The Economic Feasibility and Impacts of Electronic Markets: A Tentative Appraisal[1/]

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One obvious solution to pricing problems stemming from thinly traded markets is market "thickening." That is, many pricing problems can be mitigated by increasing the amount of trading in an organized market to the point where the volume of trading is adequate to generate prices which reflect marketwide supply and demand conditions with an acceptable degree of accuracy.

Market Thickening by Electronic Exchange

One innovative institution which has been put forth as a means of market thickening is the computerized trading floor, or the so-called electronic market. This is a marketing system in which the negotiation of prices, and perhaps other terms of exchange among a large number of buyers and sellers is centralized in a single, computerized trading operation.[3/] The physical flow of product from sellers to buyers occurs in a direct or nearly direct manner subsequent to successful sales negotiations.

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[3/] It is important to distinquish between electronic markets and computerized information systems. The latter use computer technology and often remote

Buyers and sellers do not physically stand on the centralized trading floor; rather, trading is conducted by a central computer and traders participate through various means of long distance communications such as telephones, teletype terminals, computer terminals or other remote access, high speed electronic media. The computer acts as communication manager and performs numerous marketing functions such as matching bids and offers, auctioneering, recording and confirming transactions, invoicing, managing traffic, enforcing trading rules, and compiling and disseminating price reports and other market information. Products are sold by description rather than by personal inspection and third-persons are normally used to certify the accuracy of such descriptions.

Electronic markets are organized exchange mechanisms, rather than computerized compilations of assorted and diverse private transactions. The essence of an organized market is centralized price discovery. Centralized assembly of products in one physical location is not necessary, nor necessarily desirable if the products can be accurately described in terms meaningful to the market participants. The characteristics necessary for organized trading are: 1) trading is conducted according to some predetermined set of rules; 2) all potential traders have equal and ready access to the market and the information generated from it, including prices and volumes traded, and 3) all potential buyers and sellers have freedom to act on the information available (Sporleder et al., p. 13). A successful organized exchange requires a sufficient number of potential traders to make for a competitive market.

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electronic communications to compile and disseminate information on sales offerings, purchase requirements and/or prices and other terms of trade subsequent to actual transactions. They do not include a mechanism for actual sales negotiations. Electronic markets, on the other hand, include sales negotiation as an integral part of the computerized system. That is, the computer actually monitors, facilitates, and records sales negotiations among buyers and sellers. As such, price establishment occurs within the electronic marketing process rather than in private negotiations as an adjunct to a computerized market information system.

One might envisualize an electronic market as similar to a trading pit on a major commodity exchange. Numerous buyers and sellers meet as a large group and sort out deals from among the offers and bids of other participants in a process that is competitive, visible, and governed by impersonal rules. The major difference is, in the electronic market buyers and sellers are not physically present at a single location; rather, they enter the market and engage negotiations through long distance communications while a computer manages the interface. For a comprehensive description of electronic markets, see Henderson, Schrader and Turner.

Theoretical Performance of Electronic Markets

Conceptually, the economics benefits of electronic marketing follow mainly from its characterization as a remotely-accessed, organized exchange. Because of its remote-access feature, traders do not have to physically travel to one central location to meet with other participants in the market. Because product shipment is arranged after transactions have been successfully negotiated, direct or nearly direct product movement from seller to buyer is possible. As a result, the operational efficiencies which are normally realized with directly negotiated private sales, in comparison to central assembly markets, can be achieved.

At the same time, the ability is created to generate the magnitude of pricing efficiency previously associated only with large-volume central assembly markets. Sellers offer their products to many buyers rather than one or a select few, as is characteristic of private transactions, and buyers have access to the supply of many sellers. Thus, participation in both sides of the market is much expanded compared to private trading. Furthermore, because price negotiations occur in an organized, centralized and competitive arena, the ability of a dominant trader to unduely influence price is

appreciably reduced compared to the typical one-on-one nature of private treaty. As a result, it is reasonable to expect that prices which are established within an electronic trading mechanism are more accurate reflections of market-wide supply and demand conditions and thus more efficient in their role of allocating resources and products among alternative uses.

Because a large number of transactions are negotiated at one point (the central computer) and because the computer tracks and records the results of all negotiations, comprehensive and continuously updated market and price information become an integral feature of electronic markets. Conceptually, this potential to expand the quantity, quality, accuracy and timeliness of market information and to equalize its availability among a large number of potential market participants creates a "public good" aspect to computerized marketing roughly comparable to publicly supported market reporting services.

Electronic communications makes possible an additional source of potential operational efficiencies. When computer terminals are used for communications among traders (rather than telephones or other forms of voice communication) electronic data rather than audible data are transmitted. Each bit of electronic data can be transmitted on a single electronic cycle, whereas 3,000 cycles or more are required for voice communications. As a result, a substantially larger volume of electronic data can be transmitted in the same communications space that is required for a lesser amount of voice communication. Therefore, data can be transmitted much more rapidly electronically than audibly, significantly reducing the communication time required for sales negotiation.

