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THE PACKER-FEEDER GAME: A COMMODITY MARKET SIMULATOR

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ABSTRACT

The Packer-Feeder Game simulates the market competition between eight cattle producing firms (feedlots) and four cattle purchasing/meat processing firms (packers). The four packing plants must collectively negotiate the purchase of approximately forty pens of cattle from the eight feedlots during each iteration of a series of six to eight minute playing periods. Forecasting future market conditions and timing the sale of inventories of cattle in the feedlots to match packing plant capacities and changing market conditions are the key challenges of the game. Direct cash sales between packers and feedlots as well as contracting for future delivery and use of endogenous commodity futures contracts are permitted.

INTRODUCTION

Marketing and procurement of agricultural commodities (beef in specific) presents a unique challenge. The root of that challenge lies in the fact agricultural firms have limited control over the price they offer or receive for their commodities. Instead prices are largely dictated by supply and demand seeking a market equilibrium. Thus what is referred to as the "price discovery" process becomes a critical element in the functioning of commodity markets. It is this difference in the pricing process that primarily distinguishes "product" markets from "commodity" markets. In product markets firms can exert significant control over the pricing of their product, largely because they can differentiate their product from their competitors through design, labeling, advertising, etc. Thus a distinguishing difference between products and commodities is that commodities are homogenous and products are not.

Traditional teaching of commodity marketing focuses upon teaching the economics of commodity market supply and demand theory. However such teaching lacks the ability to impart to the student the dynamics and activity of an actual market and the price discovery process. Thus, teaching of commodity marketing, perhaps even more than the teaching of product marketing, can be facilitated by the use of an experiential market simulator. The Packer-Feeder Game is designed to allow students to participate in a simulated price discovery process and to implement marketing strategies in such an environment. The Packer-Feeder Game stresses interpersonal communication and negotiation skills, marketing strategy development and implementation, forecasting, and the use of basic economic and financial principles.

The Packer-Feeder Game has been designed to simulate the economic structure of the fed cattle market as realistically as possible. Industry surveys of cost structures (Sersland, 1985; and Duewer and Nelson, 1991) and an econometric study of dynamic demand parameters (Meyer, 1992) have been used in developing game parameters. The motivation for making the simulator realistic evolves partially from the nature of job market opportunities for commodity marketing students

and partially from the nature of commodity marketing research. To elaborate briefly, commodity markets can be divided into two major types, markets for grains and markets for livestock. The two markets have distinctly different production processes and marketing dynamics. Within livestock markets three major sub-markets exist: beef, pork and poultry. Likewise within the grain market three major sub-markets exist: wheat (food grain), corn (feed grain) and soybeans (protein feed/cooking oil). Each of these markets have some what different characteristics. Agribusiness firms involved in the production end/or processing of one of these six commodities constitute the majority of the job market prospects for commodity marketing students. While these firms desire students with a strong background in marketing and economics, they also often seek individuals with commodity specific experience. Hence agricultural economics and agribusiness schools attempt to provide students with some commodity specific training.

The following sections of this paper will present an overview of the Packer-Feeder Game followed by a more detailed discussion of the environment in which feedlot and packing plant teams function. Special attention will be given to describing the type of bargaining, price discovery, and market dynamics generated by the interaction of these two environments. Finally, a summary of participant reactions and evaluations of the game will be given.

ADMINISTRATIVE OVERVIEW

The Packer-Feeder Game simulates the market dynamics and competition between feedlots, which produce (feed) and sell cattle, and beef packing plants that buy and process cattle into meat (i.e., "boxed beef" which is sold in the wholesale meat market). Competition occurs between eight feedlots and four packing plants. Each firm is managed by a team of three individuals. Feedlots are given a set of cards, with each card representing a pen of 100 head of cattle. Each card indicates the purchase date and weight of the animals. Animals are assumed to grow twenty-five pounds per week (i.e., each game iteration/trading period). Feedlots are given additional pens of 700-pound animals each week. After sixteen weeks of growth these animals are available for sale. The game focuses upon the five week period when animals are within a feasible "marketing window", i.e., from 1,100 to 1,200 pounds. Profits of both feedlots and packing plants depend upon the number and weight of the animal's traded each period, firm production cost schedules, price at which cattle are traded, and exogenous market conditions. The game scenario varies the supply of cattle being processed through the system by controlling the rate at which pens of 700 pound cattle are placed into the system.

