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## POLICY CONSIDERATIONS OF EMERGING INFORMATION TECHNOLOGIES

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Adoption of computerized decision analysis and computerized communications technology in many agricultural production and marketing situations will occur rapidly in the next decade. Computer hardware, such as microcomputers and large central processors, has become more reliable while costs have declined dramatically. Coupled with this has been the escalating costs of people and product transportation.

Further, technological developments promise a continuation of the hardware trend toward increasing sophistication and reliability at decreasing cost. The technology for mass telecommunications using computers for information storage, processing, and dissemination is more cost effective than at any previous time. The task, accomplished in the next decade or so, will be to harness the flow of information technology, both hardware and software, to many diverse cost-effective applications in our society. One will be in producing and marketing agricultural commodities.

Against this general background, this paper discusses some prospective applications of emerging information technologies to agriculture, divided along the broad lines of information networks and trading systems. The distinction between information and trading networks is made primarily for convenience in identifying potential long-range economic impacts attributable to each. The main task of the paper is to identify potential public issues which flow from the emerging information technologies. More questions are raised than answers provided.

Before these issues can be articulated however, it is useful to briefly identify both emerging information technologies and some traditional issues in farm structure and marketing policy. This review assists in the later enumeration of information policy issues.

### EMERGING INFORMATION TECHNOLOGY Overview

Several articles describe and/or prognosticate on the application of computer technology to agricultural information. Writings by Harsh; Infanger, Robbins, and Debertin; Fuller; and Sporleder 1980 are examples. This paper will not review these or attempt to describe the form of future technological applications to production and marketing agricultural commodities. Some general overview is necessary, however, to focus later discussion. Emphasis for the discussion remains at the producer-first handler level.

Information technology in agricultural production and agricultural markets and marketing is divided into two categories, information systems and trading systems. Both information systems and trading systems rely on computer technology. Both may use video display terminals, microcomputers, large mainframe processors, and communication links such as dial-up, dedicated lines, or satellite transmission. Adding to the similarity is that both systems may collect, store, process, and transfer various data on agricultural commodity prices and trading volumes.

### Information Systems

The critical distinction between the two broad categories of information technology is trading or actual price discovery. Information systems, including microcomputer decision-aids, are adept at transferring and analyzing market information or cost information necessary before managers of individual firms make management decisions.<sup>1</sup>

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Invited paper presented at the annual meeting of the Southern Agricultural Economics Association, Nashville, Tennessee, February 5-8, 1984. Invited papers are routinely published in the July *SJAE* without editorial council review but with review of the copy editor (as per Executive Committee action June 25, 1982).

Technical Article Number 19362 of the Texas Agricultural Experiment Station.

<sup>1</sup> An anonymous reviewer suggested that the types of information currently provided to agricultural firms by the public sector are in five categories as follows: (1) short-term price information such as daily auction prices and market receipts, provided by the Agricultural Marketing Service; (2) longer-term price information such as annual cash receipts from farm marketings and production, provided by the Statistical Reporting Service; (3) short-term market conditions such as current stocks and weather information; (4) medium-term market conditions such as cattle on feed or crop conditions; and (5) long-term market conditions such as inflation, money supply, or farm programs. In general, the short-term information categories are useful for making selling decisions, while the longer-term information categories are useful for making production decisions.

Information systems include two distinct types, videotex and interactive. Videotex systems are similar to other mass media information sources in the sense that users receive whatever "broadcast" information is chosen by the information service. Videotex is a receive-only type service. On-line interactive information systems and microcomputer decision-aid software allow users to interact with the information service or model provided. Output from interactive systems normally is specific and unique to users through the input data supplied by them. Certain decision-aid models are designed to provide users with the simulated outcomes of several alternative actions prior to making an actual decision.

In general, information systems provide a means of assisting intrafirm decisions. These may be decisions regarding alternative enterprises within the farm firm or decisions regarding optimal short-run marketing strategies, such as hedging or contracting versus cash sale. Information systems may also assist in actually conducting the business of an individual firm by providing electronic banking, electronic airline reservations, or electronic mail order services.