Industry structure may be impacted by electronic marketing as well as operational and pricing efficiency. Because the electronic market is

accessible through remote communication media, and because numerous trade possibilities can be found at one place (the centralized computer trading floor), the ability of smaller and more remotely located traders to participate in the market is enhanced. This should moderate the magnitude of risk associated with potential market foreclosure, reducing the exit rate of small and/or geographically remote producers and mitigating the need for both producers and handlers to engage long term contractual or other integrative arrangements.

To summarize, based upon theoretical reasoning the establishment and widespread use of electronic markets for agricultural products would be expected to result in: 1) improved pricing efficiency; 2) greater operational efficiency; and 3) a reduced rate of economic concentration and integration. The first is most directly relevant to the topic of concern in this symposium, that is pricing systems; however, the others are also important economic impacts which deserve consideration in any appraisal of this marketing innovation.

Experience With Electronic Marketing

Empirical validation of the performance expectations for electronic markets in agriculture requires observations of the results from actual computerized trading. To date, however, only a few such markets have been commercialized. Currently, there are a number of efforts underway to develop additional electronic markets for agricultural products. Most of these are experimental, designed to further test the feasibility of this institutional innovation.

The computerized markets that exist and that are being developed vary considerably in design and operation. There is, at this point, no standard design which has proved itself most effective. However, all systems combine the technical capacities of remote communication with some form of electronic computing for purposes of common price negotiation among large numbers of remotely located sellers and buyers.

The earliest commercialized electronic-type market is a teletype auction, developed by the Ontario Pork Producers Marketing Board for selling slaughter hogs produced in that province. It has been used continuously since its introduction in 1961 (Peer). The Board has a provincial monopoly for marketing hogs and has elected to sell essentially all 2.5 million to 3 million hogs produced in Ontario annually through its electronic auction. A similar hog marketing system has been in operation in Alberta since 1969 (Hawkins et al.), and another operated in Manitoba from 1965 to 1977 (Lowe, 1968B) but ceased operation when declining hog marketings because insufficient to support a competitive marketing system.

The most technically advanced system currently in operation is TELCOT, a computer terminal marketing network for upland cotton operated by Plains Cotton Cooperative Association at Lubbock, Texas. In operation since 1975, this system directly connects cotton producers, through more than 165 local gins, to about 45 cotton merchants and other buyers over a network of TV-like cathode ray tube computer terminals (Highley). All transactional activities, including invoicing, payments, inventory control and market information in addition to price negotiations, are facilitated by the central TELCOT computer. In 1977-78 this system marketed about 844,000 bales of cotton, roughly 20 percent of total Texas production (not forward contracted). It serves buyers throughout Texas and the Southeast cotton marketing areas and has recently been expanded to a capacity of more than 4 million bales per year.

Other operating systems include the computerization of a relatively small volume trading floor for nest run eggs operated by the Egg Clearinghouse, Inc. of Durham, New Hampshire (Cox), a similar system operated as the Central Egg Agency in the United Kingdom (Schwartz), and a computerized exchange system, called Woolnet, that has recently been developed in Australia for the

international marketing of wool (Computer Sciences of Australia).[4/]

In addition to these computerized markets are numerous teleauctions for various agricultural products. A large number of feeder pigs and market lambs are sold by teleauction in the U.S. along with relatively small quantities of feeder cattle, slaughter cattle and butcher hogs (Henderson). The teleauction is a manual selling procedure, utilizing conference telephone arrangements to interconnect several buyers at remote locations for bidding on consigned sales which are sold by description. Teleauctions offer some competition enhancing capability; however, trading is relatively slow and selling capacity is considerably smaller than for computer-managed systems. Thus, their potential economic impacts are not directly comparable. Some teleauctions, nonetheless, have clear potential to evolve into computerized systems as trading volume expands, and this evolutionary process provides additional insight into the feasibility of electronic marketing (See Holder, 1977, for example).

To encourage further evaluation of the economic feasibility and performance of electronic markets in agricultural industries, the U.S. Department of Agriculture's Agricultural Marketing Service (AMS) initiated a program to support, with partial funding, the development and pilot operation of a limited number of experimental projects (Schlei). Four electronic marketing projects have been initiated in response. These include: 1) an expansion of the nationwide electronic market operated by Egg Clearinghouse, Inc. (ECI) for nest run eggs by developing a computer terminal communication network whereby egg traders have direct communications with other market participants through the central market computer (Egg Clearinghouse, Inc.); 2) the development and operation of a computerized trading network for the daily marketing of slaughter hogs in Ohio and surrounding areas (Baldwin); 3) the design and development

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[4/] In addition to the described systems for agricultural products, several somewhat similar systems have been developed for marketing financial securities. Most notable are computerized trading networks for corporate stocks operated by the Cincinnati and Toronto stock exchanges.

of an electronic marketing system for feeder cattle in Texas (Sporleder and Davis); and 4) expansion of the teleauction method of selling cull cows in Virginia with a feasibility analysis for conversion to a large-volume computer-assisted system (Virginia Department of Agriculture and Commerce).