Each packing plant has a unique capacity level and a classical u-shaped average cost curve. The price that a packing plant will receive for its processed meat depends upon exogenous market conditions for processed meat, the volume of meat processed by all four packing plants, and the weight of animals purchased. The packing plant's optimal purchase weight (i.e., weight that produces the highest quality of meat) is 1,150 pounds. Packers and feedlots negotiate sales volumes and prices between them.

¹ Senior authorship is not assigned.

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Transacting between packages and feedlots are recorded on the end representing each pen of cattle. Each transaction is processed through an electronic scanner as the transactions occur. Data generated from the scanner are immediately processed by the computer and used to up-date an electronic light board that reports the market's volume and high/low price range for the current trading period. This aspect of the game reflects the activities of USDA Market News services that report beef market prices and volumes through radio and newspaper reports. The transactions data is also fed into a computer modal of the beef market which generates realistic market price responses to changes in market volumes of processed meat (boxed beef) and purchases of feeder cattle to restock the feedlot as cattle are sold from it. The price for fed (slaughter) cattle is however explicitly determined by negotiations and transactions between feedlots and packers. The computer software generates standard financial statements for each feedlot and packing plant (balance sheets, cash flow statements and inventory reports) at the end of each trading period. Each trading period lasts approximately six-to-eight minutes and simulates one week of real time. Following each trading period a two-to-four minute break in trading activity occurs. During this break financial statements covering the period of trade just finished are issued and teams are allowed time to confer and develop strategies for the next trading period. These breaks are referred to as "weekends".

Play of the game generally begins with "cash-only" trading. The game is played over the course of a fifteen-week semester in a weekly one hour and thirty minute laboratory class period. Play starts each week at the point it ceased the previous week² After players become proficient in playing the cash-only game, forward contracting sales/purchases of cattle is permitted. Following this a commodity futures contract market is added to the game. The futures market is operated endogenous to the game, i.e., prices are determined by the players trading actions in which they either hedge their positions or speculate. The potential also exists to add four players/teams to the game who serve only as speculators. This role can also be played by the game manager. Three futures contracts are traded at all times with delivery dates eight trading turns (weeks) apart. All contracts are cash settled at the average price for 1,150-pound cash cattle during the delivery week. As in the cash market portion of the game, futures transactions are recorded on a scanner form that is electronically processed and immediately reported on a second light board which functions independently from the light board reporting the cash market volume and high/low price range.

THE PACKER-FEEDER MARKET ENVIRONMENT

The market environment faced by the players can be described in more detail by summarizing the factors influencing the cost structures for feedlots and packing plants. Following these descriptions, the negotiation/market interaction resulting from these cost structures will be highlighted.

The Feedlot Environment

The cost structure faced by feedlots is summarized by the break-even analysis table presented below for a pen of 1,150 pound cattle.

TABLE 1.

FEEDLOT BREAK-EVEN ANALYSIS FOR A PEN OF 1,150 POUND CATTLE

Purchase Cost (700 lbs. x \$97.74/cwt.)	=	\$684.18
Feeding Cost (1150 lb. - 700 lb.) x \$0.477/lb.)	=	\$214.65
Total Cost	=	\$898.83
Break-Even Price (Total Cost/i 1.5)	=	\$ 78.1 6

The above calculations are relatively simple, however organizing the information with which to make the calculation is more challenging. Players are informed of the purchase price of 700-pound cattle when the cattle are purchased, i.e., this price is posted on the black board at the end of each trading period. They must record this information for use sixteen playing rounds later when cattle enter the show-list. Feedlot players do not actually purchase cattle, rather they are given a predetermined number of pans of cattle by the game manager at a specified purchase price. The purchase price is calculated by a formula that correlates price inversely with the number of pens of 700 pound cattle given to the players, i.e., when large numbers of pens are placed in the feedlots prices are low, and when small numbers of pens are placed, prices are high. In essence the correlation generated simulates a demand function for 700-pound cattle.