### **Trading Systems**

Computer-based trading systems, popularly called electronic marketing, represent computer and telecommunications technology applied to actually trading commodities (Sporleder, 1980; Bell). The essential features of such systems are sales by description, remote-access to the market by traders, and a price discovery process inherent within the system, such as auction or bid/offer.

The history of centralized remote-access trading systems dates back to 1962 with application to Canadian slaughter hogs and California fat cattle. These early systems were teletype technology but possessed the essential features of the more modern computer-based trading systems. Successful commercial application of a computer-based trading system began in 1975 for cotton (Boggs). Additional commercial applications are operating or planned, primarily for livestock.

### **FARM STRUCTURE AND MARKETING POLICY ISSUES**

There are several farm structure and marketing policy issues which traditionally are of concern to economists from an allocative efficiency viewpoint. The perspective here is to review these rather traditional farm structure and mar-

keting policy issues to enhance later articulation of issues identified as arising from emerging information technologies. These structural issues are revisited in a discussion of policy issues created by emerging information technologies.

The specific selected long-run issues offered here, in no particular order, suffice for present purposes but are not intended to be all inclusive:

- Control,
- Market Access,
- Thin Markets, and
- Public Information Availability.

Some discussion of each issue, in a structural context, follows. The issues are interdependent in nature. For example, control and market access are linked through some interdependent causal relationship in the long-run. Over time, concentration of the control of productive resources may encourage diminished market access for new or potential entrants while diminished market access may cause increased concentration. Thus, the issues are not mutually exclusive nor are the interdependencies readily identifiable.

### **Control**

One basic issue is long-run control of agricultural production. The essence of the control issue was initially articulated in 1972 through publication of "Who Will Control U.S. Agriculture?" (Guither). Long-run control over resource allocation decisions at the production level is critical from a public policy perspective. Typically concern is expressed regarding integrators, sometimes large corporate firms, becoming decisionmakers. Both the form of ownership and methods used for controlling productive resources are aspects of this issue.

The trend in firm size and numbers at the farm and processing levels is to declining numbers and increasing size. Regardless of level within the food distribution chain, concentration has continued to occur. A host of causes for this pervasive trend could be cited, ranging from farm commodity and tax policy to more general factors such as size economies and capital acquisition costs. Despite a plethora of potential causal factors, fewer and larger firms is coincident with a concentration of control among fewer firms. As concentration of commercial production units continues and as initial capitalization requirements increase, individuals desiring to enter production find it more difficult.

## Market Access

Foreclosure of certain markets to some firms, for whatever reason, is the essence of the market access issue. Alternative exchange arrangements to the open cash market exacerbate concerns about access. Various forms of contracting, such as forward cash contracting or contractual vertical integration, can occur to such a degree that open cash markets disappear.

Broilers illustrates this case well. The processed broiler market is now the first pricing point in the marketing channel. The live broiler pricing point no longer exists due to the prevalence of contracting. Comparable trends have occurred in some fruits and vegetables for processing (tomatoes and sweet corn, for example).

Contractual arrangements may also become effective barriers to entry over time. These arrangements may foreclose markets to new producers. With limited market access, concentration tendencies are reinforced. Also, limited market access through contractual arrangements could be used to impose minimum size or capital requirements on potential contractors.

## Thin Markets

Various cash contracts and ownership integration arrangements result in fewer cash market transactions. In some instances, contract transactions may result in thin cash markets where there are few buyers and sellers negotiating trades (Hayenga). Wholesale beef is an example. The majority of wholesale beef is sold on the basis of a private cash market price quotation service. This, in turn, puts a premium on accurate quotations from cash market negotiated trades which adequately reflect short-run supply and demand conditions.