Empirical Evidence

The operating and developing systems provide the basis for our research into the performance implications of electronic marketing in agriculture. At this point, the appraisal is tentative as it is based largely upon analysis of the results reported by others who have examined various aspects of existing systems, plus observations, considerations and experiences to date in the process of developing and deploying the experimental AMS-related projects.

There currently exists no body of generalizable evidence as to the performance implications of electronic marketing for agriculture, as no comprehensive evaluation has been completed nor have the various marketing systems been evaluated vis a vis one another. The Electronic Markets Task Force of the North Central Regional Research Committee NC-117 has as one of its objectives, to complete such a comprehensive evaluation and, to the extent possible, draw generalizable conclusions. While satisfactory progress toward that objective is being made, complete evaluation awaits full implementation of actual trading in the four experimental projects. These will not be completed for another 12 to 18 months. Thus, at this time the report is limited to tentative conclusions based upon developmental considerations, partial evidence, and preliminary analyses.

Pricing Efficiency

As would be expected, the Canadian teletype hog markets have been the subject of much of the research reported to date which evaluates empirical results of electronic trading. The major impetus for developing these markets

stemmed from concern over lack of effective buyer competition and the related impacts in terms of incomplete arbitrage and pricing inefficiencies. Thus, much of the reported research has concentrated on pricing impacts.

In a time series analysis, Wen-Fong Lu found statistically significant increases in average price levels for hogs in both Ontario and Manitoba which correlated with the introduction of electronic marketing. He interpreted these results as indicative of increased buyer competition. Generally, consistent findings were reported by Lowe (1968A). Lu also found a statistically significant decrease in the difference between average transportation costs and average provincial prices associated with the introduction of electronic teletype selling. These findings support the hypothesis that, electronic marketing enhances geographic arbitrage and thus improves pricing efficiency.

While the relationship between arbitrage and pricing efficiency is direct and straightforward, there is a less clear interpretation of the relationship between pricing efficiency and short term price variability. Chang-Mei Lu, in a study of price variability in the Manitoba hog industry, found both intraday and interday price variability to be greater in electronic markets than in private treaties. Lu interpreted this finding as indicative of increased pricing efficiency in the electronic system.

While little definitive theoretical work has been reported on the specification of the relationship between short term price variability and pricing efficiency, it is intuitively appealing to except Lu's conclusion. The logic can best be illustrated with a comparison of the price-contracting process in a private treaty with that in an open, organized market. In most private negotiations between farmers and others in the marketing channel, there is a considerable disparity in the amount and quality of market information possessed by each party. Typically, an individual buyer purchases larger volume and is in the market more frequently than is an individual farmer-seller. Buyers

are often supported by a staff of market experts, whereas farmers seldom have access to similar expertise. Buyers are generally in contact with sellers in other areas and with other buyers, thus affording themselves with a market-wide perspective which is difficult for many farmers to duplicate.

As a result of obvious imbalances in their extent of comprehensive market knowledge, it is likely that farmer-sellers in private treaties accept the price offered by the buyers (and the nonprice market information implicit in the price offer) as being reasonably accurate. Or, at least accurate enough to justify the lack of search for more extensive market information. As the actual number of buyers with which a given farmer-seller deals is reduced, or as the ability of buyers to coordinate their offer prices increases because of less head-to-head competition in private negotiations, the variability in prices among individual transactions would be expected to decline. That is, buyers typically set a purchase price at which they believe they can acquire needed supplies. This price may be adjusted if inventory is accumulated too rapidly or too slowly, but it is modified infrequently for individual transactions (due to quality, location, timeliness or other value-related factors) unless sellers object. Such objection is constrained by lack of adequate and comprehensive market information.

An organized market in general, and the electronic exchange in particular, increases the availability and relevancy of market information for all potential market participants. It reduces the liklihood of selective or biased reporting. Furthermore, because all of the relevant terms of trade are visable and, in the electronic market because a wide range in terms can be observed and disseminated to every potential participant, a larger number of price differentials for value differences due to quality, location, timeliness, size of sale lot and the like tend to result. Both the quality and availability of information is improved.

Sellers realize a substantial gain in market information relative to buyers in such a situation. This should reduce the seller's willingness to accept the buyer's offer price (and its implicit market information). Sellers would be expected to use their additional information to influence their individual terms of exchange. This implies that transaction prices should be more variable in an organized market. This further suggests that the price in each individual transaction should more nearly reflect the true market value for that particular exchange. As a result, the efficiency with which prices throughout the market are established is improved, thus enhancing pricing efficiency.

