PRICE IMPLICATIONS AND BIDDING STRATEGIES FOR ELECTRONIC COMPUTERIZED MARKETS

by

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CONTENTS

List of Tables

Chapter I

INTRODUCTION

1.1 CHANGES IN AGRICULTURAL MARKETS

Perfectly competitive markets are often linked with agriculture. In agriculture, many farmers produce small quantities of a homogeneous product which are typically sold through local markets. These local markets have dominated agriculture as the primary pricing mechanism for centuries.

The small decentralized markets with few buyers and sellers do not conform to the concept of perfect competition. A move away from the competitive market will change the pricing mechanism. Vertical integration is often referred to as an alternative way of pricing. But as Burns said many years ago:

> Vertical integration thus dictated by the opportunity to secure technical economies of production is not directly caused by the decline of price competition although it may contribute to that decline[1].

The primary objective of moves to vertical integration is to improve interstage coordination. In this process, however, the price negotiations at the interface between two technically related stages of activity in the marketing continuum are eliminated.

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[1] Burns, Arthur Robert, The Decline of Competition p. 421.

1.2 THE THIN MARKET PROBLEM

Thin markets and their associated issues are often referred to when agricultural pricing and marketing problems are mentioned (Hayenga et al.). If all other circumstances would allow coordinated activity, that coordination can be blocked if the markets are "thin."

Thin markets may be characterized by their relatively few number of negotiated price transactions per unit of time (Schlei). The few buyers who do participate may become aware of the opportunity to manipulate prices. As such, the prices arrived at through the thin markets may not represent the true intrinsic values of the products sold. Formula pricing is an example of how thin markets come about. Formula pricing results when price is tied to some observable market quote and prices are not "discovered" through direct market negotiation. Buyers and sellers shift from the marketing arena to formula pricing to obtain short run efficiencies (Schlei).

Vertical integration, processing specialization, and longer term contractual agreements have become more widespread and have contributed to the thin market problem (Hayenga et al.). It should be noted that thin markets may also result from natural processes. One such process may be the deterioration of markets because of changes in consumers' needs or changes in marketing technology. Smaller markets do not have economies of scale in obtaining information as do the larger markets (Hayenga). These issues are related to market evolution. As the evolution progresses, markets and institutions must change accordingly.

Longer term contracts, formula pricing agreements, or direct marketing are prevalent in new market institutions. These changes, occurring for various reasons, are dramatically decreasing the volume of commodities going through the organized markets. The result of these changes is that more thinly traded markets are appearing throughout the food and fiber sector.

One change that replaces the market exchange pricing mechanism is vertical integration. As noted earlier, vertical integration can offer efficiency in operation. However, if inefficiencies existed in the marketing system before vertical integration, then vertical integration can instead breed more inefficiencies (Breimyer). If the market for a specific commodity is possessed with few buyers and/or sellers -- a thin market -- it would now contain even fewer after vertical integration. Instead of alleviating the thin market problem, vertical integration can aggravate the situation.

Thin markets may also suffer from insufficient market information. Increased availability of market information could alleviate the market imbalances in thin markets and help the small firms to remain viable in the industry. Concentrated markets will at least not become more concentrated and may even begin to disaggregate with more accessible information. Market discrepancies should be diagnosed sooner and market arbitrage increased by improvements in market information. Not only would incomes be expected to be allocated more equitably among the market participants, when more market information is available, but the resulting price signals to current market participants and other potential ent-

rants would be expected to be more accurate indicators of the opportunity costs for resources in this sector of the economy[2].

Alternative forms of public market information and accurate price reporting exist. One form, electronic markets, is being explored and tested as more of these markets emerge. Electronic marketing is especially worthwhile in areas where arbitrage among geographically isolated markets produces imperfect information due to the high costs of tapping other markets (Hayenga). Electronic markets would not only increase arbitrage, but they could provide a vast source of accurate market news. The ability of electronic markets to provide more buyers and sellers a better source of markets news helps reduce the thin market problem.

1.3 THE IMPACT OF ELECTRONIC MARKETING ON PRICING EFFICIENCY

Electronic marketing has become a viable alternative to the problems of price and technical inefficiencies and thin markets. Electronic markets can put volume back into the thin and decentralized markets. The electronics industry is a new one, barely 20 years old (Sporleder). However, the need for electronic marketing in agriculture arose with the increasing costs of transportation, moves to decentralization, increased costs of procurement, and the emergence of thin markets.

Electronic markets are capable of accessing potential buyers in many remote areas without them physically congregating in one area. Electronic markets are also capable of providing direct transfer of the

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[2] Hayenga, Marvin L., "Market Information and Price Reporting on Thinly Traded or Imperfect Markets," Market Information and Price Reporting in the Food and Agricultural Sector. Proceedings of a Conference Sponsored by the North Central Regional Committee 117. p. 69.

physical commodity. Thus, the price discovery process can be centralized while leaving the physical transfers decentralized (Schlei).

Competitive pricing can now be realized through an electronic medium. Keeping the physical commodity at its place of origin reduces the costs of obtaining the good, and in the case of livestock, keeps the livestock in a fresher condition. If electronic marketing increases pricing accuracy, then it could be concluded that electronic marketing would help to reflect the true intrinsic value of commodities traded by the system.

1.3.1 Theoretical Advantages

The empirical and theoretical evidence supporting electronic marketing is growing. Numerous authors have noted increases in both technical and pricing efficiencies (Ethridge; Henderson et al., 1976; Henderson et al., 1979; Johnson). Since electronic marketing is transmitted through computers or some other electronic medium, buyers and sellers do not have to leave their offices. Electronic marketing is a more efficient way for business transactions to be executed, allowing otherwise unaccessible buyers and sellers to enter the market. With more buyers and sellers bidding, a balance of power is established and prices are not as easily manipulated to the advantage of any one participant. A commodity, say livestock, does not have to be assembled prior to the sale. The animals can be graded on the farm, then assembled on paper to form more convenient loads which decreases cross-hauling of the animals. The end result is less shrinkage, death loss, crippling and sickness to the livestock being auctioned.

In computerized electronic marketing systems, computers disperse all the available information to all the traders on the system. Thus, no one trader can obtain more information through the system. All the commodities sold can be listed and described in detail prior to the sale, giving buyers a better feel for the values of each lot. This implies that the lots are graded uniformly to set standards, with price premiums or discounts for non-par qualities. Quality descriptions are thus more heavily relied upon to determine price.

Russell and other authors noted that other cost saving attributes are available through computerized marketing. The auxiliary services available are as extensive as can be programmed. Some examples are accounting, invoicing, arrangements for transportation, market news, and even local weather reports (Schlei).

Also pointed out by Russell and Schlei is that the costs of the electronic system must be eventually surpassed by its benefits for the system to be feasible. Schlei noted appropriately that even though the fixed costs may be large, the marginal cost of operating a computerized system may be far less than the marginal cost of operating a conventional system. Since electronic marketing is relatively new, the literature dealing with impact on price is limited. Electronic marketing is touted as a "competitive" pricing procedure, but little is known about the bidding strategies employed by system participants.

1.4 PROBLEM

The theoretical discussion suggests electronic marketing provides more cost effective marketing, increased pricing and marketing efficiencies, and increased buyer and seller accessibility. However, little research has been conducted on the impact of electronic marketing on prices. Holder, Henderson and Sporleder all conclude that electronic markets have reduced costs, increased information, and increased the number of buyers and sellers. Russell completed a preliminary analysis of Eastern Lamb Producer's Coop (ELPC) electronic marketing program and indicated that the electronic system had a significant effect on the price level for slaughter lambs. Further research in this area is needed to clarify the impact of electronic marketing.

An area of electronic markets which has received little or no attention is that of bidding strategies. However, the concept of bidding strategies is not new in conventional auctions. The literature cites many types of strategies used in different types of auctions. However, there is little documentation, if at all, on how bidding strategies in electronic systems differ from strategies in conventional markets.

1.4.1 Working Hypotheses

The general hypothesis is that a computerized electronic marketing system will influence price level, contribute to price discovery process, and will witness the same type of bidding strategies employed in conventional markets. More specifically, it is hypothesized that:

1. Prices will be higher in computerized electronic markets than in conventional markets;
2. Price changes on the electronic system will lead or precede price changes in conventional markets; and
3. Bidding strategies in electronic markets will not differ significantly from strategies employed in conventional markets.

1.4.2 Objectives

The general objectives of this study are to: (1) model price behavior and measure the price impacts of a computerized electronic marketing system developed and implemented by ELPC, and (2) to conceptualize and analyze bidding strategies employed by buyers using the system. More specific objectives are:

1. To update Russell's analysis, using a larger data set, in order to identify any changes in the relationships;
2. To conceptualize and analyze the bidding strategies of different types of buyers in the computerized electronic marketing system for lambs; and
3. To measure the impact on final sale price of selected variables that differ across sales for slaughter lambs including number of buyers, number of buyers bidding, length of sale in time, distribution of time between bids, and the anonymity of the bidding process.

1.5 LITERATURE REVIEW

The literature for this thesis will be treated in two sections. The first section will cover the area of auctions and bidding strategies, and the second section will look at the literature on electronic marketing.

The auction and bidding strategies section is not a complete search of all the literature. Only strategies pertaining to auctions with similar characteristics to the electronic auctions are documented. ELPC's electronic auctions are of the English type with multiple lots. The electronic marketing section is more of a synopsis of literature on computerized systems. Russell, in his dissertation, completed a more thorough review of all the current literature.

1.5.1 Auctions and Bidding Strategies

Chamberlin was one of the first to investigate the results of decentralization and market imperfections compared to a full-information market. He designed a model to give each buyer and seller a symetric demand or supply price, respectively. A specfic time was set for buyers and sellers to negotiate with each other and establish contracts of sale. A warning signal alerted potential buyers and sellers that they must come to a pricing agreement quickly. Chamberlin reported from this experiment that larger quantites were traded but at lower prices than in a centralized full-information market.

V.L. Smith continued Chamberlin's work. Smith allowed for the same initial conditions. The number of buyers and sellers was the same and

they received symetric supply and demand conditions. Smith gave each participant a card which indicated a buyer's or seller's position and a reservation price. He conducted several market periods within one experiment. He established more formal bidding arrangements and a more intricate information network. A monetary incentive was provided in the form of a payment for a completed transaction plus an amount based on the difference between the contract price and the participant's reservation price.

Smith wondered if the potential intersection point of the initial supply and demand schedules possessed any power to predict observed market behavior. From the completed experiments, he concluded that the initial schedules do have power to predict behavior, even after a number of transactions have taken place. Smith introduced two variations to the bidding procedure. First, he allowed only buyers to bid and sellers to accept or reject these bids. Second, he allowed only sellers to offer bids and buyers to accept or reject them. The first alteration to the bidding process yielded higher prices for the seller. The second yielded higher yields for the buyer. When both buyers and sellers were allowed to bid, a faster convergence to the full-information equilibrium was found. ELPC's system is designed to allow buyers to bid and sellers to accept the high bid if it exceeds the sellers' reservation prices.

Frahm and Schrader investigated the effect of trading systems on price outcome. They used both the English and the Dutch system in an experimental environment. In the English auction, the lot is sold to the last and highest bidder. In the Dutch system, the lot is sold to

the first buyer who accepts the seller's descending offers. The English auctions had bid intervals of 5 seconds. Upon reaching the fifth second, the lot was sold unless a new bid was entered. The Dutch auction had prices start three units above the previous sale price and drop by one bid unit every two seconds until a bid was received. Participants were rewarded in proportion to the profit they earned and were not penalized for negative profits.