Central to the wholesale meat situation is "formula trading." When a trade is made where price is based upon a specific price report, the transaction is characterized as a formula trade. Obviously, an adequate volume of negotiated trades must occur for the formula traded prices to accurately reflect supply and demand. In relation to the total meat traded, a relatively small number of buyers and sellers influence market price (U.S. Department of Agriculture). The market consequently is characterized as "thin." Other agricultural markets, such as local livestock auction markets, have been characterized as thin (Sporleder, 1980). The general extent to which the thin market issue pervades producer-first handler markets is not known.

The issue is directly related to performance dimensions of a marketing system such as allocative efficiency and operational efficiency. Even though a pricing point within a marketing channel may have the structure of a large num-

ber of buyers and sellers, the price discovery process customarily used by traders may lead to undesirable performance consequences.

## Public Information Availability

Concern over competition and efficiency in agricultural markets and the public sector's need to monitor behavior in these markets led to federal government involvement in information. Federal and state governments currently are involved in collecting and reporting a myriad of statistics on prices, volumes, and related factors across many agricultural markets. The public or tax-supported information provider remains the major source of information on production and marketing. This category includes agencies such as USDA, state Departments of Agriculture as well as institutions such as land-grant universities and libraries. Justification for public market information normally revolves around assurance of reliability and equality of access to information among traders (Henderson, Schrader, and Rhodes).

The private sector also is an information provider. This includes private market news reporting services such as Commodity News Service, Reuters, and mass media. Some argue that private firms could substitute for the public sector involvement in market information acquisition and reporting. In fact, private information services such as Urner-Berry and the Yellow Sheet are leading sources of market information for egg and wholesale beef traders, respectively. However, since market information is a public good, theory suggests government collection and dissemination yields net public benefits in which all consumers have an interest.

The long-term impact of publicly available information presumably is to slow the rate of increase in agricultural market concentration. Also, to the extent privately held information constitutes a barrier to entry, publicly available information should lessen this as a factor.

## POLICY ISSUES CREATED BY EMERGING INFORMATION TECHNOLOGY

Most observers agree that our society has entered the so-called "information age." Despite general agreement concerning the pervasive role information technologies will play in the future, relatively scant attention has been paid to policy issues that may be created by such technologies. Perhaps this situation arises because of the difficulty in being proactive concerning information technology policy issues when one does not have specific knowledge of the form and applications which will occur over the next several decades.

However, several issues are currently identifiable. The list probably oversimplifies the complex web of potential policy issues which could be enumerated. No manageable enumeration of issues would be sufficient to capture all important considerations. The issues identified serve as "umbrella" areas under which numerous specific issues could be listed.

There are several assumptions underlying the long-term issues identified. One is that technology will continue to progress so that all information and trading systems will become more user friendly and cost effective over time. Another is that various information networks will increasingly be linked together and that current problems of incompatibility among hardware, software, and communications will ease. In general, a positive future environment is assumed for the development and adoption of all types of information technologies.

The broader issues are categorized for discussion purposes as follows, again in no particular order:

- \* Distributional Impacts,
- \* Access to Information,
- \* Role of Information Providers,
- \* Confidentiality and Integrity, and
- \* Market Structure Impacts.

Each issue is treated in turn with some discussion of its scope and meaning.

### **Distributional Impacts**

A critical policy issue created by emerging information technologies of all types is the distributional impact they may have by size of firm. It is doubtful that various technologies are scale neutral, yet the impact of any given technology is difficult to define or research. The potential for cost-effective applications of various information technologies only for larger volume farm operators or agribusiness firms is of concern.

Information systems may possess more scale neutrality than trading systems. Consider decision-aid programs which assist a manager with defining an optimal feed ration for livestock. Relative benefits derived from the decision-aid technology are probably not significantly different whether the firm's manager is feeding 100 or 10,000 head. However, trading systems may have an impact on small scale operations relatively more favorably than large scale op-

erations. Access to many buyers by small scale operations is possible through an electronic market. This simply would not be possible through conventional marketing channels.

It may be that user costs associated with various information technologies preclude smaller scale operations from availing themselves of such high technology services. User charges may be sufficient so that larger volumes are necessary to keep users' average total costs at a reasonable level. This is not of paramount concern if comparable information is available to potential users through conventional distribution channels, such as newspapers or radio. Also, information brokers or other organizations such as producer cooperatives could provide shared costs access to users.