In the case of a daily hog market, for example, this logic suggests that a market demonstrating greater price variability would be more pricing efficient that one in which individual transaction prices are equal or nearly so.

To distinguish between price variability around a general point of market equilibrium and instability in market equilibrium prices over time, we will hereafter refer to the former as "price nervousness." As such, greater price nervousness refers to greater price variability and bears no direct relationship to long run price instability.

Analysis of egg prices in the U.S. prior to and following the introduction of electronic egg trading on ECI provides further support for the expectation of improved pricing efficiency as a result of electronic marketing. ECI price behavior has been observed over the past four years and compared with egg prices as reported by a proprietary reporting service, Urner Barry Publications, Inc. Urner Barry price reports are generally accepted as the benchmark for market value determinations for private trades in much of the U.S. egg industry. Thus, comparison of ECI price behavior with Urner Barry price reports gives a valid comparison of electronically-negotiated prices with private treaty

price performance.

In addition to a direct comparison of ECI prices and Urner Barry price reports during the 1974-78 electronic trading period, it is also valid to compare Urner Barry price reports prior to ECI trading (1969-72) with those price reports during ECI trading. Prior to electronic trading, the major source of Urner Barry price information was a daily survey of private egg transactions. Subsequent to the development of ECI, Urner Barry has utilized ECI prices in compiling price reports along with the survey of private trades.

That is, Urner Barry price reports are influenced to some extent by ECI but continue to retain primary emphasis on private trades. Thus, the impact of electronic trading on egg price performance revealed by a cross-sectional comparison of Urner Barry price reports with ECI prices in the 1974-78 period would tend to be confirmed if the same direction of change, but of smaller magnitude, is revealed by a time series comparison of Urner Barry price reports between the pre-ECI (1969-72) and during-ECI (1974-78) periods.

A comparison of egg price behavior as reported by ECI and Urner Barry is presented in Table 1. It is clear from these data that both the frequency of price change and the magnitude of price nervousness, as measured by the short run standard deviation in reported prices, is appreciably higher in the electronic market than in private transactions. Furthermore, the magnitude of the average price change is less in the electronic market. Therefore, ECI prices change more often but by smaller amounts. This would appear to further support the positive impact of electronic trading on pricing efficiency. Not only are prices more nervous, but the resulting market price aggregate (periodically reported average market price) appears to adjust more rapidly and with less amplitude in response to changing market conditions, thus more accurately tracking temporal changes in market supply and demand relationships.

TABLE 1: U.S. Egg Price Behavior (Grade A Large White)

	Urner Barry Price Reports		ECI Prices
	1969-72	1974-78	1974-78
Average Price Change (cents per dozen)	1.16	2.32	2.18
Frequency of Price Change[1/]	0.347	0.481	0.687
Short Run Standard Deviation in Prices[2/]	2.09	2.19	2.47
Long Run Standard Deviation in Prices[3/]	8.03	8.46	8.43

1/ Calculated by dividing the number of changes in the reported prices by the total number of prices quoted.
2/ Calculated on a four week moving average, in cents per dozen.
3/ Calculated across all observations, in cents per dozen.

Not only do ECI prices demonstrate greater price nervousness than do the Urner Barry reports, the amount of nervousness in the latter has appreciably increased since the outcome of electronic trading has been incorporated into its population of observed prices. The analysis was extended to determine whether the increased price nervousness as reported by Urner Barry was a result of the price nervousness evidenced in ECI prices, or whether price nervousness in the private transactions captured by the Urner Barry report had increased between the two time periods.

The results of a correlational analysis between daily ECI prices advanced in front of Urner Barry price reports, and of Urner Barry price reports advanced ahead of ECI prices, are presented in Table 2. High correlation exists between these two price series on a same-day basis. Relative to the

lead-lag relationship, the correlation between the two price series is notably higher when ECI prices are advanced in front of Urner Barry prices than when Urner Barry is advanced over ECI, for as far as six days lead. This indicates that ECI prices tend to lead Urner Barry prices rather than vice versa. This finding, therefore, suggests that the impacts on pricing efficiency extent beyond the electronic exchange to the product market in general.

TABLE 2: Lead-Lag Relationship Between Urner-Barry Egg Price Reports and Egg Clearinghouse Prices (Grade A Large White, 1974-78)

Number of Days ECI Advanced Over Urner-Barry	Coefficient of Determination	Number of Days Urner-Barry Advanced Over ECI	Coefficient of Determination
0	0.916	0	0.916
1	0.900	1	0.848
2	0.822	2	0.735
3	0.712	3	0.621
4	0.599	4	0.525
5	0.506	5	0.462
6	0.442	6	0.423

At this point, we have no clear evidence regarding what constitutes sufficient trading volume on an electronic exchange to generate efficient pricing throughout an entire product market. The Ontario hog marketing system, which (by mandate) prices virtually 100% of the slaughter hogs sold in that province over an electronic exchange, stands at one extreme. It has become a pricing base for hogs throughout much of Canada. The Egg Clearinghouse stands at the other extreme, with perhaps two to three percent of the negotiated egg sales represented. ECI prices have clearly become a factor in egg price determination. However, this market does not yet reflect sufficient trading volume to be generally accepted by traders as the major determinant of true market value for eggs, given the continued reliance by much of the industry upon Urner Barry price reports.