The a priori hypotheses and conclusions offered by Frahm and Schrader were:

1. Hypothesis: The variance of the English auction was greater than for the Dutch auction. Conclusion: The experiments were tabulated and the authors were able to reject their null hypothesis at the 5 percent level that English auctions will have a higher variance.
2. Hypothesis: English auctions will result in faster convergence toward theoretical equilibrium price. Conclusion: There was no sound statistical evidence that descending price auctions converge more quickly than ascending bid auctions.
3. Hypothesis: Average prices for an entire auction period will tend to be higher in Dutch auctions. Conclusion: The experimental auction prices tended to be higher for the English auctions.
4. Hypothesis: Observed equilibrium prices will tend to be higher in Dutch auctions. Conclusion: The statistical analysis was inconclusive.

Vickrey examined auctions where only one indivisible item is allocated to a number of bidders. The combinations of buyer and sale price were determined by any number of auctioning or bidding procedures. Vickrey chose to study the simple progressive auction, which he describes as bids made freely and publicly, until no other buyer is interested in bidding further. Vickrey claims that normal bidding will end at a price equal to the second highest price among the bidders.

The English auction is compared to the Dutch auction. Vickrey explained that the Dutch auction is essentially a "game" in the technical sense. The bidders need to take into account all the information available to them in order to know when to place a bid that has a good probability of obtaining the item. When the price comes down to the full value of the lot, the bidder maximizes his opportunity of obtaining the lot. But he gains nothing in the form of profit by placing his bid at the full value of the lot. Obviously, as the price keeps declining, the opportunity to earn a profit increases but the probability of obtaining the lot diminishes.

Vickrey also looks at multiple lot auctions of identical value. Two types exist: one is the simultaneous auction, and the other is the successive auction. Simultaneous auctions are where all the lots to be sold are auctioned at the same time, and each bidder is permitted to raise his own bid even though it may not be the highest bid. Vickrey states the price of this auction, which has m lots, will be equal to the (m+1)st highest value among those placed on the lots. The m highest bidders therefore obtain one of the identical m lots at the same value

as the other (m-1) bidders obtain the rest of the (m-1) lots. Vickrey emphasizes that this auction is only stable if all the objects are identical and of the same value.

An auction may have several sales in which items are considered identical. However, since some doubt as to the homogeneity of such auctions exists, the more popular and relevant auction is the successive auction. This is where each lot is auctioned one at a time. The use of bidding strategies dominates these types of auctions. The reason is that each bidder must decide whether to bid aggressively for the present lot or step back and speculate that the next lot can be obtained at a lower price.

Riley and Samuelson examined alternative forms of auctions. Their paper demonstrates a general characterization of the implications for resource allocation of various auction designs within the orginal model by Vickrey. Riley and Samuelson use the auction model to illustrate the "thin market" problem. Riley and Samuelson submit that when the seller is in a monopolistic position, he usually chooses the method of sale. When the rules of the auction change, the bidding strategies of the buyers change accordingly.

Kuehn developed regression models showing the relationships between feeder cattle price and breed, grade, sex, average weight, the size of sale, sale place, year, and the number of buyers. His major objective was to isolate factors which can be controlled by auction market managers and farmers in a way to influence price. From the initial study, more questions were raised.

One of the first questions was generated by the apparently contradictory result that as the number of buyers increased, the price declined. Kuehn hypothesized that this contradictory result occurred because of the nature of the buyers. A greater proportion of the buyers were farmers than were order buyers. The objectives of these two types of buyers differed greatly. Kuehn broke the buyers up into two different groups and confirmed that the number of farm buyers would have a curvilinear effect on price. The curvilinear impact implied that as the number of buyers increases up to a certain level (17 farmers), the price increases and thereafter declines. Kuehn discovered that order buyers paid 46¢ per cwt. less than the average of all buyers for cattle, ceteris paribus.

The next hypothesis Kuehn formulated was that lot size would have a significant relationship to price, first correcting for the types of buyers. Lot size was found to have an increasing effect on price up to 41 head and then have a negative effect on price. Kuehn deducted that 41 was significant because it was the number that could make up a truck load.

Other researchers, Kuehn noted, felt that the order of sale would effect the price, ceteris paribus. The variable did not have a very strong statistical effect on price. Kuehn noted:

> An interesting point was that price decreased until the 106th lot was sold and then began to increase, ceteris paribus. The prices tended to be higher in the last third of the sale suggesting that buyers strategies were influencing this new increase in price. The buyers could have been "feeling each other out" or shopping for bargains in the first two-thirds of the sale. Then the increase in price could be explained by buyers needing to fill quotas or their buying objectives.

Engelbrecht-Wiggans studied the subject of auctions and bidding models. He defined auctions as games with incomplete information. These auction models have some underlying state of nature which prescribes the relevant characteristics and number of objects being auctioned, the von Neumann and Morgenstern utility functions and the number of participating strategic players, and the behavior of any nonstrategic players. Each player does not precisely know what specific state of nature exists for a given auction. But each player must choose a bidding strategy given the information he has. Payoff functions of auctions provide a method of determining who gets what on the basis of a particular buyer's strategy and determines how much is paid by a particular buyer.

Bidders in auctions have developed a strategy from an assortment of criteria. Engelbrecht-Wiggans cited several strategies. First, a "min-max" strategy exists when bidders choose to maximize the minimum possible utility of the final sale over all conceivable possibilities of bidding strategies of the other bidders. On occasion, in simultaneous auctions with small stakes, the bidders tried to maximize the amount by which their profits exceeded those of the rest. Second a Nash equilibrium[3] strategy exists in multi-bidder auctions if each bidder uses a strategy which, for the particular strategies used by the remaining bidders, maximizes the expected utility of the sale. Third a "local" equilibria exists as a variant to the Nash equlibrium. This occurs when

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[3] A Nash equilibrium is where each individual chooses to market the quantity of output that maximizes its own profits, assuming the quantities marketed by rivals to be fixed.

each bidder's strategy results in attaining a local maximum of his expected utility.

An interesting contrast can be made between single lot auctions and multi-lot auctions. In the single lot auction, a phenomenon occurs called the "winner's curse." The winner's curse results from the winners' tendancy to pay more for the object than it is truely worth, given the expectations of the other bidders. Engelbrecht-Wiggans postulated that if each buyer bids an unbiased estimate of his own true value for an object, then the minimum bid will in general be biased upwards with respect to each bidder's true values. Such action allows the selling price to exceed the intrinsic value.

When auctions have more than one strategic bidder, the problem of examining bidding behavior becomes difficult. Engelbrecht-Wiggans and Weber studied a simple simultaneous auction with a number of non-independent single commodities. Each auction employed the first rejected price mechanism: each bidder values a single lot at some fixed known amount, considers additional lots worthless, and is allowed to independently submit bids in up to two randomly selected auctions. In these auctions, bidders used a mixed equilibrium strategy - - i.e., where a bidder submits one "high" bid and one "low" bid. Each bidder has the same known value for the lot, but his capacity constraints are different, causing bids to come in at two distinct levels.

If the auctions are inefficient in allocating the goods, then secondary markets will appear after the first round of auctions. Bidders incur the costs of these secondary markets where the goods must be in-

ventoried, capital is tied up, and additional sales must be conducted. When these secondary markets occur, the bidders have the potential to communicate among each other which may reduce the overall "competitiveness" of the allocation process. Therefore, sellers may not want these secondary markets to occur.

When Sosnick refers to an auction, he is speaking of the typical auction for which: (1) many lots of a commodity are for sale; (2) the lots are sold successively; (3) each lot is sold as a unity; (4) all bidders make open bids which are in sequential order; and (5) the direction of bidding is upward and the highest bidder receives the lot at a bid equaling the sale price. This auction type is similar to ELPC's electronic auctions. Sellers have the choice of refusing a winning bid by rejecting the highest bid, by entering the highest bid himself, or by having a different reserve price quoted to the auctioneer. The buyers had made no previous agreements with each other. In theory, if all other bidders value the lots in the same manner, then the price trend for the entire auction could be down or at best stable throughout the sale.

Sosnick hypothesized that prices should trend down at livestock auctions when buyers are not following any strategies but are concerned with quality variations. However, no downtrend was found. Several explanations are:

1. A change in participants could block the downtrend. When a new potential buyer enters the bidding process bringing new information, the discrimination process may start over.

2. Quality variation could cause an upward trend in prices. Buyers may not all have the exact evaluation of every lot sold even though it is graded ex ante. The lots could also be of differing sizes where truckload sizes quote premium prices.
3. Changes in buyers' estimation of value could cause an upward price trend. Buyers often change their minds as to how they previously estimated the lot for sale. "They often raise their implied estimates," states Sosnick.

In Sosnick's early work, he developed objectives for professional buyers on how to select their bidding techniques. Bidding objectives may represent a bidder's own goals or they may represent instructions from his employer. The bidding objectives Sosnick identified were: (1) percentage buying, where the bidders know the total amount for sale and are to purchase a set proportion of it for as low a price as possible, and (2) maximizing gain, a more common objective, where buyers buy as cheaply as possible.

Sosnick used what he called "the shrewd strategy" to demonstrate how a gain-maximizer employs his explicit estimates of later supply opportunities to both guard against discrimination and to be alerted that his buying may change others' bids. In an auction with a group of lots, the present lot may be considered a substitute for other equivalent lots. The buyer's strategy is maximized if he can buy this present lot. This lot is regarded as one of a set of complementary lots that, when all lots are put together, constitute a potential substitute for the best set of purchases that the bidder can make if he does not purchase

the present lot. The advantages include smaller expected outlay, better quality, and larger quantity. The expected advantage determines the optimum upper limit for the present lot.

In Sosnick's mind, that does not constitute a complete bidding strategy. A lower optimum limit is also required to raise a competitor's offer. Most auctions have a standard incremental raise. If a bidder chooses to accelerate the bidding process, he may increase the price by more than the increment, possibly revealing his identity and altering the bidding pattern. It may also increase the price unnecessarily. The optimum lower limit equals the price at which the expected value of savings, minus the expected value of discounted future costs (reduction in supply, entry of additional buyers, etc.), is largest.

1.6 ELECTRONIC SYSTEMS

TELCOT, the cotton electronic marketing system was one of the first computerized electronic markets and has been throughly researched (Schlei). Ethridge claims that market information was less available before the development of TELCOT.

TELCOT provides cotton producers with three ways to sell their product (Russell). The methods are forward contracts, a regular offer system and a firm offer system. Forward contracts are acreage contracts at a designated price per pound of cotton. Price quotes arise from the loan rate value and are generally a few cents above it to allow for quality variations. In the Regular offer system, cotton producers receive price estimates from the Plains Cotton Cooperative Association

(PCCA) for their particular grade of cotton. When the producer agrees to sell at his quoted price, bidding opens for a 15 minute period. If the high bid is within 1/4¢ per pound of the quoted price, the cotton is sold to the highest bidder. On the other hand, if it is not within 1/4¢ per pound of the quoted price (unknown to the buyers, of course), the producer has the choice of accepting or rejecting the bid, but it must be done in the 15 minute period. The Firm offer system is where the producer quotes a reservation price below which there will be no sale. The cotton is then sold to the first buyer willing to accept this "firm offer" price. Athe the end of each sale, the computer prints out invoices to both the buyer and the seller.

The Egg Clearinghouse, Inc., (ECI) was developed by egg producers in 1971 to promote more competitive price discovery (Schlei). This was not initially a computerized system but a telephone system. Buyers and sellers could telephone the clearinghouse with offers and bids for eggs. The introduction of ECI raised both the short run standard deviation of prices and the frequency of price changes for the private Urner Berry price reports (Russell).