On balance, the general distributional impacts of all information technologies probably favor small-scale firms relatively more than larger-scale firms.<sup>2</sup> Low cost delivery of various information, decision-aid models and even market outlets to producers has an equalizing effect across size of operation. Yet, the issue remains one of importance, and is worthy of continual monitoring from a public policy perspective.

### **Access to Information**

This issue of access to information refers primarily to ownership and control of large computer-based information systems. The issue encompasses concern about the impact on access to information when that information resides as part of a computer-based system and cannot be retrieved in a conventional manner.

As information technologies progress, both physical and economic access to various types of information could change. The promise of increasingly user friendly technology could increase future physical access, but the costs and control of access are of obvious importance.

The control of access to information should not be narrowly held. The socially desirable consequences of competition apply as readily to information collection and dissemination as other economic activity. From a policy perspective, it is important to monitor over time the potential control of access by dominant firms, particularly through control of communications linkages. Large companies, such as AT&T, could exercise influence on information access via control of telecommunications technology. The potential interaction between control of data communications and control of access to information or capacity to transmit information merits continual public scrutiny.

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<sup>2</sup> This does not mean that information collection is scale-neutral. Conventional wisdom is that there are economies of size in information collection. However, technology may well provide cost effective access to information not previously possible for small-scale firms.

## **Role of Information Providers**

Both public and private information providers currently exist and will continue to provide information to various users. The essence of this issue is the relative roles of the two types of information providers and concern over the socially optimal mix between private and tax-supported activities. The optimal mix question involves both developing and adopting new technologies of interest to agriculture as well as the collection, analysis, and dissemination of information.

The notion of "value-added information" is relevant to the collection-dissemination issue. Value-added information is data collected by the public sector that are repackaged to embody human expert interpretation. Extension outlook information is a leading example of value-added information provided totally by the public sector, although there are numerous examples where the private sector provides value-added information to users, such as Commodity News Service.

The policy issue regarding value-added information concerns the relative roles of the private and public sectors in dissemination of value-added information. Little argument exists that the public sector has primary responsibility for collection. However, controversy surfaces concerning the dissemination of information. Some argue that the public sector should be involved in dissemination only to a limited degree and allow private sector competitive market forces to operate in dissemination (U.S. House of Representatives, pp. 236-237). Others argue that the public sector must be involved in dissemination as well to assure continued public access to all potential users of the information. This controversy is also related to the previous policy and market structure issue of public information availability.

Data base ownership is another aspect of this issue. If a private firm places a data base developed by the public sector on its corporate computer, perhaps reformatting the data, does the firm have proprietary ownership of the data base? Can they sell it? Presumably, the current public policy is affirmative to these questions. As data bases are developed and dominant private firms develop in certain information market segments, this issue may become of considerable public concern.

Also, because of the "user fee" stance recently taken by the public sector, pricing of public data is important. This includes the desirability of price discrimination. Should computer data bases or other information be made available to public institutions, such as universities, at a lower charge than private firms requesting the same information? One policy which could be established is for the public sector to dissem-

inate data only to private systems which would supply paid subscribers (U.S. National Commission of Libraries and Information Science). Is this desirable?

## **Confidentiality and Integrity**

There are two related issues, confidentiality and integrity. Confidentiality refers to individual firm information with a public data set. The important facet of a larger problem of information sharing encompasses retrieval of information from individual farm or agribusiness firms and the responsibility for control of confidentiality. If, in the future, individual firms supply proprietary information about their operations to either government agencies or proprietary information systems such as electronic markets, who has the responsibility for maintaining confidentiality and how should it be enforced?

A second related issue is the integrity of the firms or agencies collecting information. For example, electronic markets generate information on individual transactions for buyers and sellers. If these markets are proprietary, the information generated in the normal course of operating the market has economic value. The firms operating such exchanges could sell the information to outside users. The issue then is whether or not such firms should be allowed to sell it and how the integrity of each exchange should be maintained. Perhaps such exchanges should be subject to federal regulation by an agency such as the Commodity Futures Trading Commission.