There has not yet been sufficient experience with the deployment of computer terminals directly to egg traders to determine the impact on ECI trading volume. It was hypothesized at the outset of the ECI experimental project that, deployment of computer terminals would positively impact upon the volume of trading. If that is observed over the length of the project, trading volume may grow to the point where ECI prices become acceptable to many in the industry as a primary market value indicator.

In a study of the impact of teleauction selling on prices in the Virginia and West Virginia lamb market, Holder reported evidence of improved pricing efficiency associated with enhanced buyer competition (1979). While teleauctions do not include all of the characteristics of electronic market, they do centralize price negotiations among numerous traders. Therefore, price behavior impacts should be similar to our expectations for computerized markets.

Increased buyer competition, improved arbitrage and expansion of market information have been important considerations in the design of the experimental computerized markets for feeder cattle and slaughter hogs. The feeder cattle industry, for example, is composed of a large number of relatively small independent producers on the selling side and, on the buying side, a much smaller number of considerably larger feedlot operators. Trading occurs primarily in small country auction markets and through direct sales by private treaty. As a result, marketing can be characterized as many small producers selling to one or a few buyers in spatial monopsonies or shared ologopsonies. Nonprice terms of trade tend to be quite variable spatially due to the large number of locations at which transactions occur. Collection of market information is not comprehensive nor are the results necessarily representative. Therefore, price information cannot be easily aggregated into information of industry-wide value.

In designing the electronic feeder cattle exchange, emphasis has been placed upon equalization of market power by increasing information equality, expanding the number of buyers involved in price negotiations, and decreasing the potential for price manipulation, and upon minimization of spatial restrictions on price discovery by increasing the relevant geographical market area (Davis and Sporleder).

Specifically, the computerized spot market for feeder cattle is designed to increase competitive interaction among buyers by consolidating price negotiations for a large number of local markets onto one centralized computer trading floor. That is, rather than price negotiations occurring at numerous country locations (as is currently the practice), the electronic market will provide, for each participating country market, remote terminal access to a centrally located computer. The market computer will conduct simultaneous price negotiations for numerous buyers across all selling locations. Furthermore, uniform descriptive terminology for quality factors such as frame size, muscling, flesh condition and confirmation have been specified. Thus, the electronic exchange will both expand buyer competition in the price negotiation process and extend it to a much larger market area. It will also capture, internally, comprehensive price information over a large and known geographic and quality distribution.

The combination of more comprehensive spatial and quality-related price information with a vastly expanded trading area is expected to facilitate the process of price arbitrage, thus, aligning price differentials more accurately with differences in marketwide assessments of supply and demand conditions for different categories or classifications of product type and location. Based upon these considerations, it appears that existing barriers to spatial and quality price arbitrage in the feeder cattle market can be

significantly reduced through the advantages of design flexibility possible in computerized trading systems.

The slaughter hog industry, in contrast with feeder cattle, has undergone major production and marketing changes during the past two decades. Considerable concentration and specialization has occurred, resulting in a substantial increase in the volume of hogs marketed per farm. Associated with this has been alterations in acquisition practices by packers. Between 1950 and 1976, for example, the share of hog purchases by packers at terminal markets declined from 40 percent to 17 percent. During the same period, direct purchases increased to 71 percent (Packers and Stockyards). The number of packers also declined during this period. Slaughter hog marketing today can be characterized as, many farmers selling hogs direct by private treaty to a few buyers in spatial monopsonies or shared ologopsonies. Thus specialization and concentration have been associated with direct marketing which, in turn, may have an adverse effect on market information and pricing efficiency.

The movement toward direct sales created a situation in which price discovery depends on the relative bargaining strength of buyers and sellers. Bargaining strength is related to the adequacy and accuracy of market information possessed by the participants. Because buyers normally are engaged in daily acquisition of large number of hogs, they typically have more complete information than farmer-sellers. Prices and other terms of trade in direct sales are not fully sampled nor reported by market news services and are not generally meaningful to farmers until enough trades are reported so that market trends can be detected. At least in the eastern part of the corn belt, individual daily sales negotiations are nearly complete by the time the overall market trend becomes apparent (Baldwin).