The computerized system for nest-run eggs was opened in 1977 (Schrader). Two trading sessions occur daily. Buyers and sellers can enter bids and offers. Each session has four periods. It appears that traders use the computerized system to feel out their most profitable options and then phone in to ECI to negotiate their actual trade. To participate in ECI, monthly fees are charged and brokerage fees are charged for completed transactions. In turn, ECI guarantees performances on both sides of the market and handles the bookkeeping.

CATTLEx (Cattle Exchange) was developed by Texas A&M University and the Texas State Department of Agriculture, under a matching funds grant from the Agricultural Marketing Service (AMS) of the USDA. A two and a half year testing period for CATTLEx was proposed. The time allocations were a development stage which began in September 1980, and an evaluation stage which began in mid-1981 (Schlei). Descriptions of lots of 20 head or more of feeder cattle are entered into a centrally operated computer from various remote-access terminals. Each lot is supplemented with a description of number of head, breed, sex, age, estimated weight, primary grade, flesh condition, location, and delivery date. Accompanying these characteristics is a third party description which has a more detailed breakdown of the individual animals in each lot. The descriptions are offered to traders before the actual sale begins. An auction occurs five days a week. Lots are listed randomly.

In an auction, eight recently sold lots are listed, including prices, along with eight available lots. Each lot is offered for sale in 16 minute auctions. The prices are in ascending order with the highest bidder receiving the lot, at two minute intervals (Sporleder). Producers are allowed to place reservation prices on their lot(s) of cattle and if no sale occurs, the lot(s) can be reoffered for five consecutive days. Partial payment is required on the sale date.

A feasibility study was completed on CATTLEx by Glazner. Her primary objective was to estimate how many cattle producers were interested in using an electronic system. The producers were opposed to two issues: grading and commingling. Otherwise, about 16 percent of the producers surveyed indicated they would participate.

For CATTLEx to be successful, two necessary conditions were established (Sporleder). These were:

1. Accurate and acceptable cattle descriptions must be provided to the buyers and sellers.
2. Reputation of the system must be established at an early stage. Sellers must deliver the specified cattle that were sold and buyers must honor their agreements in accepting them.

HAMS, the Hog Accelerated Marketing System, was to be used in marketing slaughter hogs in Ohio (Baldwin). HAMS was a joint project between the Ohio Department of Agriculture, Ohio State University and the Ohio Producers Livestock Association and was also funded in a matching funds grant from AMS (Schlei). An initial committee of packers, buyers, order buyers, farmers, dealers, educators, and others interested in hog marketing was formed to help establish the framework for HAMS. HAMS had the ability to reward farmers for good breeding and production techniques and could also bring more price variability to the system since the market discriminated value related characteristics of a certain lot of hogs (Baldwin).

HAMS provided two basic methods of sale. The first was the auction system which sold hogs through collection yards. They initially offered both the descending and ascending auction. The second method was the firm offer system, which provided a market for lots of 50 or more.

Henderson et al. (1981) reported that prices through the electronic system had been consistent with a priori hypotheses. The prices reflected operational efficiencies. It was also reported that the inter-

day price variability within the week was larger in HAMS than in privately negotiated markets (Russell). The proposed advantages of HAMS were reduction of packer acquisition costs by allowing purchases from the office, minimizing death loss and shrinkage by keeping the hogs on the farm longer, and decreasing packers costs by giving them control over the delivery schedule (Schlei). Despite its apparent advantages, HAMS did not attract sufficient sales volume to maintain the interest of longer term buyers and the operation of the system was stopped.

A feasibility study was done by Engelman et al. of using electronic markets for wholesale meat. A widely recognized problem in the wholesale meat industry is formula pricing. With formula trading, the value of market information decreases and the opportunity for price manipulation increases (Engelman et al.). Engelman et al. concluded that wholesale meat was well suited for electronic marketing. Their results showed that using electronic marketing as a market for wholesale meat could eliminate the formula pricing problem.

An electronic marketing system was established for wholesale meat. It is called CATS which stands for Computer Assisted Trading System. The system itself does not declare sales of meat but only lists bids and offers over the system (Albanos and Curtain). To date, industry acceptance has been minimal.

A few authors have written in general terms about the advantages of electronic marketing systems. Ethridge decided that for an electronic marketing system to be successful, three conditions were vital:

1. An acceptable grading system to both buyers and sellers.

2. Enough participants to eliminate the thin market problem and to provide cost efficiency.
3. Substantial capital backing in order to get started.

Ethridge hypothesized that electronic systems were better able to alleviate the pricing inefficiencies than the technical inefficiencies. However, the technical inefficiencies may be corrected as a secondary benefit.

In work done by Henderson et al. (1979), the authors reported that, from empirical data on electronic marketing, pricing efficiency, technical efficiency, and industry structure could all be greatly improved. Improvements in the competitive structure of the markets could be increased by the increased price variability in electronic sales. Russell did a study of the Urner Berry egg price reports, finding that the short run standard deviation of prices and the frequency of price changes were greater after the introduction of the electronically traded eggs by Egg Clearinghouse, Inc. (ECI).

1.6.1 Electronic Marketing in Virginia

Electronic marketing in Virginia began with teleauction sales of slaughter lambs, feeder pigs, slaugher hogs, feeder cattle, and slaughter cattle. Teleauctions are auctions held over conference telephone lines. Benefits of this system were computed by Holder. He developed econometric models and found that the price for prime and choice lambs in West Virginia and Virginia had been raised by as much as $1.53 per cwt. Holder felt that teleauctions had positive impacts on technical and pricing efficiency and producer control.

A project funded by a matching funds grant from AMS of USDA allowed Virginia Tech and the Virginia State Department of Agricultural and Consumer Service (VDACS) to explore the feasibility of expanding teleauction and/or computerized sales to slaughter cows and lambs. Funding was received in late 1978.

Russell and Purcell did the preliminary groundwork for the project. They developed and administered mirror image surveys to 83 Virginia slaughter cattle producers and 20 Northeastern packers. Russell and Purcell drew from the pool of electronic related information six critical elements to be included in the development of the Eastern Electronic Marketing Association (EEMA). Briefly, these elements consisted of:

1. Isolating areas of agreement and disagreement from the mirror-image surveys and using these in conceptualizing the system.
2. Involving currently operating auction markets.
3. Establishing a nonprofit electronic organization with a board of directors consisting of producers and marketers using the system.
4. Insuring low cost operation.
5. Early development of an educational program stressing the advantage of electronic marketing in the area of thin markets.
6. Involving all interested persons at an early stage in the development of the electronic system.

Even at this early stage, a cost analysis on electronic marketing versus conventional marketing had been completed by Chieruzzi. Cost at Virginia slaughter cattle markets and cash cost involved during sales were aggregated. In the final analysis, computerized auction markets

were shown to be advantageous. Chieruzzi made some assumptions on head sold per week, sale days per week, number of seller terminals, number of buyer terminals, connect time per lot, and lot sizes. She was able to conclude, using reasonable assumptions, that the total marketing bill would be lower for the computerized system, using a relatively small level of volume, than for the conventional auction system.

EEMA was established as a nonprofit organization in 1980 to administer the electronic marketing system and to work with potential traders in developing a usable system (Schlei). The system was best received in the slaughter lambs sales which have increased in volume since the beginning. EEMA was recognized as an affiliate of the National Livestock Producers Association in late 1982 and is operating as NEMA in the private sector.

Conceptual benefits of electronic marketing have now been confirmed by empirical studies using National Electronic Marketing Association (NEMA) data (Bell and Purcell). The benefits are:

1. More buyers can participate in any given sale. Location is no longer a factor.
2. The thin market problem has diminished with the increase in buyer competition.
3. Marketing and transportation cost have decreased. The sheep are in much fresher condition with minimal amounts of hauling.
4. Electronic markets are more price efficient. Conventional auction prices respond with a lag to the electronic sales.

The process of procurement begins with the sellers having the sheep graded on the farm by either a local grader or by the farmer himself. The producer, a local extension agent, or an agent of VDACS contacts NEMA to consign the lot(s). Through a computer program, the lots are entered by giving specific details for each lot. The program is designed to "prompt" the sellers to give complete and adequate information. The descriptive information contains location of lot, number of head, quality grade distribution, estimated dressing percentage, breed and date of auction.

Once all the lots are entered, the information is accessed by the management of the system in NEMA headquarters to "build" an auction. The "sale order" with detailed descriptive information is available to buyers and sellers one hour before the sale. The description sheets are available in either detailed or summary version. The sales are conducted so that the buyers remain in their offices and the livestock remain on the farm.

Initially, sales were held every Friday at eleven o'clock in the morning. The sheep now come from producers in Virginia, West Virginia, North Carolina, Kentucky, Tennessee and Ohio. The buyers are located in Baltimore, Maryland; Rochester, New York; Detroit, Michigan; Philadelphia, Pennsylvania; Toronto, and Kitchener, Ontario. The lots are offered initially in order of decreasing reservation price. Prices are started above the reservation price and fall in $1.00 increments each twenty seconds until a bid is received or the lot is designated as a "no sale." Once a bid is entered, prices can be bid up in 25¢ per cwt. in-

crements in a progressive auction. The bids are updated every 5 seconds. Bidders only know when they have the current bid, thus the anonymity of the auction is preserved. It has been indicated in the literature that when buyers know who each other are, the bidding pattern may change because of intimidation from aggressive bidders (Vickrey; Holder). Bids are accepted in milliseconds so that the possibility of a tie is eliminated. When 25 seconds elapse with no higher bid, the sale is completed, and each buyer can receive a summary of his purchases. The buyer has one week to collect the lot(s). Buyers agree to pick up the lambs at a designated area where they are offically graded by state graders.

When the computerized system was first introduced, some livestock traders feared that the electronic system would replace them. Others were opposed to learning a new system for selling livestock, which had been sold through conventional markets for centuries. Because this opposition was mainly felt in the cattle markets, the computerized cow sales were not widely accepted. The computerized lamb sales fared well from the beginning. One reason for the success was the credibility and experience with teleauction sales that ELPC, the producer group sponsoring the lamb sales, had obtained.

Reaction to the computerized lamb auction sales has been positive. Buyers are happier with the superior communication as compared with the previously used teleauction sales. The computerized system allows buyers to know the detailed descriptions of each lot without having to bother with hooking all the potential buyers up to a conference call.

Costs of the computerized system are competitive with a conference telephone call. It has been reported that buyers are more satisfied with the complete anonymity of the computerized auction and they feel the system is more efficient (Bell and Purcell).

Chapter II

DOCUMENTED RESEARCH ON PRICE CONSIDERATIONS

2.1 INTRODUCTION

Research on the price impact of electronic markets is very limited. Prices are vital in the correct allocation of resources. Any misallocations of resources may be caused by an imbalance of market power in the marketing system. As mentioned in the first chapter, the ability to manipulate prices may be attributed to the lack of coordination of marketing processes and/or the lack of a competitive number of participants in the market. Both of these issues might be alleviated by the implementation of electronic marketing. Ethridge argued that electronic marketing has the potential of increasing pricing efficiency. The only documented research on pricing efficiency using electronic markets is from Henderson, Baldwin, and Russell. Of the three, Russell's work used data from ELPC which coincides with the data used in this study. Russell analyzed the price effects of ELPC's computerized slaughter lamb sales.