Information posted on the black board each trading period also informs the players of feeding cost per pound of gain for the current week. Since this cost changes during the feeding period, they must average the cost of feeding over the 16-20 week feeding period to find the correct feeding cost per pound of gain to USA in the break-even calculation. An added complication is that feeding costs are increased by B percent and 18 percent for 1,175 pound cattle and 1,200 pound cattle respectively. This is done to represent the reality that past a certain weight cattle become increasing less efficient at converting feed into weight/growth. This is the case because more and more of the caloric/energy content of the feed is required to maintain body weight, leaving less available to support growth.

The Packing Plant Environment

The break-even price calculation process characterizing the business environment of packing plants is in many respects more complex for packing plants than for feedlots. However, it is simpler in one dimension. Packers are not required to keep long historical records of costs. The time dynamics of packer activities are that cattle that are purchased one week are processed and sold as boxed beef the following week. Despite this simplicity, the calculation of a packer break-even bid price requires nearly a page of calculations of the type reported in Table 1. Because of this complexity the actual details of the break-even bid price calculations will not be given here. (Sa. Koontz, at al., 1992) Instead a brief overview will be presented.

The main problem facing a packer in determining a break-even bid price is that the price received for the boxed beef produced from a pen of cattle is not known at the time cattle are purchased. The boxed beef price is determining via a dynamic boxed beef demand

² On numerous occasions the Packer-Feeder Game has been used with nonstudent groups. In such cases it is usually played continuously, except perhaps for lunch or coffee breaks. To be an effective learning tool a minimum of four hours of play is required. A two-day workshop setting has been found to be quite productive.

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formula which depends upon current sales of boxed beef by all four packers as well as sales of boxed beef in the recent past, i.e., about 30 percent of the price change is dependent upon current sales and 70 percent upon sales over the past ten trading periods (Meyer, 1992). The structure of the dynamic boxed beef demand function is such that a ten percent change in quantity will cause an immediate change in price of about 2 percent, followed by an additional 4.5 percent change distributed over the next ten weeks in a geometrically declining pattern.

Packer break-even bid prices change with animal weight for several reasons. First, the quality of meat produced changes with an animal's weight. Specifically the fat content of beef starts to increase significantly at a weight of about 1,100 pounds. Low-fat beef lacks flavor and juiciness, and high-fat beef is undesirable for health reasons as well as flavor reasons associated with too much fat. Second, the percentage of live animal weight that is actually meat versus bone, byproducts, and waste changes with weight. In general, heavier animals yield a larger percentage of meat. Past experience of meat packers has enabled them to develop standard tables of discounts for pens of cattle of different average weights that account for changes in quality and percentage of meat yielded by different weights of cattle. Similar tables have been developed for use by packer teams in the game.

A final factor complicating the calculation of a packer break-even bid price is that processing costs per animal are specified to be a function of the number of animals processed by the firm. Each of the four meat packing firms has a classical u-shaped average cost curve with a different optimal size, i.e., the low cost output level on the cost curve of the four meat packing firms are specified to be eight, nine, eleven, and twelve pens per trading period. The specific cur-