An associated item related to integrity is the "quality" of information within a computer data base. Typically, users of information lack the ability to check information contained in a data base for accuracy or the extent of noise in the information. This situation is of concern especially in value-added information systems where private firms have the power to "filter" information.

Integrity even has an international dimension. If trading systems and agricultural information systems become prevalent in developed countries, there may become a need to negotiate agreements among governments on information exchange. There could be concern about reliability of information, or the potential for "misinformation," should governments become involved while seeking their own nationalistic interests. Also, international access to remote-access markets could become an issue, especially if state trading countries were involved.

## **Market Structure Impacts**

This issue deals with the long-term structural consequences of information technology. The

previously enumerated farm structure and marketing policy issues essentially are a subset of this issue. That is, the consequences of emerging information technologies on control, market access, and thin markets are all relevant here. Few research results are available concerning the long-term consequences of information technologies on any of these.

Information technologies are not well-understood in terms of their potential impact on structure, conduct of firms, or marketing policy. Because the technology is recent and extremely dynamic, the unknowns are significant. Simply, sufficient time has not passed for studies and the literature to document actual cause and effect relationships between the technology and structure. Numerous hypothesized linkages exist which remain scientifically untested.

Both information systems and trading systems have the potential for affecting the structure of agriculture at the producer-first handler level and/or the conduct of the myriad of firms engaged in various marketing channels for agricultural commodities. The present author has argued elsewhere that proprietary firms and co-operatives engaged in marketing which are primarily information conduits in conventional channels may be adversely affected, particularly by trading systems (Sporleder, 1983). This is because these technologies represent a substitute for the information function currently being provided by such firms in conventional marketing channels.

However, a more important long-run structural consideration may well be the adoption of computer-based remote-access markets to forward cash contract negotiations. These type systems hold promise for enhancing vertical coordination compared to cash market trading systems and, at the same time, largely mitigate the lack of market information available on conventional private treaty cash contract markets (Holder and Sporleder). Adapting current computer technology to an electronic market for forward cash contracts could induce more contracting at the producer-first handler level and favorably affect coordination, thereby reducing uncertainty and costs.

### IMPLICATIONS

Some technologies appear to provide a means for private firms to reduce uncertainty. As a result, they also may reduce the need for ex-

change arrangement alternatives to the open cash market. However, information technologies have no clear relationship to vertical coordination enhancement. The apparent drive toward non-cash market vertical coordination mechanisms is not assisted or lessened by these technologies since normally they are adapted to cash commodity markets.

Cash contracting or vertical integration appears to provide a means for risk management and coordination superior to producer-first handler cash markets for some commodities. Computer-based trading systems certainly do not hinder vertical coordination compared to conventional markets. The potential appears significant for using computer technology to create centralized open markets for cash forward contracts. Improved coordination would result from contracting while retaining the benefit of improved market information from centralized markets.

Quantity and quality of public information could improve significantly from information systems technology. Structural adjustments will occur as a result of information technology adoption. Structural impacts from the technology on both public and private information providers is certain. A reasonable hypothesis is that information technologies will slow the rate of increase in concentration of agricultural commodity markets over time.

Serious policy and research questions remain unanswered. For example, does the advent of electronic cash markets for agricultural commodities really mean that traditional information asymmetry is alleviated? Are electronic cash markets analogous to inventing a better buggy whip, since the trend is increasingly toward non-cash transactions in agricultural commodity markets?

Various information technologies are not likely to be scale neutral in impact. Does the advent of this technology mean small producers and/or marketing firms will suffer aggravated market access and information availability problems, or is the hypothesized relationship that it favors relatively small-scale producers correct?

The policy issues identified here represent only a beginning to a needed public policy debate on emerging information technologies. No one list of issues is sufficient for the debate, nor can any one person supply the answers. The issues simply must evolve over time and conscious policies should be established surrounding each issue.

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