2.1.1 Models of Price Magnitude

Virginia is a fairly important eastern sheep producing state. There were 2,800 sheep operations in Virginia, as of 1982. During conventional sales the number of participants is often few, thus contributing to the thin market problem. Electronic marketing provides markets with more buyers and more pricing information. The electronic auctions for slaughter lambs in Virginia have had as many as 12 buyers on the

system for a given sale. A record of the number of buyers logged on the system and their identities during each auction are provided by the computerized system. The increased number of buyers alleviates the thin market problem and should, in theory, increase the price of computerized sales over conventional sales, assuming no technical changes (Russell). Since the electronic market allows producers to leave the livestock on the farm, the description of each lot must be complete so that buyers can estimate their value accurately. The increased use of descriptive qualifications on the lambs will provide more credible information available on lambs, thus increasing the occurrence of Pareto-optimal resource allocations.

Russell had the opportunity to analyse ELPC's computerized lamb sales data. One of his concerns was how electronic marketing would change the price discovery process. Russell hypothesized that the computerized lamb prices would be higher than either the regional price of lambs (PLR) or the national price of lambs (PLN). He developed two new price series by subtracting the regional price of lambs and the national price of lambs from the computerized price of lambs (PLC). These variables are defined in Table 2.1.

The mean of the national difference (NDF) was statistically different from zero at the 10 percent level of significance. Similarly, the regional difference was statistically different from zero at the 10 percent level. Russell explained these positive differences as follows:

1. the national difference included a mixture of lambs with some grading low Choice which would not be included in the Blue 0 grade used in the electronic sales;

Table 2.1 Variables Used in Defining the National and Regional Price Differences[a]

Variable	Definitions
PLR	The regional price was derived by the average price of 95-125 lb. prime and choice lambs sold at Abingdon, VA and Staunton, VA livestock markets from May through September, 1961-1981. Only the years 1980-1981 were used.
PLN	The national price was derived by the average price of prime and choice spring lambs sold at the San Angelo, TX; Sioux Falls, SD; and South St. Paul, MN markets from May through September, 1961-1981. Only the years 1980-1981 were used.
PLC	The computerized price was based on a Virginia state grade called Blue O. A Blue O is a U.S. high choice and prime lamb, weighing 95-125 lbs. and estimated to dress better than 50%, hot weight.
NDF	The national difference was calculated by subtracting PLN from PLC.
RDF	The regional difference was calculated by subtracting PLR from PLC.

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[a]This table is reproduced from Russell's dissertation.

2. increased competition through access to more buyers; and
3. reduced buyer risk through the credible grading system.

Russell directly attributed the positive regional difference mean to the computerized system for increased competition, credible value related information and reduced buyer costs. He pointed out that the mean of the regional differnce was even more important when Red O lambs were included. The regional markets were discounting up to $6 per cwt. for Red O lambs. The computerized market, ELPC, had fixed discounts to Red O's of $3 per cwt. below the Blue O grade. Russell concluded that computerized lamb sales had a statistically significant effect on both the national and regional price of lambs.

Russell modeled the computerized price of lambs (PLC) against the number of buyers buying (BB), the bidding time increment in seconds (BI), and the national price of lambs in dollars per cwt. (PLN). Refering to Table 2.2, all the specified variables in his first model are statistically significant at the 1 percent level. The signs of the variables are in agreement with his a priori hypothesis. Refer to Table 2.3 to obtain variable signs and explanations.

The first model regressed the computerized price of lambs (PLC) against BB, BI, and lots offered (LO). All the signs on the variables agreed with Russell's a priori hypothesis, except that BB was now statistically insignificant. A possible explanation for using lots offered (LO) is that the variable picks up the effect of the number of buyers buying. As more lots are offered, buyers fill their quotas and their aggressiveness in buying rapidly decreases. Thus, the two variables are correlated.

Table 2.2 Russell's Models Explaining the Price Received for Blue O Slaughter Lambs sold through ELPC Computerized Sales (5-80 to 9-81), N = 145[ab]

Model	Intercept	Buyers Buying	Bidding Time Increment	Lots Offered	National Price (PLN)	Lagged Price from Computerized Sales (LPLC)	R^2
1	4.84 (1.16)	0.34 (0.83)	0.31 (3.67)*	-1.88 (-5.41)*	0.93 (16.09)*		0.72
2	3.91 (1.51)			-0.90 (-4.15)*	0.29 (4.42)*	0.70 (12.46)*	0.85

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[a]The parenthesized numbers represent t-statistics. The asterisked variables are significant to the 1% level.

[b]This table is reproduced from Russell's disertation.

Table 2.3 Explanations of Variables used in Russell's Models Explaining the Price Received for Blue O Slaughter Lambs Sold Through ELPC Computerized Sales (5-80 to 9-81)

Variable	Explanations of Signs
BB	Given a competitive environment, actual number of buyers making purchases would be small only if their marginal revenue product was high relative to the other buyers. This is likely to occur when one or more buyers experience the short run phenomenon of being more concerned with the quantity of lambs purchased than price.
BI	The positive sign indicates that giving buyers a little more time to decide whether or not to bid has a positive influence on price.
LO	For a given amount of buying power, price should vary inversely with the number of lots offered. Price should rise as buyers compete for scarce offerings and fall when offerings are plentiful.
PLN	It could be assumed that most buyers would use a working knowledge of the national lamb price to formulate the maximum price that they would be willing to pay for lambs offered in ELPC sales. As such, national price would be expected to vary directly with PLC.
LPLC	ELPC sales appear to be a residual supply for at least some of the buyers on the system. Such buyers are more likely to rely on ELPC sales for a part of their supply of lambs if they have recently purchased lambs through ELPC.

The last model also estimated the computerized price of lambs. In this model, the explanatory variables were LO, PLN and the one period lagged dependent variable (LPLC) as defined in Table 2.3. All the variables were statistically significant. Russell realized that using the lagged version of the independent variable caused his parameters to be biased, however, he felt that is was intuitively appealing to include this variable. Much of the increase in the coefficient of determination can be attributed to the lagged dependent variable, as it is highly significant.

2.1.2 Models of Price Responsiveness to Market Information

The current thinking on pricing efficiency is that the more efficient a market is, the more quickly new information gets processed. Russell's hypothesis was that if electronic markets are more price efficient than conventional markets, the prices in the electronic market would react faster than the prices in the conventional markets to new market information.

Six models were developed to test the responsiveness of the computerized price to market information. Table 2.4 lists the variables and their definitions. The only significant impact was the one week lagged differenced computerized price, DPLC1, on the differenced regional price.

Russell explained this significance by stating that a tendency existed for the computerized market to establish the price at the Abingdon and Staunton Virginia markets. The computerized sales are conducted on

Table 2.4 Explanations of the Variables used in Models Developed by Russell for Price Responsivness to Market Information [a]

Variable	Definition
DPLR	The first differences of PLR. PLR represents the average price of prime and choice lambs weighing 95 to 125 pounds at the Abingdon and Staunton VA livestock markets. Weekly data for the months May through September, 1980-81 were used. Units are $/cwt.
DPLR1	One week lag of DPLR.
DPLR2	Two week lag of DPLR.
DPLC	The first differences of PLC. PLC represents the average price of Blue 0 lambs at the ELPC computerized sales. Weekly data for months May through September, 1980-81 were used. Units are $/cwt.
DPLC1	One week lag of DPLC.
DPLC2	Two week lag of DPLC.

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[a] This table is reproduced from Russell's dissertation.

Fridays at eleven o'clock in the morning and the regional auctions are held earlier in the week. Therefore, Russell assumed that the regional markets would look at last Friday's computerized prices to help discover this week's regional prices of lambs.

Russell reasoned that (1) computerized sales may react to market information more rapidly than conventional markets, and (2) that buyers in conventional markets may feel threatened by the computerized markets and bid up the prices in conventional markets to coincide with the computerized markets. The first reason supports the increased pricing efficiency hypothesis, while the second does not. The data that Russell used were from the early sales over the computerized system and may not now truly represent the current behavorial patterns.

2.2 THE TIME RELATED COMPONENT OF SLAUGHTER LAMB PRICES

The electronic marketing data that Russell used began in May 1980 and ran through September 1981. In modeling, Russell only used the months May through September because of the price premiums for spring lambs. Russell's data series was from the early sales by ELPC, thus he did not have as many sales per day as the data used in this study. It is believed that because Russell's data series was so short, only 39 observations, he was not able to identify all the time related components influencing the electronic lamb prices.

The data series used in this study began in April 1981 and went through September 1982. The data contained 153 lamb auction sales. However, for the months May through September, only 107 observations

were usable. The raw data was plotted against time to reveal significant price patterns. A very prominent seasonal pattern was evident. It was therefore hypothesized that some of Russell's relationships were influenced by the presence of this seasonal pattern. Before reexamining some of Russell's relationships, the data was detrended. The purpose of detrending the data series is to create a data series that is free of systematic time related components.

2.2.1 Current Work Done on the Magnitude of Computerized Prices

The time period used by Russell for the electronic market data was early in ELPC's development. It is possible that the previously established relationships have changed as ELPC's computerized sales grow in acceptability. These early prices may have been artificially supported by the enthusiasm for the new system, the coincidence of the change in the grading standards for Blue 0 lambs, and the occurrence of rival behavior in other markets.

In this study, the length of the data set was increased. Russell found significant positive means from his differenced price series. If the electronic markets did increase competition and provide value related information and reduce buyer costs in regional markets, then it can be hypothesized that the differenced regional prices will continue to have a significant positive mean. The same differenced price series, defined in Table 2.1, was calculated. The differenced regional prices from the computerized prices had a mean of $1.36 per cwt., which was statistically significant. However, the differenced national price ser-

ies did not provide statistically significant results. The mean for the NDF was .006. The insignificance could be attributed to increased feedback found to exist between the computerized prices and the national prices.

2.2.2 Current Work Done on Computerized Price Responsiveness to Market Information

The most significant results obtained by detrending the computerized price series came from the models testing computerized price responsiveness to market information. It was proposed and tested by Russell that if electronic prices are more efficient than conventional markets, then the computerized markets could process the information before the conventional markets were able to digest it.

Since trend played a large role in determining the price level, the updated models are tested using the detrended data. Russell had only tested this relationship against the differenced regional price of lambs. It is hypothesized that if such a lead-lag relationship does exist, it would also be picked up by the price responsiveness of the national prices. The updated version of Russell's price responsiveness models are defined in Table 2.5. Table 2.6 shows the differenced computerized and regional prices of lambs, lagged 0, 1, and 2 weeks. This is an update of what Russell did, except for having a larger data set. The format of the models were changed in order to reinforce the belief that price responsiveness is occurring instead of showing simple correlations. Tables 2.7 and 2.8 are the results from the detrended prices, lagged 0, 1, and 2 weeks. Table 2.7 shows how the national price and computerized interact in various lagged periods.

Table 2.5 Definitions of the Variables used in Modeling Price Responsiveness to Market Information

Variables	Definitions
DCPL	The first differences of the computerized price of lambs (CPL). Where CPL is the price of Blue 0 lambs at the ELPC computerized sales. Weekly data for the months May through September, 1981-82 are used. Units are $/cwt.
DCPL1	One week lag of DCPL.
DCPL2	Two week lag of DCPL.
DRPL	The first differences of the regional price of lambs (RPL). Where RPL is the average price of prime and choice lambs weighing 95 to 125 pounds at the Abingdon and Staunton VA livestock markets. Weekly data for the months May through September, 1981-82 are used. Units are $/cwt.
DRPL1	One week lag of DPRL.
DRPL2	Two week lag of DPRL.
DNPL	The first differences of the national price of lambs (NPL). Where NPL is the average price of prime and choice spring lambs sold at the San Angelo, Tx; Sioux Falls, SD; and South St. Paul, MN markets. Weekly data for the months May through September, 1981-82 are used. Units are $/cwt.
DNPL1	One week lag of DNPL.
DNPL2	Two week lag of DNPL.
DETCPL	The detrended computerized price of lambs (CPL). Where CPL is defined as above.
DETCPL1	One week lag of DETCPL.
DETCPL2	Two week lag of DETCPL.