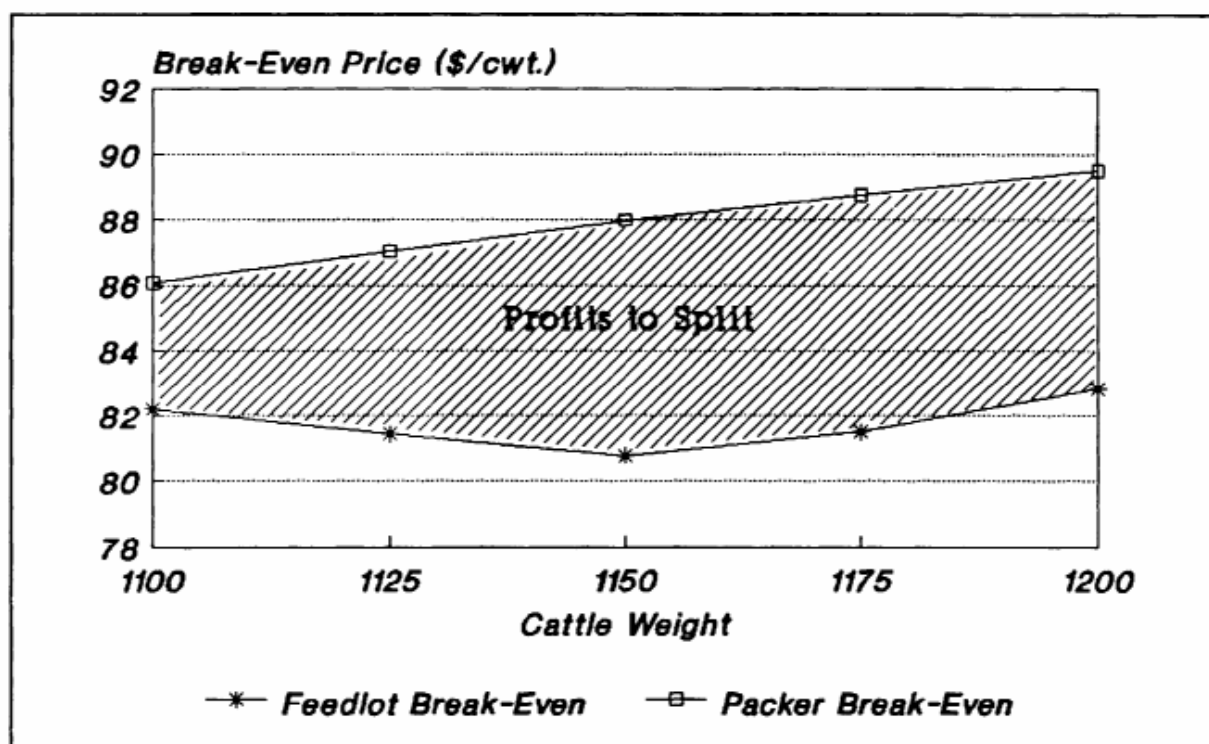
vature and level of each firm's cost curve is based upon data from two studies of the industry (Sersland, 1985; and Duewer and Nelson, 1991). The smallest firm is specified to have the highest processing cost structure, while the largest firm has the lowest.

Because of the complexity and uncertainty involved in calculating a packer break-even price, meat packing plant players often do not calculate a precise break-even price. Instead they approximate the break-even using a variety of self-created approximation methods, including formulas, tables, and computer spreadsheets.

The Price Negotiation and Discovery Environment

The break-even conditions described above typically result in a relationship between feedlot and packer break-even prices similar to that depicted in Figure 1. Because of its shape, this figure has been named the "profit cigar". The greatest profit potential is for 1,150-pound cattle. Because of this most trades occur at this weight. The splitting of profits on 1,150 pound cattle end for other weights of cattle is not always equal and often has a systematic pattern depending on market conditions and bargaining power. If more than forty pens of 1,150 cattle of cattle are available for sale (i.e., an above-average supply) two things frequently occur. First, cattle sold at 1,150 pounds are sold relatively close to the feedlots' break-even price, thus packers receive most of the available profit. Second, there is a tendency for feedlots to hold cattle past 1,150 pounds in order to reduce the immediate slaughter rate and to wait for a better bargaining position. This strategy is often self-defeating for feedlots since their cost of production rises for weights above 1,150 pounds. Also cattle not sold prior to reaching 1,225 pounds are sold auto