The dominance of direct sales has also created a situation in which farmers are often paid average rather than quality-related prices. Mixing hogs from different farms is a common practice by packers. To simplify the process, packers frequently pay an average price upon delivery, with only a minimal initial sort. This practice in conjunction with the lack of a uniform industry-wide grading system is not conducive to rewarding farmers for producing superior products, thus creating pricing inefficiencies (Armstrong, et al.).

Improving pricing efficiency is a major consideration in the design and development of the electronic slaughter hog market. Specific design considerations include the use of uniform grading and descriptive standard for all sales, the sale of one-owner lots where feasible, formulation of settlement prices for different quality hogs in commingled lots based upon market-determined value differences, creation of the central computerized trading arena in which numerous buyers compete, and improving the collection and dissemination of market information.

The Federal hog grading system is being modified in order to consistently describe all market hogs by respecifying and standardizing variables such as backfat thickness, degree of muscling, and percentage of lean cuts. Additional descriptive information such as eye appeal, tastiness, and by-product value may ultimately be included for price determination purposes.

Because of the difficulty often encountered in accurately and consistently grading live slaughter hogs, a carcass weight and grade system is also an integral part of the electronic market. By utilizing the extensive capability of computers to handle data, it is feasible to provide simultaneous trading information on both live weight and grade and carcass weight and grade. This will encourage live-carcass price comparisons which should also result

in improved alignment between quality and price. Ultimately, buyers will be able to bid live and carcass prices for each lot of hogs simultaneously, with sellers selecting the one for actual settlement which they consider to be "best." With this capability, price-quality and live-carcass price differentials will both be determined through competitive bidding.

By selling one-owner lots, where feasible, price will be directly related to the quality and type of hog sold by individual producers. Most of these lots will be sold while the hogs are still on the farm, thus allowing prices to reflect the market value of "fresh" hogs delivered direct to the packer with minimum risk of disease or stress from commingling and excess handling. Commingling will occur for farmers who sell in small numbers. Payment for commingled hogs will be based on a settlement price which is tied to price-quality differentials generated by competitive bidding for other lots of uniform quality hogs. This procedure should extend rewards for producing quality products and penalties for producing inferior products to smaller producers.

Competition will be enhanced by consolidating price negotiations for a large number of direct sales, each somewhat unique as to lot size, quality, location, or time of offering, onto a centralized exchange. The electronic market will provide to buyers, farmers and country marketing points computerized terminal access to the centrally located computer. The computer is being programed to conduct price negotiations through three different procedures; a descending auction, sealed bids, and firm offers. Traders will, for the most part, be able to choose the pricing system that best serves their needs.

Pricing efficiency will also be enhanced by collecting and disseminating

comprehensive price information for each sale. All bids, offers and acceptances will be reported in the system; carcass equivalent prices based on live weight and grade prices will be determined and reported; periodic sales summary and market analysis will be made available; and price in other cash and futures markets will also be reported via the computer marketing network.

It is hypothesized that the combination of more comprehensive price information, an improved descriptive system, and the centralization of price negotiations on direct sales will result in enhanced competition and substantially improved spatial and quality price arbitrage. If the electronic system eventually captures an adequate volume of trade, prices established in this system should accurately reflect regional, and possibly national supply and demand conditions for a wide variety of slaughter hogs.

Operational Efficiency and Industry Structure

To round out this tentative appraisal is a preliminary assessment of the impacts of electronic trading on other aspects of market performance, specifically operational efficiency and industry structure.

There have been two studies that estimated costs for marketing livestock in the U.S. through hypothetical electronic markets which have received general attention. Holder examined the costs for marketing slaughter hogs through a simulated computerized system in the U.S. and compared these costs with conventional marketing methods (1972). Results show electronic transaction costs ranging from about 18% above 85% below the costs for conventional marketing methods, depending upon volumes marketed electronically and the type of existing method used for comparison. Transactional costs were higher for the electronic market, however, only when its volume was low and when compared to direct purchases by packers. Combined with non-quantified factors, Holder concluded that electronic marketing should generally result in a net reduction in transaction (selling and buying) costs.

In another analysis, Johnson estimated costs for marketing all fed cattle in the United States through an electronic teletype system similar in design to the Ontario hog marketing system, and compared these with estimated costs for conventional marketing methods such as terminal markets, auctions and private treaties. He also included cost estimations associated with pricing inefficiencies and inequities in bargaining strength between producers and packers under assumed conditions. The results showed a potential net efficiency gain for teletype marketing ranging from $38 to $60 per head, depending upon which conventional system was used for comparison.

These potential operational efficiencies associated with electronic marketing appear to be supported by a fairly complete analysis of computer and communication costs for the experimental electronic hog market, as it is currently designed. Potential costs have been examined for the exchange function, facilitating functions (weighing, description, sorting and commingling, transportation, and the like) and the loss-arbitration function (disease, death losses, injuries or cripplings and weight losses).