Table 2.5-Continued

DETRPL	The detrended regional price of lambs (RPL). Where RPL is defined above.
DETRPL1	One week lag of DETRPL.
DETRPL2	Two week lag of DETRPL.
DETNPL	The detrended national price of lambs (NPL). Where NPL is defined as above.
DETNPL1	One week lag of DETNPL.
DETNPL2	Two week lag of DETNPL.

Table 2.6 Updated Models Testing the Price Responsiveness to Market Information, N = 107[a]

Model	Dependent Variable	I	DCPL	DCPL1	DCPL2	DRPL	DRPL1	DRPL2	R^2
1	DRPL	-0.0023 (0.2055)	0.1523 (0.0731)	0.3717 (0.0803)	0.0823 (0.0845)		0.01608 (0.1463)		0.40
2	DRPL	-0.4676 (0.4068)		-0.4984 (0.1639)		0.6130 (0.2940)	-0.1418 (0.2621)	0.1282 (0.2504)	0.19

[a]The numbers in parentheses directly below the parameter estimates are the standard errors.

The statistics from Table 2.6, do not coincide with Russell's results. The one week lagged computerized price is still explaining a statistically significant portion of the weekly price change in the regional market for the next or following week. The current computerized price is, however, also explaining a statistically significant portion of the weekly price change in the regional market. Also the current regional price is affecting the computerized price.

This instanteous two-way relationship implies that a change has occurred in the previously determined relationship. An explanation for this change comes from Russell's hypothesis that the regional markets were acting competitively with the new computerized markets in setting their weekly price levels. This competitive attitude has diminished since both markets now share current information, thus both establishing prices from the same set of supply and demand forces.

The hypothesis that the markets react simultaneously to each other was confirmed when the detrended regional price series was lagged 0, 1, and 2 weeks and regressed against the computerized price series. The results are in Table 2.7. The detrended price series does not show a two-way relationship between the current prices. This can be attributed to the fact that in this data series the prices are corrected for both the time and seasonal components. This model gives a much better indication that the computerized price can in fact lead the regional price. Theoretically, both techniques are used to remove trend, but the transformation used here also removed seasonal components.

Table 2.7 Models of Detrended Regional and Computerized Price of Lambs Showing Price Responsiveness to Market Information, N = 107[a]

Model	Dependent Variable	I	DETCPL	DETCPL1	DETCPL2	DETRPL	DETRPL1	DETRPL2	R^2
1	DETRPL	14.131 (6.788)	0.2168 (0.1077)	0.4362 (0.1193)	0.2062 (0.1280)		0.2464 (0.1552)		0.50
2	DETRPL	19.172 (10.272)		0.1404 (0.1921)		0.3986 (0.2075)	0.1727 (0.1911)	-0.0678 (0.1799)	0.28

[a]The numbers in parentheses directly below the parameter estimates are the standard errors.

If such relationships exit between the regional and computerized markets, then it can be hypothesized that some type of causal relationship would exist between the national prices of lambs and the computerized prices of lambs. Again an instanteous two-way relationship may be seen from the results shown in Table 2.8. The detrended national price and the computerized price react to the same sets of supply and demand forces. These results confirm the belief that both of these markets are competitive, since they both have access to the same set of information. The national lamb markets, as defined by NPL in Table 2.4, use the information available from the computerized markets in establishing their prices. Likewise, the computerized markets use the national prices in helping to determine their relevant opening prices for various auction lots.

One further series of prices were regressed against one another to test for price determining relationships. The differenced national prices and differenced computerized prices were lagged 0, 1 and 2 weeks and regressed against one another as shown in Table 2.9. It was hypthesized that since the differenced regional and computerized prices showed significant relationships when lagged and regressed upon one another, the differenced national prices of lambs lagged 0, 1, and 2 weeks would also show statistically significant price responsive relationships. This was the case for the differenced national prices and differenced computerized prices. The differenced computerized price was statistically significant when regressed against the differenced national price. This is an instanteous relationship. That is, neither market

Table 2.8 Models of Detrended National and Computerized Price of Lambs Showing Price Responsiveness to Market Information, N = 107[a]

Model	Dependent Variable	I	DETCPL	DETCPL1	DETCPL2	DETNPL	DETNPL1	DETNPL2	R^2
1	DETNPL	9.649 (4.129)	0.3442 (0.0740)	-0.0552 (0.8901)	-0.0765 (0.0722)		0.6058 (0.1197)		0.71
2	DETNPL	5.639 (6.713)		0.2781 (0.1251)		0.7976 (0.1706)	0.1561 (0.2472)	-0.3504 (0.1728)	0.60

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[a]The numbers in parentheses directly below the parameter estimates are the standard errors.

has an informational advantage; they are both reacting to the same set of information at approximately the same time. They may both also be affected by the same time related components. The occurrence of this relationship may indicate that the national markets for lambs, as defined by the variable in Table 2.1, are as efficient as the computerized markets. It can not be inferred from these relationships that the development of the computerized markets influenced the efficiency of the national markets, since the computerized prices are effected by the lagged national prices.

Table 2.9 Models of Differenced National and Computerized Prices of Lambs Showing Price Responsiveness to Market Information N = 107[a]

Model	Dependent Variable	I	DCPL	DCPL1	DCPL2	DNPL	DNPL1	DNPL2	R^2
1	DNPL	-0.1494 (0.2132)	0.3683 (0.0724)	0.1632 (0.0828)	0.0298 (0.0670)		-0.3260 (0.1400)		0.33
2	DNPL	-0.1639 (0.3371)		-0.4002 (0.1211)		0.8880 (0.1765)	0.7419 (0.2070)	-0.0780 (0.1831)	0.44

[a]The numbers in parentheses directly below the parameter estimates are the standard errors.

Chapter III

THEORETICAL CONCERNS FOR CONSIDERING BIDDING STRATEGIES

3.1 INTRODUCTION

Agricultural markets provide farmers and processors with information to guide their production, marketing and storage decisions (Gupta and Mueller). Conventional markets have not always provided the farmers and processors with all the available information, thus decreasing the competitiveness of agricultural markets. In conventional markets, the number of buyers is usually small, thus contributing to the thin market problem (Schlei). Hayenga noted that thin markets are usually mentioned whenever pricing and marketing problems arise. One very prominent pricing problem is the fewness of participants at agricultural markets. This problem may have been accentuated by the increase in decentralized markets.

Buyers who do participate in these agricultural markets realize that the opportunity for price manipulation does exist in thin decentralized markets. Generally, in agricultural markets, price manipulation may be partially attributed to the fact that each buyer is well recognized by all the other buyers. Buyers and sellers are generally few in agricultural markets, as locational differences affect the number of participants. When a large order buyer or a prominent local buyer begins to bid aggressively, other buyers may alter their usual bidding patterns. These buyers usually do not try to compete with the large aggressive buyers when they are known.

Electronic marketing makes it possible for more buyers and sellers to participate in decentralized markets. This increased accessibility eliminates the geographical barriers prominent in agricultural markets. With increased buyer accessibility, a greater volume of trade occurs at auctions thus increasing the competitiveness of the market. Electronic marketing provides more information to all the buyers, thus eliminating informational advantages which might accrue to larger buyers.

3.1.1 Bidding Characteristics

A behavioral study of bidding characteristics is warrented by an analysis previously done on conventional auctions. Kuehn, in his study of West Virginia cash slaughter cattle auctions, noted that price trends were higher toward the last one-third of a sale day. His reasoning for this occurrence was that bidders may "feel the market out" or are shopping for bargains in the first two-thirds of the day. As the sale progresses, packers and order buyers must fill their quotas or buying objectives, so they begin to bid more aggressively. Vickrey, in an earlier study, made conclusions along the same lines. He used an experimental setting to test his hypothesis that bidders usually sit back and speculate about the next lot's identity and value. These results imply that bidding strategies create differences in a buyer's behavior and are an inherent and important part of auction settings.

As markets shift from conventional auctions to electronic auctions, many of the standards of operation change. As would then be hypothesized, bidding strategies may also change (Riley and Samuelson). The

bidding behavior of each type of buyer can be analyzed to identify any behavioral patterns.

3.2 PROFILE OF EACH TYPE OF BIDDER

ELPC's electronic system is organized as a membership organization. Of its members, three different types of buyers exist. The largest proportion of buyers consists of farmers, local buyers or ELPC acting as a marketing agent and taking title to some of the lambs. Local buyers generally need small quantities of lambs. They may buy the lambs to add to a small lot until they have enough to send to market in load-size lots, or they may be expecting an increase in the price of lambs across time or between markets and are looking for arbitrage profits. The next largest group of buyers consists of packer buyers. Packers need lambs in large quantities. They have to consider fixed costs of their plants and must try to make a profit. Order buyers are the third type of buyer represented on the system. Order buyers are concerned with filling quotas and executing their orders. They also usually need a large amount of lambs.

Since each type of buyer has different objectives, it can be hypothesized that each has different bidding strategies. The packer buyers should have more economic constraints than the other two types of buyers. They may own plants and have to meet certain managerial objectives. Their bidding strategies should be clearly defined to meet their objectives. Packers will attempt to buy lambs at a price to reflect gross margins per load. At the limit, they would bid to a level where

average variable cost is approaching selling price. The order buyers also face economic constraints. They have instructions from employers as to what should be paid for the lambs and how many they need. Paying "too much" costs indirectly through the loss of clients. Packers and order buyers should have a good knowledge of the current economic conditions and have probably participated in numerous auctions.

The small local buyer, on the other hand, may not have such full access to pertinent information. He may rely more on the current "coffee shop" talk. The small buyer will also have economic constraints but may not have the most current cost and return figures for his business. These buyers are thus not as inclined to have efficient bidding strategies as the other larger buyers -- although ELPC could well be an exception in this group. The number of lambs needed will also be much smaller. Thus, it can be hypothesized that the small local buyer does not bid as effectively as the large buyers in terms of buying to meet a specific set of costs and/or expected returns.

The bidding characteristics that each type of bidder possesses are defined in Table 3.1. These variables are measurable qualities of electronic auctions which help to catagorize each buyer type. Table 3.2 quantifies the differences between each type of buyer and Table 3.3, gives a summarization of the number of successful lots by final buyer identification numbers. The results from Table 3.3 further confirm the analysis above that the larger buyers bought more lots.

As can be seen, the local buyers bid on average 1.57 more times than the packer/order buyers, but these extra bids did not help them to

Table 3.1 Definitions of Bidding Related Variables

Variable	Definition
NB	The average number of bids by a particular type of buyer, on a given lot.
WINS	The average number of lots won by a particular type of buyer.
FTIME	The average number of seconds that a particular type of buyer waits before entering the sale. The unit is seconds.
STIME	The average number of seconds that a particular type of buyer waits before bidding the second time on a lot. The unit is seconds.
DETCPL	The average detrended electronic sale price of slaughter lambs. The unit is $/cwt.
PDIFF	The average amount by which the price improves between the first and last bid. The unit is $/cwt.
BTIMDIFF	The average number of seconds that any given bidder waits between each bid. The unit is seconds.
NUMBUYRS	The number of different buyer types bidding during a sale. There are three different buyer types, local, packer, and order buyers.
NUMBIDS	The number of bids counted during a sale.

