in production technologies occurs by increasing or decreasing stocker industry production relative to cow-calf industry production.

Therefore, the stocker industry is not only a unique industry, it is also a crucial sector in the entire beef production system through which the fixed factors of beef production are allocated between competing enterprises. In doing so, the stocker industry functions to maintain both the short-run and long-run balance between cattle, grain, and forage markets.

CHAPTER 6

Summary and Implications

6.1 Summary

The U.S. beef cattle industry is an extremely complex sector in which many production and marketing functions must be completed before fresh beef is available to be purchased by consumers at the retail level. The beef industry's sole purpose is to produce beef calves and transform them into a constant, steady supply of meat available for consumption. The beef industry does a remarkable job of accomplishing this task considering several obstacles which must be overcome. Two of the most important obstacles are: (1) the biological production lags of cattle, grain, and forage; and (2) informational lags between consumers and producers. These two obstacles, together, cause the production of cattle to be very cyclical over time.

The U.S. stocker industry performs two important roles within the beef production system which help contribute to the beef industry's ability to overcome these obstacles. The first important role performed by the stocker industry is to add time, place, and form utility to beef calves before they enter the feedlot phase of production. In doing so, the stocker industry adds value to beef cattle, implying there is a marketing margin associated with the stocker industry.

The stocker industry adds time utility to beef calves by helping to smooth out the flow of cattle through the year. Although calving occurs throughout the year in the

United States, almost seventy percent of these calves are born in the spring and weaned in the fall. Traditionally, these weaned calves are marketed immediately after weaning. This implies that a large number of calves will enter the beef production system during the fall and winter months. If there were no stocker industry, the feedlot feeding phase would be required to operate large fluctuations in the number of cattle they are feeding. The stocker industry helps to provide the rest of the sectors in the beef cattle production process an even supply of cattle over time. In a sense, the stocker industry "stores" the cattle and distributes them through the system within the year.

The stocker industry adds place utility to beef calves by providing a destination for the weaned calves which is relatively closer to the feedlot feeding industry. Winter wheat stocker operations are especially important in adding place utility to beef calves. During the winter, when other forages are declining in both quantity and quality, winter wheat and other small grain pastures are increasing in quality. The stocker industry adds place utility to beef calves before the feedlot phase of production by purchasing the calves from the forage deficit regions and shipping them to the forage surplus regions. In doing so, the stocker industry adds value to the beef calves before they enter the feedlot phase of production.

Finally, the stocker industry adds form utility to beef calves by improving the quality of both individual calves and groups of calves. The stocker industry increases the value of beef calves by improving their age, size, quality, and health. The stocker industry improves the quality of groups of cattle by purchasing various cattle from all regions of the U.S. and assembling them into groups of similar age, sex, size, and breed. By increasing the health, size, age and quality of individual calves, and assembling them into uniform groups, the stocker industry adds value to the cattle before they are placed in the feedlots.

The second important role performed by the U.S. stocker industry is a fundamental short-run and long-run resource allocation role. This is the most important, and often ignored, role performed the U.S. stocker cattle industry. Because of the short-run rigidities in both acreage allocation and total beef output, the U.S. stocker industry enables the beef cattle industry to adjust the production of beef from a grain-intensive production technology to a forage-intensive production technology. The ability to switch production technologies in both the short-run and long-run is unique to the production of beef cattle and is a direct result of actions that occur primarily in the stocker phase of production. By allowing the beef cattle industry to switch from forage-intensive production to grain-intensive production, and vice-versa, the stocker industry helps to maintain the short-run and long-run balance between cattle, grain, and forage markets.

The stocker industry is the primary sector in the beef cattle industry which has the flexibility to adjust its production practices from grain-intensive to forage-intensive production. The cow-calf sector is the primary supply sector. There is a fairly rigid time frame between when the cows are bred and the calves are weaned. Although calving is seasonal, once the calves are weaned there is little change in the number of feeder cattle that enter the beef production process. The feedlot phase of production also has a fairly rigid time frame in which to market the cattle to the packing industry. Once the fed cattle reach a certain weight plus a certain amount of fat, the cattle must be marketed relatively quickly. Cattle which become too fat are severely discounted by the packing industry. Therefore, the sector which functions to adjust the production of beef cattle is the stocker industry.

The stocker industry enables the beef cattle industry to switch from the grain-intensive to the forage-intensive production technology by allowing the cattle to be grown on forage to heavier weights before they enter the feedlot phase of production. Therefore, the relative price spreads between the different feeder cattle class weights are the market signals concerning which production technology the beef cattle industry needs to be utilizing.

Because the stocker industry is the primary sector which has the ability to adjust from grain-intensive to forage-intensive production, and because the stocker industry adds value to beef calves before they enter the feedlot phase of production, the stocker industry is an important and necessary sector in the entire beef cattle production system.

6.2 Implications

There are many implications of this research. The first is that there needs to be a renewed research interest in both individual stocker operations, as well as the stocker industry in general. Several theoretical concepts were presented in this thesis in relation to the roles performed by the stocker industry in relation to the beef cattle industry. Several hypotheses were also made concerning the production of beef cattle in the United States.

For instance, it was hypothesized that in the short-run the only relevant factor demands relating to forage and grain inputs in the production of beef, were the conditional factor demands. If this hypothesis holds true, what implications does this have for the profitability of the firms operating in the beef cattle industry? It was also hypothesized that the beef cattle industry could not be a profit-maximizing industry in the short-run due to output being a constant. The beef cattle industry can only be constrained cost-minimizers in the short-run. If the industry as a whole cannot maximize profits, what does this imply about the individual firms operating in the beef cattle industry? Are they too unable to maximize profits in the short-run, and if so, what types of firm-level research are appropriate for analyzing the beef cattle industry's firms?

In addition to the production economics implications, there were several theoretical concepts included references concerning forage markets. There has been very little research conducted on forage markets in general. Understandably, forage markets are difficult to research because of the lack of relevant data. This leads to the second implication of this research.

The second implication of this research concerns problems with data. Most of the data that are currently collected by the government and other agencies do not record information that is relevant to the stocker industry. Only recently has the government begun to include feedyard placement weights with their routinely collected data. This data is crucial for both academic researchers and individual stocker operators, as well. There definitely needs to be some type of data collected concerning forage markets. Currently, the only forage market price that is collected is the price of hay. While this may be vital to some producers, it is unlikely that the price of hay fully captures the different forage types across the United States.

Third, there needs to be a research agenda which studies the effects of ending the farm programs on the beef cattle industry, and in particular, the stocker phase of production. It would seen that academic researchers have been caught unaware that the farm programs might ever be canceled. University researchers appear to be in danger of losing their relevance in the coming decades, unless they are willing to accept and adapt to the fact that farm programs are going to be decreased, if not cut entirely.

This suggests a wide variety of new research that is needed. For instance, now that producers no longer have to plant wheat and/or corn to protect their base acres, what alternative crops are available? If certain crops will grow as well as wheat, then what are the impacts of switching to this crop for cattle producers? Will the new variety of crops be able to support winter grazing as well as wheat has, and if not, what will be the effects of switching to this alternative crop on both the fundamental marketing and resource allocation roles performed by the U.S. stocker cattle industry?

There is already a movement to improve the relevance of agricultural economics research (Brorsen and Irwin). Focusing on an industry as crucial and important as the stocker industry, even in a very basic way, would be a move in the right direction.

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