Costs associated with the computerized function are reported in Table 3. The monthly computer cost is fixed by contact. All other costs are estimated at relatively high levels. For example, average rental fees for computer terminals being considered for use equal $93/month. For this analysis, a higher rental cost ($110/month) is assumed, to allow for unexpected cost increases.

On a per head basis, these estimated costs for operationalizing the computerized market total to between 42 and 64 cents depending upon volume marketed (see Table 4). The minimum market volume (40,000 head per month) approximates current hog marketing by the EOB Company. EOB is the subsidary of Producers Livestock Association (PLA) which handles daily

TABLE 3: Estimated Costs for Computer and Communications Capability, Experimental Electronic Hog Market (HAMS)[1/]

		Monthly Cost ($)
Central Computer System (including management software and maintenance)		2,600.00
Remote Computer Terminals (50 ea. @ high cost estimate of $110 ea.)		5,500.00
Auxiliary Printers for Remote Terminals, market points only (17 @ high cost estimate of $100 ea.)		1,700.00
Modems (100 @ $20 ea.)		2,000.00
Leased Line Communications		9,565.00
17 Marketing points (955 mi. @ $2.50/mi.)	2,387.00	
3 Columbus points ($50 ea.)	150.00	
7 Ohio-located Packing Plants (582 mi. @ $2.50/mi.)	1,455.00	
10 On-farm locations in Ohio (561 mi. @ $2.50/mi.)	1,402.50	
11 Packers located outside of Ohio	4,170.00	
Operations Personnel		4,375.00
Total		25,470.00

1/ A Hewlett Packard (HP 3000) has been acquired and is being programed. Since terminal selection process is underway, high rental estimates are reported for this equipment. All terminal and line cost estimates are based on location of a computer in Columbus, with trading terminals located in Columbus, at 17 marketing points around Ohio and eastern Indiana, on 10 Ohio hog farms, at 7 Ohio packing plants, and at 11 packer sites in the northeastern and midsouth regions of the United States. Operations personnel include a sales manager, a half-time equivalent administrative assistant and a half-time equivalent computer technician.

livestock sales. PLA is a cosponsorer of the experimental project, and all EOB marketings will be converted to the electronic exchange. The upper range limit (60,000 head) permits a 50 percent increase in marketing volume during the programmed six month experimental period. To achieve this increase in volume, approximately 25 percent of the Ohio hogs currently direct marketed outside the PLA/EOB system must be converted to the centralized electronic market. Approximately 4200 head of hogs per month, which are currently marketed directly to packers, will be immediately available to the system during the experiment via on-farm selling terminals located at ten large volume hog farms.

TABLE 4: Estimated Per Head Costs for Marketing Slaughter Hogs Electronically, HAMS Experimental Project

	Cost Per Head	
	40,000 Head Per Month[1/]	60,000 Head Per Month[2/]
Computer and Communications Functions	$0.64	$0.42
Facilitating Functions (grading, weighing, sorting, etc.)[3/]	0.98	0.87
Total	$1.62	$1.29

1/ Current average monthly hog marketing volume through the EOB Company which will be diverted in total to the electronic market during the experimental period.

2/ Requires conversion to the electronic market of 25 percent of the slaughter hogs in Ohio that are currently being marketed directly by farmers to packers. About one-fifth of this requirement can be obtained directly from the farms on which computer terminals will be located during the experiment.

3/ Cost estimates are based upon current costs realized by Producers Livestock Association and its EOB Company subsidary for handling hogs, exclusive of sales negotiation and market clearing activities. Costs are about 52 percent labor and 48 percent for travel, buildings, maintenance and related overheads.

Assembly, handling, weighing, grading and other farm-to-packer costs (facilitating functions) were also estimated for the proposed electronic exchange (Table 4), based upon current PLA costs associated with their weekly auctions, adjusted for potential savings in labor due to more direct and faster hog movement and replacement of some telephone and other services with the computer network. Approximately 52 percent is allocated to labor services and 48 percent allocated to buildings and equipment, travel, supplies, and other overheads. It is estimated that total marketing costs will range between $1.29/head and $1.62/head, depending on the volume marketed.

Combining the costs of the computerized price negotiation system with the estimated costs for performing the necessary facilitating functions generates a basis for comparison of anticipated marketing costs for the experimental electronic market with existing marketing fees (Table 5). These data indicate that the costs for performing the pricing and facilitating functions are appreciably less than fees incurred at the major assembly (terminal) market in the relevant marketing area. The findings further suggest these hypothetical cost relationships: 1) operating costs for electronic markets are somewhat higher than direct sales to packers when electronically marketed volumes are low; and 2) substantial gaines in economies are possible as trading volume increases.

Costs for performing the loss-arbitration function have not yet been specified, but there appears to be no reason why these should be any greater in the electronic market than in the current daily sales operation of EOB. Such costs could be somewhat lower to the extent that the more extensive information communicated on the electronic system regarding quality and other value-related factors reduces the gap between buyer expectation and

reality. Also, if the computer communications system is used to arbitrate disputes in lieu of more expensive telephone communications, arbitration costs may be further reduced.