Table 3.2 Analysis of the Bidding Related Variables by Buyer Type

Bidding Variables	Local Buyers			Packer/Order Buyers		
	Mean	Min	Max	Mean	Min	Max
NB	3.17	1.00	9.00	1.60	1.00	2.00
WINS	5.43	1.00	15.00	23.40	5.00	44.00
FTIME	16.25	0.00	108.00	17.00	0.00	54.00
STIME	29.08	0.00	65.00	16.40	0.00	46.00
DETCPL	60.36	49.75	75.00	59.68	45.50	75.75
PDIFF	1.78	0.00	5.75	2.11	0.00	7.75
BTIMDIFF	8.46	0.00	25.00	11.15	0.00	25.00
NUMBUYRS	2.55	0.00	6.00	2.61	1.00	6.00
NUMBIDS	7.84	1.00	21.00	9.06	1.00	26.00

Table 3.3 Summarization of the Number of Lots by Final Buyer Identification Number

Final Buyer	Number of Successful Bids	Type of Buyer
1	1	Local
2	3	Local
3	15	Packer/Order
4	17	Packer/Order
5	14	Local
6	34	Packer/Order
7	5	Packer/Order
9	15	Local
10	44	Packer/Order
14	2	Local
18	2	Local
22	1	Local
Total	153	

obtain any more of the lots. Local buyers bid 3.17 times per lot. They won 38 lots, 24.8 percent of the total 153 lots (Table 3.3). It was observed that the local buyers entered the sale 16.5 seconds after the initial bid and then rebid 12.8 seconds later. Thus, a local buyer tended to enter a sale early and then would wait to rebid in the later portion of the sale. The local buyers, on average, paid $60.36 per cwt. The difference between the local buyers price and the packer/order buyers is $.68 per cwt., which is not a significant difference.

The packer and order buyers bid 1.6 times per lot. The packer/order buyers were able to bid a fewer amount of times, on average, and obtain more lots of lambs for a lower price. The packer/order buyers obtained 115 lots or 75.2 percent of the total 153 lots sold (Table 3.3). The packer/order buyers tend to enter a sale at an average of 17.0 seconds after the first bid. Their rebid time, however, is less than their initial bid time. This phenomenon can be explained by the occurrence of packer and order buyers generally bidding later in the sale and usually bidding once. The bidding techniques for the packer/order buyers provide a more disiplined method for procurring lots. From a study of West German slaughter hog markets, processors tended to be the better informed buyers and bought larger quantities (Gupta and Mueller).

3.3 ANONYMOUS BIDDING

In conventional markets, the identity of each bidder is fully known. In the electronic markets, none of the bidders know which or how many other bidders are on the system during an auction. One hypothesized advantage of the electronic market is that the buyer's identities remain anonymous and thus the market can function more effectively in discovering the instrinsic value of the commodity. It is hypothesized that when the identity of the bidders is unknown, bidders will continue to bid on a given lot until as few as two bidders are actively participating in the bidding process. Significantly, one or both of the two final bidders could be the large aggressive buyers referred to above. It is this "extra" bidding which needs to be investigated to determine whether or not it has a significant impact on price level and/or the magnitude of price improvement during the auction.

3.3.1 The Anonymity Feature

To analyze the impact of the anonymity feature on price in the computerized lamb auctions, the concept of a "coupling" is developed. A coupling is defined as a repeat bid by one bidder of a pair of bidders. For example, assume a bidding sequence involving buyers A, B, and C develops in the order A, B, A, C. There is one coupling in this series. The second bid by A, before C intervenes, is a "repeat bid" following the initial pair of bids, AB. In the sequence A, B, A, B, A, C, A, C, A, C, B, there are three couplings registered by buyers A and B and four couplings registered by buyers C and A. Note that the first bid by C

broke the string of bids recorded by buyers A and B. Buyer A bid after the initial bid by C, and when C then rebids, one coupling has been recorded. Three more repeat bids are recorded by A or C, giving a total of four couplings.

The conceptual discussion presented above supports an hypothesis that price level and/or price improvement[4] would be influenced by the number of couplings in an auction. To further analyze this dimension of the auctions, three variables were initially defined:

1. COUP = the total number of couplings, across all bidders, during the auction;
2. COUP1 = the number of couplings by the dominant pair of bidders divided by the average number of couplings during the auction, across all bidders; and
3. COUP2 = the number of couplings by the dominant pair of bidders divided by the total number of couplings during the auction, across all bidders.

The variables COUP1 and COUP2 were introduced to help offset the problem of a tautological relationship between COUP and the detrended computerized price or price improvement variables.

Table 3.4, records the hypothesized relationship between the variables COUP, COUP1, and COUP2 and price and/or price improvement. Also included is a brief statement of the theoretical support for the direction of the hypothesized relationship.

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[4] Price improvement is defined as the final price minus the first bid price entered by a potential buyer.

Table 3.4 Hypothesized Relationship Between Variables Defined to Reflect the Relationship Between the Anonymity Feature and Final Detrended Price or Price Improvement in the ELPC Computerized Lamb Auctions

Variable	Expected Relationship	Theoretical Support
COUP	+	It is a tautology that price and price improvement will increase with an increase in couplings. But a positive relationship would also be expected between price and the number of couplings for auctions which record the same number of bids.
COUP1	+	Increases in COUP1 could be evidence that the dominant pair is indeed dominating the auction process. This would occur when the ratio is large because the numerator is large. Conceptually, an exception could occur when the ratio is large and the dominator is small because of a large number of different bidders in the auction.
COUP2	+ or -	The relationship would be expected to be positive when the increase in COUP2 is due to a large numerator. The relationship could be negative when a large COUP2 is due to a small demoninator, suggesting a small number of total bidders.

The three COUP variables are correlated to both the price level and the price improvement variables, shown in Table 3.5. The correlation coefficients give some indication as to how these three variables will impact the price level and the price improvement variables.

All the variables conformed to their a priori hypotheses. No a priori significance was attached to the null hypothesis that the parameter is equal to zero. Thus, when it is stated that statistical significance occurred, the level is that of the probabilities associated with the t-distribution. The first variable, COUP, is not significantly correlated with the price level. For that matter, none of the COUP variables are highly correlated with the price level. However, when COUP is correlated against PDIFF, it is highly significant. This result is further evidence that the presence of couplings impacts the improvement in the computerized price of lambs.

The second variable, COUP1, has a positive sign and is highly correlated against the price improvement variable, PDIFF. COUP1 increases when (1) the number of couplings by the dominant pair increases, (2) the number of buyers increases, bringing a decrease in the average length of couplings across all buyers, or (3) some combination of the two. Regardless of the source of the increase, any increaeses in this variable bring a highly significant increase in the price improvement which occurs during an auction. The third variable, COUP2, has a positive sign and is again highly correlated with PDIFF. The expected sign for COUP2 was not clear a priori. Its positive impact on price suggests that increases in COUP2 came from increases in the number of dominant couplings. Examination of the data confirms this conclusion.

Table 3.5 Correlation Coefficients of COUP, COUP1, and COUP2 with the Detrended Computerized Price and Price Improvement, N = 153[a]

	COUP	COUP1	COUP2
DETCPL	0.13084 (0.1069)	0.12493 (0.1239)	0.08446 (0.2993)
PDIFF	0.61502 (0.0001)	0.46505 (0.0001)	0.26153 (0.0011)

The numbers in parentheses directly below the coefficients are the probability values.

Before testing the hypothesis that anonymous bidding yields a higher price, the issue of an increase in price simply by more bidding has to be more thoroughly investigated. A legitimate concern is that a test conducted upon the hypothesis would merely be a tautology; that is, that more bidding yields higher prices. Several preliminary hypotheses were developed in order to guide further testing. It was important to test that prices received for lots where coupling occurred were higher than prices received for lots with no coupling. Each lot was identified as either having the occurrence of a coupling or not having the occurrence of a coupling. This classification is used as a dummy variable[5]. The price had to be stated in such a manner as to avoid the criticism that the price was higher because there were more bids. What was done was to test the change in price between the first bid and the last bid. This change in price, PDIFF, was then segregated by the occurrence or nonoccurrence of the final coupling, by using a dummy variable. The dummy variable takes the value of 1 when coupling occurred and 0 otherwise.

The means of each price difference, PDIFF, are tested against not being statistically different from each other, as shown in Table 3.6. The hypothesis that guided the testing was that during electronic market auctions, buyers tend to "couple-up". The occurrence of couplings has a positive impact on price. It was observed that coupling occurred 80 out of 153 times during the period studied.

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[5] The dummy variables are used to quantify the presence or absence of a particular attribute. A one represents the occurrence of this qualtive attribute whereas a zero represents the nonoccurrence.

Table 3.6 Test for the Difference Between the Means of Detrended Computerized Price and the Means of Price Improvement, when the Coupling Phenomenon Occurs, N = 153

Variable	Occurrence of Couple	Mean	Minimum	Maximum	Std Err. of Mean	p-values for Equal Variances	p-values for Unequal Variances
DETCPL	0	50.204	38.87	59.40	0.4210	0.0792	
DETCPL	1	51.258	39.37	62.12	0.4359		
PDIFF	0	1.561	0.00	4.75	0.1158		0.0001
PDIFF	1	2.481	0.50	7.25	0.1420		

The mean for the price difference, PDIFF, with coupling is $2.48 per cwt., while the price difference without coupling is only $1.56 per cwt. The maximum value of the mean with an occurrence of a final couple is $7.25 per cwt., while the maximum value of the mean without an occurrence if a final couple is only $4.75 per cwt. The null hypothesis that the variances of the PDIFF means are equal can be rejected at the 5 percent level. The means with unequal variances are statistically significant at the 5 percent level.

The mean for the detrended price level, DETCPL, with coupling is $51.26 per cwt., while the detrended price level without coupling is $50.20 per cwt. The maximum value of the mean DETCPL without coupling is $59.40 per cwt. The null hypothesis that the variances of the DETCPL means are equal can not be rejected. There is no statistically significant difference between the mean detrended price with or without coupling.

The theoretical discussions surrounding the possible importance of anonymous bidding have focused on bidding at the end of the auction process. Because of the anonymity in the bidding process, repeat bids (couplings in this analysis) recorded between two bidders at the end of the auction might not occur if each buyer knew that there were only two potential buyers still bidding, and the identity of the other bidder.

To extend the analysis, focusing attention on bidding behavior at the end of the auction, two additional and related analytical steps were taken. First, tests were conducted to determine whether there exists a statistically significant difference in the mean price for the group of

auctions with at least one coupling at the end of the auctions compared to the group with no couplings at the end. Second, since the two broad groups were found to be statistically different, the three variables introduced above were then to be redefined as follows:

1. FCOUP = the total number of couplings which occur at the end of the auction;
2. FCOUP1 = the number of couplings by the final pair of bidders divided by the average number of couplings during the auction, across all bidders; and
3. FCOUP2 = the number of couplings by the final pair of bidders divided by the total number of couplings during the auction, across all bidders.

Table 3.7, records the statistical measures and tests applied to FCOUP, FCOUP1, and FCOUP2 relative to price and price improvement.

All three of the FCOUP variables have positive signs in their correlation coefficients, for both the detrended electronic price and price improvement. These variables are not intended to explain a great deal of variation in either the price or price improvement, but are expected to show the significance of this anonymity feature on detrended computerized price or price improvements.