FIGURE 1
EXAMPLE FEEDLOT AND PACKER BREAK-EVEN PRICES BY WEIGHT



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matically to the game manager at a significant discount. This discount reflects the fact that cattle this heavy are of very inferior quality and generally are not marketable to major meat packing companies. Packing plants know this and therefore know that they have a distinct bargaining advantage with respect to 1,200 pound cattle. On-the-other-hand, if less than forty pens of cattle are available for sale (i.e., supply is below average) the bargaining advantage generally shifts to feedlot teams. The primary reason feedlots achieve a bargaining advantage in this situation is that not enough cattle are available to simultaneously operate all the packing plants at their optimal size (i.e., at the low point on their u-shaped average cost curve). Packers therefore begin to compete aggressively for the limited supply of cattle available. In many cases packers buy cattle weighing less than 1,150 pounds in order to reach their optimal slaughter capacity and keep their processing costs low. The profit cigar at times may cease to be a cigar due to fed cattle production cost rising relative to boxed beef price or vice versa. For example, when large supplies of cattle are present, market conditions generally force feedlots and packers to negotiate shared losses.

The volume of cattle marketed by the players (used in conjunction with the dynamic boxed beef demand function) determines the boxed beef price. As previously noted packing plant players do not know the price they will receive for the boxed beef produced from a pen of cattle at the time they buy the cattle. This is the case for two reasons. First, they do not know the dynamic boxed beef demand function, and second, they do not know how many cattle will be collectively bought by all four packers in a given week. With experience, players intuitively begin to understand the dynamic nature of the boxed beef demand function they are dealing with. They also become aware that they must be observant of their competitors' behavior with regard to their volume of processing activity in order to be able to anticipate with reasonable accuracy what the boxed beef price will be. This awareness is a key part of the game dynamics and determines whether a given group of players will achieve an efficient market price discovery system.

An efficient price discovery system generally brings with it an orderly and rational market. Without an efficient price discovery process, prices and volumes of cattle traded tend to move in erratic patterns leading to non-optimal processing levels by packing plants and the frequent feeding of animals above 1,150 pounds (i.e., animals with inefficient costs of gain) by feedlots. Another lesson learned from the game is that a smoothly operating market depends not only upon an ability to effectively discover equitable prices, but a business ethics environment that leads to cooperation and compromise between buyers and sellers. Often teams experiment with cartels, blackballing of certain firms, fraud, deception, etc. Game manager reaction to such activities while the game is in progress is to remain uninvolved. Players are often told that with regard to competitive interactions between themselves they live "in the jungle" and must make their own rules. Once the game has ceased play, discussion of such activities provides very useful teaching material.

A helpful piece of information for determining marketing volumes over time or for any extended time into the future is to know the inventory and weight distribution of cattle in the feedlot. This can be ascertained by both packers and feedlot players circulating around the game playing area and attempting to count the cattle in the feedlots. However, this is generally difficult to do and some teams actually cover their cattle inventories to prevent such activity. However, a part of the computer generated information system of the game is the presentation of monthly (i.e., every four trading turns) cattle on feed reports." These reports list the total number of cattle in all feedlots by two hundred-pound weight groupings, i.e., 700-899 pounds, 900-1,099 pounds, and 1,100 pounds and over. Similar reports are actually made by the United States Department of Agriculture. These reports become key pieces of information when

teams are permitted to contract cattle for sale/delivery at some future date, or trade futures contracts to either hedge their positions or speculate. Prices for the futures market are determined entirely from trades made by the players. Thus trading in the futures market also becomes a part of the price discovery process. An interesting teaching point is to ask players about their perception of the efficiency of the price discovery process with and without the futures market. It is equally informative to ask players how their marketing and negotiating strategies change given the presence of a futures market.

PARTICIPANT EVALUATIONS AND REACTIONS

The Packer-Feeder Game has been in use for approximately three years. During that time the game has been used with college students at three different universities as well as a variety of other audiences including top level agribusiness executives (from Cargill and Excel Corporations), actual feedlot and packing plant managers, ranchers, vocational agricultural instructors, agricultural economists, and a group of Polish agribusiness leaders. Evaluations tailored toward each group have been given with every application of the game. Two questions have been common to all of these evaluations. They were: 1) How would you rate the industry end market realism captured by the game?; and 2) How would you rate the effectiveness of the market simulator as a learning tool about markets, marketing, and pricing? Participants were asked to respond to these questions on a scale of one to seven with one described as "very effective" and seven as "not very effective". The response to these questions by group and in total are reported in Table 2.