TABLE 5: Comparison of Existing Hog Marketing Fees and Costs with Estimated Electronic Marketing (HAMS) Costs.

	Indianapolis Terminal Market	PLA/EOB Marketings	Electronic Market 40,000 Head Per Month	Electronic Market 60,000 Head Per Month
		- Dollars Per Head -		
Marketing Fee	1.80 - 1.90	0.30[1/]	---	---
Marketing Costs	---	1.17[2/]	1.62	1.29
Total	1.80 - 1.90	1.47	1.62	1.29

[1/] Fee currently charged buyers by EOB for marketing services.

[2/] Based upon typical fee structure for local auction markets operated by PLA, less marketing fee charged packers in daily EOB sales operation. Excluded from PLA/EOB fee structure as current PLA/EOB income from daily hog marketings derives mainly from purchase-resale margins rather than direct marketing fees.

The experimental feeder cattle project has also been designed to effectuate operational efficiencies. Both geographical dispersion and seller-buyer size differences contribute to operational inefficiencies. Cattle must be pooled from numerous sellers, and often across a fairly large geographical area, in order to meet the needs of many individual buyers. Order buyers and marketing agents currently perform this function in most instances. However, in collecting feeder cattle from several areas and assembling large lots, considerable cross-hauling and handling results. This causes stress on the cattle which results in shrink, sickness and death, and adds appreciably to marketing costs. Because the electronic feeder cattle exchange is designed to consolidate offerings of a large

number of sellers on one trading floor, it should be less costly for buyers to accumulate desired quantities compared to purchasing at numerous country points.

To the extent practical, trading rules are being specified which will require a minimum amount of pooling and handling between the farm of origin and the buyer's feedlot. For producers who sell truckload lots, direct shipment can be facilitated as the sales arrangements will be completed and destination (buyer location) known before the cattle leave the seller's farm or ranch. Local pooling will be used for smaller (less than truckload) lots prior to sale. Because buyers will be able to acquire cattle assembled at several locations simultaneously without traveling to each separate assembly point, procurement needs should be fulfilled more rapidly, thus allowing for expeditious movement of cattle to and from those local concentration yards. The extent to which these potential gains in operational efficiencies are actually realized, of course, will not be known until this experimental system is operationalized and actual trading experiences documented.

To date, only one study has shed light on the impact of electronic trading on industry structure. In an evaluation of trading on the Manitoba electronic hog market while it was operated on a voluntary basis, Chen found that the producers who marketed through the electronic system operated significantly smaller hog enterprises, on average, than did producers who sold through private treaties. Although Chen did not draw such a conclusion, one implication of this finding is that the electronic system provides viable market access for smaller producers, thus mitigating structural concentration pressures at the farm level. Impacts, if any, of the

experimental electronic markets on industry structure are being closely monitored as these systems are operationalized.

Concluding Comment

Based upon theoretical reasoning, electronic markets offer high potential to enhance pricing efficiency by thickening markets. This is accomplished by bringing about greater competition among traders, expanding spatial market boundaries, expediting the process of price adjustment toward an equilibrium point, improving price arbitrage, balancing market power among participants in the price negotiation process, and quite possibly, attracting more traders into a price negotiation process. Equally important, market information is appreciably improved because pricing occurs in a central arena where all resulting prices are observable, and a broader array of transactions are brought into the information base. This substantially reduces problems of sampling for price in a large number of widely diverse and geographically dispersed private sales, and increases the number of price observations which can be reliably related to product type and quality, location, time of sale and other value-related factors.

These theoretical expectations with regard to the pricing impacts of electronic trading are supported by observations from the limited number of electronic markets which have been developed and operationalized to date for agricultural products. Furthermore, the design flexibility possible in computerized trading systems appears to offer high potential for realizing these benefits in experimental markets which are currently under development.

Theoretical reasoning supported by limited experimental evidence suggests that the additional economic impacts of improved operational efficiency and reduced structural concentration may be associated with electronic marketing in agriculture. Further insights into these

potential impacts is being gained as the development and commercialization of these marketing systems progresses.

However, no single institution can be viewed as a panacea. Much of the potential impact of electronic trading stems from the improved information flow. But, there is no assurance that such improved information will necessarily flow to those who could most gain from it. If the operation and control of an electronic exchange is such that acccess to either the trading mechanism or to the information generated therein is unduly restricted, the economic benefits will be jeopardized, and perhaps reduced below costs. The rules of operation and ownership structure can also influence the distribution of both benefits and costs among market participants and between participants and nonparticipants, which could be a source of considerable inequity. Additionally, there is no assurance that an open market system is optimum for agricultural products in an industrialized economy.

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