The first variable, FCOUP, was not highly correlated with the detrended price. However, when FCOUP is correlated with the price improvement, it becomes highly significant. This result tends to suggest that as the number of dominant final couplings increases, the price will also improve. The second variable, FCOUP1, is positively correlated to

Table 3.7 Correlation Coefficients of FCOUP, FCOUP1, and FCOUP2 with the Detrended Computerized Price and Price Improvement, N = 153[a]

	FCOUP	FCOUP1	FCOUP2
DETCPL	0.12845 (0.1136)	0.18376 (0.0230)	0.13288 (0.1015)
PDIFF	0.60917 (0.0001)	0.44837 (0.0001)	0.22822 (0.0045)

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[a] The numbers in parentheses directly below the coefficients are the probability values.

both price and price improvement. As FCOUP1 becomes larger from an increase in the total number of couplings (generates a small average coupling length) or from an increase in the dominant number of final couplings, the price level increases and the price improvement increases dramatically. The third variable, FCOUP2, has positive signs with both price level and price improvement. FCOUP2 is not highly correlated with the price level. It is, however, highly correlated with PDIFF. Again, this significant impact on price improvement further supports the hypothesis that the presence of final couplings increases price.

3.4 FURTHER INVESTIGATION OF FINAL COUPLINGS

The appearance of couplings at the end of each auction exerts a significant influence on price improvement. To facilitate further analysis of this measure of anonymity in bidding, the auctions with couplings at the end of each sale were segregated. The final coupling variable, FCOUP, was then divided into equal increments. Dummy variables were again used to measure the impact of each increment. The increments were created by taking the longest final string of final couplings and dividing each up equally. The largest final couple was 18. To obtain the equal increments 18 was then divided up into three groups; D1 (1-6 bids), D2 (7-12 bids), and D3 (13-18 bids).

The hypothesis to be tested is that the means of the price and price improvement are different for couplings of different magnitude. The results of tests on both price level and price magnitude are reported in Table 3.8. As the length of the couplings increased, the differ-

Table 3.8 Tests for the Difference Between the Means of Detrended Computerized Price and the Means of Price Improvement, when a Final Coupling Occurs within Three ranges, N = 153

Model	Variable	Class D1	Class D2	Class D3	Mean	Min	Max	Std. Err. of Mean	p-values for Equal Variances	p-values for Unequal Variances
1	PDIFF	0	0	0	1.98	0.00	7.75	0.1479		0.4325
	PDIFF	1	0	0	2.13	0.50	5.75	0.1238		
2	PDIFF	0	0	0	1.93	0.00	7.75	0.1045		0.0001
	PDIFF	0	1	0	3.00	2.00	5.00	0.2079		
3	PDIFF	0	0	0	1.93	0.00	5.75	0.0887	0.0001	
	PDIFF	0	0	1	5.15	3.75	7.25	0.6828		
4	DETCPL	0	0	0	50.57	38.86	62.12	0.4103	0.4834	
	DETCPL	1	0	0	51.00	39.37	59.13	0.4622		
5	DETCPL	0	0	0	50.64	38.86	62.12	0.3238	0.2823	
	DETCPL	0	1	0	51.72	43.91	55.48	0.9426		
6	DETCPL	0	0	0	50.74	38.86	62.12	0.3111	0.7677	
	DETCPL	0	0	1	51.25	43.92	55.48	1.9500		

ence between the means of price also increased. However, the means were not statistically different from each other.

The means of the price improvement variable were always greater in the presence of the final couplings and the mean differences increased for the longer couplings. The only price difference mean that is not statistically significant is for the class D1 variable. The other two price difference means are statistically different.

If this postive relationship between the number of bids and the improvement in price was purely a tautological relationship, then the improvements in the means would be directly proportional to the average number of couplings occurring within each group. For example, if price magnitude was purely increasing as a function of the increased number of couplings, then the average number of couplings multiplied by the price increment, $.25 per cwt., would yield the expected price improvement. In the first class group, 1 through 6 couples, the average number of couplings is 3.5, which when multiplied by $.25 per cwt., yields $.88 per cwt. price improvement due to the presence of coupling. The actual price improvement with couplings is only $.15 per cwt. For couplings occurring between 7 and 12 times, in class D2, the average number of couples is 9.5. When the average number of couples is multipled by $.25 per cwt., the average price improvement due to the presence of couplings is $2.38 per cwt. The actual was again less than the average price improvement. In the last class, D3, with bids occurring between 13 and 18 times, its presence causes the mean price improvement to be significantly different from the mean price improvement with the other two classes

of couplings. The actual price improvement in this last class grouping was also less, by $.51 per cwt., than the expected price improvement of $3.88 per cwt.

3.5 TIME RELATED INFLUENCE ON PRICE LEVEL AND PRICE IMPROVEMENT OF COMPUTERIZED ELECTRONIC SLAUGHTER LAMB SALES

During each auction, the bidders participate in the sale by bidding. The bidders place initial bids and rebids at various intervals throughout the sale. Thus, the time elapsed between each bid varies throughout the sale. The bidding intervals used by each different type of bidder may vary among bidders and across each bidder type. This aspect of electronic markets is intriguing. Much can be learned from an analysis on a bidder's bid wait time.

The three different types of buyers using ELPC's electronic system are local buyers, order buyers and packer buyers. BTIMDIFF, defined in Table 3.1 as the average difference in seconds between bids, must be divided up to allow for comparisons between its classes. BTIMDIFF ranges from 0 up to 25 seconds. The means of the BTIMDIFF variable range from 0 up to 18. It is these mean values which are analyzed, with six different classes designating groups containing 3 seconds.

3.5.1 Impact of the Bidtime Differences as they Effect the Detrended Electronic Price Improvement of Slaughter Lamb Sales

The six classes of the mean bid wait times are hypothesized to have different impacts on the price improvement of electronic slaughter lamb sales. The results are reported in Table 3.9. This information can be

Table 3.9 Distribution of the Mean Bid Wait Time by the Six Bid Time Intervals and their Impact on the Price Improvement of Computerized Electronic Slaughter Lambs, N = 153[a]

Bid Time Classes	Explanatory Variables within the Classes	Coefficient	p-value	Std Errors	Number of Bids by Class
C4 (10-12 sec.)	I	2.26	0.0001	0.1637	51
	C1	-1.91	0.0001	0.4712	7
	C2	-0.265	0.5751	0.4712	7
	C3	-0.099	0.6474	0.2166	68
	C5	-0.765	0.0209	0.3274	17
	C6	-0.319	0.6471	0.6445	3

The six bid time intervals are: (1) C1 = 0 to 3 bids, (2) C2 = 4 to 6 bids, (3) C3 = 7 to 9 bids, (4) C4 = 10 to 12 bids, (5) C5 = 13 to 15 bids, and (6) C6 = 16 to 18 bids.

used to evaluate the effectiveness of longer or shorter bid wait times on price improvement. The first mean bid wait time class contains all of the one bid auctions; thus, the bid wait time is zero. All other classes contain bid wait times between the defined intervals.

The fourth class, C4, has the most observations and was thus felt to be a better representation of a bidder's bid wait time between bids. When the fourth class of bid wait times, C4, is omitted from a multiple regression equation, all the coefficients are negatively impacted. Only the first class of bid wait times, C1, was highly significant at the 1 percent level. This implies that bid wait times below three seconds have significantly decreased the price improvement of lambs. The fifth class of bid wait times is fairly significant at the 20 percent level. This implies that bid time intervals longer than 13 seconds negatively impact the price improvement of lambs. Since all of the variables are negative, it can be stated that the fourth class of the bid wait times has a positive improvement on the price of lambs.

3.5.2 Analysis of Bidtime Differences as they Impact the Type of Buyers

Each type of buyer is analyzed by time difference classes to test whether any significant relationships exist between the two. The results of this test are reported in Table 3.10. Most bids, across all types of buyers occur in classes 3, 4, and 5. Packers and order buyers, especially order buyers, show a slight tendency to wait longer to bid than do the local buyers. There are no significant patterns apparent in the data.

Table 3.10 Distribution of Different Type of Buyers in Various Bid Intervals, N = 1390[a]

Class	Type of Buyer Local	Packer	Order	% of Bids by Type
1	5			1.40
		1		0.18
			1	0.68
2	35			5.00
		28		5.60
			1	1.00
3	322			45.93
		213		39.23
			53	36.30
4	239			34.09
		203		37.38
			62	42.47
5	86			12.27
		80		14.73
			20	13.70
6	14			2.00
		18		3.30
			9	6.16
Total	701	543	146	100%[b]

The bid intervals are defined as, class C1 = 0 to 3 bids; class C2 = 4 to 6 bids; class C3 = 7 to 9 bids; class C4 = 10 to 12 bids; class C5 = 13 to 15 bids; and class C6 = 16 to 18 bids.

The percentages in each class totals to 100 %, any slight difference is due to rounding error.

3.6 MULTIVARIATE PRICE MODELS FOR ELECTRONIC MARKETS

In trying to document the impact of electronic auctions on prices, several behavioral parameters must first be defined. The parameters which merit attention are the number of bids per lot, number of different buyers per lot, and the time between each bid.

A correlation matrix was constructed to test the relationship between the variables identified above and the detrended price and/or price improvement. The number of bids per lot, NUMBIDS, is expected to have a positive effect on the detrended computerized price of slaughter lambs. NUMBIDS was not statistically significant when correlated with the detrended computerized price of lambs (Table 3.11). NUMBIDS shows a positive correlation with PDIFF and the relationship is statistically significant. The number of head per lot, even though it is not unique to electronic auctions, may have an impact on the price and price improvement.

The number of buyers per lot, NUMBUYRS, is also expected to have a positive effect on the price of lambs. The reasoning for this sign comes from the competitive market theory. As more buyers participate in auctions, the price of the commodity is usually higher. NUMBUYRS is positively correlated with both price and price improvement levels with significance levels of .0071 and .0001, respectively.

The BTIMDIFF variable is negatively correlated with the price of slaughter lambs. The relationship, however, is not strong. The correlation with the price improvement variable is positive but, once again, is not highly significant. HEAD also was not significantly correlated

Table 3.11 Correlation Coefficients for Selected Variables with the Detrended Electronic Computerized Price of Slaughter Lambs and Price Improvement, N = 153[a]

	NUMBIDS	NUMBUYRS	BTIMDIFF	HEAD
DETCPL	0.06082	0.21747	-0.1115	0.08450
	(0.4567)	(0.0071)	(0.1714)	(0.3007)
PDIFF	0.12063	0.42812	0.12063	0.20425
	(0.1375)	(0.0001)	(0.1375)	(0.0116)

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[a]The numbers in parentheses directly below the coefficients are the probability values.

to the price of lambs. But it was significant with the price improvement variable.

These four variables, NUMBIDS, NUMBUYRS, BTIMDIFF, and HEAD with the previously defined anonymity variables, FCOUP, FCOUP1, and FCOUP2, are used collectively to formulate multivariate models on price improvement and on the computerized price of lambs. The other variable which is used in the price model is the lagged detrended regional price. This variable is used to pick up other important economic factors that effect the general price level. The models with detrended computerized price and price improvement are reported in Table 3.12.

The models are constructed based on the significance of the correlation coefficients. The high correlation coefficients indicated that multicollinearity may be a problem between FCOUP and FCOUP1 and also for NUMBUYRS and NUMBIDS. Only two variables are employed intially to get an indication of how well these specific variables explain the variation in, or more importantly, the improvement in price during the auction.