Participants gave the Packer-Feeder Game high ratings. The ratings were slightly higher for learning effectiveness than for realism. Approximately 75 percent of the learning effectiveness ratings were either #1 or #2 ratings, with only about 5 percent of the participants rating effectiveness worse than a #4 rating.

Interestingly, nearly all groups rated the Packer-Feeder Game in a similar manner, i.e., no one group appears to distinctly stand out in thinking the game was more or less effective or realistic than another group. It is reassuring to note that the agribusiness managers, a group which included feedlot and packing plant managers, rated the game as very effective. The fact that the ratings indicate the game is effective for groups with diverse backgrounds confirms observations made by the game managers during play of the game. Furthermore, observation by the game managers indicates that the game does not teach each group the same thing, rather it is capable of teaching groups (and individuals) at their own level and in a manner compatible with their background. Indeed the game permits individuals standing side-by-side and interacting within the game to be learning at totally different levels simply because they are experiencing different things. The point to be made here in retrospect is that it is not surprising that a truly experiential based learning system is effective with a broad variety of participant groups.

SUMMARY

In summary, participants (students and others) have demonstrated increased understanding about how to make marketing and management decisions in a commodity market after experiencing the Packer-Feeder Game. Participants better understand the need to develop sound but flexible strategies, which are rooted in basic economic principles such as production efficiency, break-even analysis, economies of size, and risk management. They have a better understanding of how fundamental supply and demand effects market price

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Table 2
EVALUATION SUMMARY OF THE PACKER-FEEDER GAME BY PARTICIPATING GROUP TYPES
Question 1: How would you rate the industry and market realism captured by Packer-Feeder Game?

	Percentage Response by Rating						
	Very Realistic						Not very realistic
	1	2	3	4	5	6	7
Undergraduate students	5.7	54.3	22.9	11.4	5.7	0.0	0.0
Vocational Teachers	13.8	48.3	27.6	3.4	6.9	0.0	0.0
Professional Economists	6.3	81.3	12.4	0.0	0.0	0.0	0.0
Agricultural Producers	20.8	40.3	22.1	7.8	6.5	2.5	0.0
Agribusiness managers	5.3	26.7	44.0	14.7	1.3	8.0	0.0
All Groups	10.4	50.2	25.8	7.5	4.1	2.1	0.0

Question 2: How would you rate the effectiveness of the market simulator as a learning tool about markets, marketing, and pricing?

	Percentage Response by Rating						
	Very effective						Not very Effective
	1	2	3	4	5	6	7
Undergraduate students	22.9	42.9	25.7	0.0	5.7	2.9	0.0
Vocational Teachers	31.4	48.2	12.4	2.2	2.9	2.2	0.7
Professional Economists	28.1	54.4	10.5	5.3	1.7	0.0	0.0
Agricultural Producers	38.2	35.5	17.1	5.3	2.6	1.3	0.0
Agribusiness Managers	30.7	41.4	21.3	0.0	0.0	6.6	0.0
All Groups	30.3	44.5	17.4	2.6	2.6	2.6	0.1

determination, and they see how market psychology affects the dynamics of price discovery. Furthermore, participants respond that even the best-formed strategies cannot be realized if they conflict with others in the system and when participants do not have effective communication and negotiation skills to resolve such conflicts. These are skills which are important to agribusiness employers but which are infrequently included in agricultural economics curricula (Litzenberg and Schneider, 1987). Further, such realizations about interpersonal dynamics are difficult to achieve in the traditional classroom. Finally, and perhaps most importantly, students have fun playing the game. Enthusiasm for the study of agribusiness increases and learning becomes simultaneously enjoyable, challenging, and practical.

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