The first model uses LDETRPL and NUMBUYRS and explains 28 percent of the variation in the dependent variable, the detrended computerized price of slaughter lambs. All the variables follow their expected signs and have a significant impact on the dependent variable. As the lagged detrended regional price increases one dollar per cwt., the detrended computerized price of lambs will increase by $.82 per cwt., ceteris paribus. If the number of different buyers increased by one, the computerized price of lambs will increase $.29 per cwt. The explanatory power of the model did not significantly increase when other variables were

Table 3.12 Models of Electronic Market's Influence Over the Price Improvement and the Detrended Computerized Price of Slaughter Lambs, N = 153[a]

Model	Dep. Variable	I	LDETRPL	FCOUP	FCOUP1	NUMBUYRS	HEAD	R^2
1	DETCPL	9.003	0.823			0.290		0.28
		(5.596)	(0.1125)			(0.2114)		
2	DETCPL	8.77	0.812		0.820	0.203	0.0019	0.30
		(5.589)	(0.1178)		(0.4427)	(0.2137)	(0.0024)	
3	PDIFF	0.588		0.206		0.356		0.53
		(0.1648)		(0.0191)		(0.0545)		
4	PDIFF	0.275		0.202		0.330	0.001	0.54
		(0.2300)		(0.0190)		(0.0541)	(0.0006)	

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[a] The numbers in parentheses directly below the parameter estimates are the standard errors.

added, which also caused multicollinearity problems between the highly correlated variables. Most of the variation in the detrended computerized price of lambs is accounted for by the lagged detrended version of the regional price and the number of different buyers.

With the price improvement variable as the dependent variable, statistical properties of the model improve. When only two variables, FCOUP and NUMBUYRS, are regressed, 53 percent of the variation in the price improvement is explained. All the variables have a significant impact upon the price improvement. When the number of head, HEAD, is included the explanatory power of the model is not increased significantly to warrant keeping this variable. All the variables are highly significant and of the correct signs. It may be concluded that as the number of different buyers on the system increases and more coupling occurs, there is a significant impact on price.

Chapter IV

SUMMARY AND CONCLUSIONS

4.1 INTRODUCTION

Livestock markets are increasingly plagued by the "thin market" problem. Increased cost of travel and the desire for large uniform lots can lead to situations with only 2 to 3 buyers in some small conventional markets. Communication technology has improved, costs have declined, and the possibility of selling livestock via electronic systems is receiving increased attention. In recent years, many resources have been expended in efforts to conceptualize, develop, and initiate electronic marketing systems. All systems which have been developed have common characteristics. Selling is by description which allows centralization of the exchange process with subsequent direct movement of the product from the seller to the buyer. Access to buyers is increased since buyers or their agents do not have to be in physical proximity with the livestock.

A computerized electronic system was developed by Virginia Tech and Virginia Department of Agriculture and Consumer Services (VDACS), working with a matching funds grant from the Agricultural Marketing Service (AMS) of the USDA. Eastern Lamb Producers Association (ELPC) adopted the system for use in the Association's lamb sales. Sales were initiated in mid-1980 and were continued through October 1, 1982 when the non-profit corporation which had been operating the sales was acquired by National Live Stock Producers, a private firm. This study examined

the impact of the electronic system on price levels and looked at the bidding strategies employed over the system.

4.2 THEORY

Agricultural markets tend to be characterized by small localized market settings. This market system has served in setting price levels for farmers over many years. The farmer, as the price taker, has had little opportunity to become the more aggressive marketer. The conventional system is changing with the spreading acceptance of electronic markets.

Electronic markets, developed only 20 years ago, are becoming a vital part of the marketing continuum. Electronic markets provide several advantages. The costs of procurement can be decreased. Electronic markets, through their computer network, allows buyers and sellers to remain at their offices and the animals to stay on the farm. By reducing transportation costs and cross-hauling, buyers can pay more for better conditioned animals. The increased accessibility that computers provide allows otherwise unaccessible buyers and sellers to participate in the market, putting more "buying power" in the market on days the supply is large and price is under pressure.

Since several costs advantages are provided by electronic markets, prices for the commodity may trend higher. These prices should be more nearly consistent with the value of the commodity, thus improving price accuracy. Prices discovered via an electronic medium do not tend to be altered by nonintrinsic price discounts. Discounts and premiums can be

set according to market value and are clearly identified and related to observable product attributes. This improves the efficiency of the system and its ability to send a message to the producer to indicate what quality he should or should not be producing and offering. Electronic markets are thus more price efficient. Market information can be processed more rapidly and made available to more buyers and sellers.

4.3 PRICE CONSIDERATIONS

Early analysis of ELPC's electronic computerized slaughter lamb auctions revealed significant impacts on both the prices received for slaughter lambs and the process by which they were discovered. The computerized price of lambs was shown by Russell to be higher and to lead the regional markets in the price discovery process. Computerized prices are still significantly higher than regional prices, but the difference between the computerized and national prices has disappeared. There have been some changes in the price discovery process since Russell's work. Electronic markets still show a tendency to "lead" price changes in conventional markets, but they now more nearly react simultaneously with both the national markets and the regional markets.

The factors that may have contributed to the change in price reactions are:

1. The regional markets no longer feel that the computerized markets are a threat to their position and are less inclined to make sure prices in week t match the prices in the computerized system in week t-1.

2. The regional markets are benefiting by the increased availability of market information, some of which comes from the computerized sales.

A significant difference between the mean regional and computerized price levels still exists. Advantages to value related information and increased competition can still be accredited to the computerized system. Knowing that the computerized market is an efficient market will allow industry and policy leaders an alternative as the issues surrounding the thin market problem continue to be discussed and studied.

The cost and price advantages that are created by electronic marketing can be used to promote extension to other markets and to other agricultural commodities. In a theoretical context, the computerized systems can be simple, accessible, and offer an effective alternative which can bring an increased level of competition to the market arena.

4.4 BIDDING STRATEGIES IMPLICATIONS

Three types of buyers generally participate in livestock markets. The first two, packer and order buyers, demonstrate more effective pricing behavior by buying the largest quantities, with the fewest number of bids, and at the lowest price. These buyers take full advantage of the more efficient electronic markets. Since this type of buyer dominates agricultural markets, analysis of their behavior during auctions will help provide information for developement of future electronic markets and how they may promote competitive buying.

A primary emphasis in this study of bidding behavior was that involving the anonymity issue. The evidence that electronic markets provide the stimulus for more competitive bidding behavior and a different bidding strategy has not been previously reported. The results provide the link to a previously unquantifiable issue. When bidders' identities remain unknown, they bid for a significantly longer period of time, which causes the change in the price during the auction to be significantly greater. If the identities of all bidders were fully known, then this extended bidding might not occur. Would buyer A, a strong buyer, and buyer B, a second strong buyer, compete head to head at the end of an auction if they knew only they were still bidding? It was proven that in the 80 sales with couplings (repeat bids by one of a pair of bidders) at the end, the price improvement was significantly greater than in sales where no couplings occurred at the end of the sale. The value of the coupling variable ranged up to 18 -- meaning there were as many as 18 repeat bids by two buyers when only the two were still bidding. The results indicate computerized electronic market systems, or other types of systems with anonymous bidding, can significantly enhance competitive bidding during auctions.

The time between bids had a significant impact on the improvement in the price of lambs. The bid wait time interval in the ELPC system is set at a maximum of 25 seconds, which allows each bidder up to 25 seconds in which to make the decision of whether to raise the last bid or not. The analysis indicated the full 25 second bid wait time did not help price improvement. Once the average bid wait time interval goes beyond 12 seconds, no further price improvement is realized.

Discovering that a bid wait time interval as long as 25 seconds is not beneficial to price provides new electronic systems with valuable information. One of the critical elements in the success of an electronic system is the actual auction process. Farmers and all other types of buyers have become accustomed to conventional style auctions. If the electronic auctions are not functionally appealing, if they are moving too slow because the "wait increment" is too long, then full participation can not be assured.

4.4.1 Conclusions and Implications

This thesis attempted to provide answers to several key issues about electronic computerized sales. A list of specific conclusions are:

1. The computerized price was used as part of the information set available to conventional markets in the area. Conventional markets look at the past computerized price to help establish current levels. However, the current computerized price is also significant in the price discovery process. There is more interaction between computerized prices and prices in conventional markets in recent months than was the case when the electronic markets were initiated.
2. The ability of the computerized markets to include previously unaccessible participants helps to eliminate the thin market problem. Computerized markets will provide producers in many remote areas a more viable pricing mechanism. The small producer,

who in the past has been strictly a price taker and subject to the price variations associated with different numbers of buyers, now has the opportunity to participate in a more competitive market. This is confirmed by the electronic's system prices being significantly higher than the regional prices discovered in conventional markets.

3. Computerized markets have the unique ability to allow the buyers to remain anonymous during the bidding process. Since the buyers do not know who or how many buyers are participating, they have a tendency to bid a longer time. The anonymity feature was measured by identifying when two bidders bid against each other. During the period studied, 80 out of the 153 sales had the occurrence of "couplings", repeat bids when only two buyers are left. The price improvement during the sale was significantly greater for the 80 sales where couplings occurred. That is, when the identities of the buyers remain unknown, they will bid for a longer period of time.
4. When two bidders bid against one another more than 6 times, the impact on price improvement was greater than when this type of bidding occurred less than 6 times. Thus, it is very important for anonymous bidding activity to be encouraged by producer groups and electronic marketing organizations.
5. Electronic computerized markets are structured so as to limit the amount of time between bids. ELPC set their bid wait time interval at a maximum of 25 seconds. The length of this interval was

arbitrarily set. It is important that this interval allow enough time for bidders to decide whether or not to bid. In the sales, the maximum " wait time" observed was 18 seconds. The interval was broken down into six catagories of three seconds each. It was shown that when the average bid wait time interval is between 9 and 12 seconds, price improvement during the sale was at a maximum. Larger average "wait times" brought significantly smaller improvements in price improvements which were smaller, on average, than those in the 9 to 12 second interval.

The overall conclusion is that electronic markets can benefit producer groups nationwide. Those producer groups interested in setting up new electronic markets now have a base on which to set such parameters as the "wait time" allowed and they have strong reasons to opt for s system that keeps the bidding process anonymous. As more data are generated, the theoretical advantages of electronic marketing can be subjected to more testing. The results of the study suggest practical advantages to electronic market systems.

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PRICE IMPLICATIONS AND BIDDING STRATEGIES FOR COMPUTERIZED ELECTRONIC MARKETS

by

Shannon Reid Hamm

(ABSTRACT)

The working hypothesis underlying this research was that computerized electronic marketing influences price level and the price discovery process. Electronic markets were also hypothesized to alter bidding strategies of participants.

The theoretical background which stimulated this study arose from the shortcomings of the competitive market system in agriculture. One possible solution to agriculture's pricing problems is electronic markets. Solving the thin market problem through increased participation via electronic markets can help to increase prices.

Three types of buyers use ELPC's system: packers, order buyers, and local buyers. Larger buyers are more disiplined buyers. They bid less, pay lower prices, and obtain a higher percentage of lambs sold. Large buyers have different objectives than smaller local buyers and are under more economic pressure to stay abreast of market conditions.

Electronic markets are unique since they set bid wait time intervals and identities of bidders remain anonymous. Both the bid wait time

interval and the anonymity feature significantly influences improvements in price during the auction process. Bid wait time intervals are necessary in developing electronic markets. Finding the optimum interval (9 to 12 seconds) will aid in setting bid increments for new electronic markets. Bidders, with anonymous bidding, will bid for longer periods of time and this means higher prices. This important finding suggests that overt or tacit collusion, which could occur in conventional auctions, does not occur in the computerized sales with the anonymous bidding.