# COST ANALYSIS OF ALTERNATIVE COMPUTERIZED SYSTEMS FOR THE MARKETING AND DISTRIBUTION OF MULTIPLE FOOD COMMODITIES

By

J. E. Epperson, D. P. Helmreich, L. C. Moon,
D. H. Carley, C. L. Huang and S. M. Fletcher
Assistant Professor, Former Research Coordinator,
Systems Specialist, Professor, and
Assistant Professors, respectively
Department of Agricultural Economics
Georgia Experiment Station
Experiment, Georgia 30212

The authors make cost comparisons among alternative computerized marketing systems. The systems described could encompass any number of commodities and stages of distribution involving cash and/or futures transactions.

## Statement of Problem

Concern about efficiency in the marketing and distribution of food and fiber has stimulated research in electronic marketing as a means of exchange (Epperson and Moon; Helmreich et al.) Electronic devices used in marketing primary commodities may include telephones, teletypes, computer systems and video equipment. Various commodities, such as cattle, hogs, eggs, sheep, meat, cotton and fresh produce, have been identified as ones which, because of thin markets and unbalanced information, are likely candidates for electronic exchanges (Helmreich et al.; Epperson and Moon).

## Objective

The overall purpose of this paper is to provide essential cost information for the decision-making process of organizations or groups of market participants who might now or in the near future contemplate the adoption of an electronic marketing system.

## Methodology

The pilot study area encompasses southwestern Georgia which is an area of about 6 million acres of intensive and diversified agriculture. Commodities common to this area which were selected for study in a multiple commodity framework include: corn, soybeans, peanuts, pecans, feeder cattle and slaughter hogs.

The basis for cost comparisons among alternative electronic marketing configurations is quite involved and thus is left to a much longer report by Helmreich et al. to be published elsewhere. Suffice it to say here that the foundation of the cost estimates encompass the following factors: 1) designed trading rules; 2) quantities of commodities marketed in the study area; 3) number of producers (potential sellers) in the study area; 4) number of buyers

available to the area; 5) estimated utilization time of an electronic market by participants; 6) estimated value of commodities traded; and 7) physical arrangements and capabilities of electronic hardware (machinery and equipment) used.

The analysis considers three computerized systems at four levels of trade, given that all six commodities are traded in a multicommodity framework. The four levels of trade include 3, 15, 50, and 75% of the amounts of the six commodities actually marketed in the pilot area in 1979. In addition a four-way comparison is accomplished at one level of trade for four of the six study commodities. The four-way comparison includes the three computerized systems indicated and a telephone system at the 15% level of trade for corn, soybeans, feeder cattle, and slaughter hogs. Information pertaining to the telephone system was obtained from a marketing organization operating in Georgia while information used for the computerized considerations was compiled from a multitude of sources which are reported by Helmreich et al.

For this evaluation a computerized multicommodity exchange consists of a central processing unit (CPU) connected via telephone lines to buyers' and sellers' terminals. Terminals could be located at assembly points or in individuals' houses or offices. The range of terminal choices open to a participant is determined by the computer hardware. In this analysis allowances are made for using equipment which would allow buyers and sellers to utilize practically any type of terminal. The cost of terminals to buyers and sellers is not considered in the cost comparison analysis as the desire for terminal capabilities would vary widely by market participant. Suffice it to say that an average user of the system would be expected to spend 0.1% of the value of commodities they buy and sell on a terminal worth about $2000 (Helmreich et al.).

The three computerized systems isolated for analysis include: 1) a time-sharing network which utilizes the computing power of several large CPUs (central processing units), owned by a company which sells computer time; the network is established by connecting buyers' and sellers' terminals through telephone lines to the computer facility; 2) an owned CPU, purchased by a marketing organization which employs the CPU as the communications hub of the network; and 3) a leased CPU, employed by a marketing organization in a manner identical to that of an owned CPU.

The total cost of a computerized multicommodity exchange can be very high. However, given a moderate amount of usage, the cost/unit would become relatively small. This could be a major advantage to all market participants. This analysis encompasses the costs of hardware, software, personnel, operations and overhead used in running a computerized exchange.

Successful implementation of a computerized multicommodity exchange would allow its users to access potentially valuable auxiliary features. Information networks could provide buyers and sellers with timely facts related to agricultural markets. The power of the system's computer could be brought to bear in analyzing production, marketing, and distribution problems allowing users to make better informed decisions. However, in the ensuing exposition on marketing costs, no auxiliary features are included in the estimates. Individuals would purchase auxiliary functions and be billed accordingly. The cost of accessing the system to gather trading information or utilize other alternative features will not be included in the calculated

costs of actually marketing commodities through the system.

Comparisons of marketing expenses for the three computerized systems center on computer costs as such costs are expected to be the only area of cost differences. Overhead and operating expenses are anticipated to be identical among the three alternatives. Examination of computer costs for the three systems reveals differences which are important in considering alternative modes of operation for a computerized multicommodity exchange.

## Results and Conclusions

### Cost Comparison of Computerized Systems

Table 1 depicts estimated computer costs for the time-sharing system. The costs shown include computer connect time, monitoring costs, and programming expense.

Connect time refers to the amount of time that the users or market participants are using the computing facility. The cost of $27.50/user/hour also covers the expense of "dial-up" phone service, whether local or long distance, from users' terminals to the network's computer facilities.

An allowance is made for a terminal at the marketing organization's headquarters to be connected to the computer to monitor trading. This item, listed in Table 1 as monitoring cost, in actuality represents another expense for computer connect time.

Table 1. Annual costs of a time-sharing computer network for various levels of trade for six commodities through a potential multicommodity exchange

| Item | Levels of Trade 3% | 15% | 50% | 75% |
|---|---|---|---|---|
| | dollars | | | |
| Computer Connect Cost (@ 27.50/hr./terminal) | 8,775.25 | 49,431.25 | 173,607.50 | 260,430.50 |
| Monitoring Cost (@ 27.50/hr. and 250 days/yr.) | 13,750.00 (2 hrs/day) | 27,500.00 (4 hrs/day) | 55,000.00 (8 hrs/day) | 82,500.00 (12 hrs/day) |
| Programming Expense | 22,058.90 | 42,058.90 | 42,058.90 | 42,058.90 |
| Total CPU Cost | 44,584.15 | 118,990.15 | 270,666.40 | 384,989.40 |

Sources: Survey data, a major computer time-sharing company, and a systems specialist for the University of Georgia.

An initial investment of $60,000 for creating necessary software (a set of instructions which the computer executes) to allow use of the computer for commodity trading is amortized over five years at 13% interest. The five year period for amortization assumes that to be the length of time between generations of computers while the 13% rate of interest assumes an underlying inflation rate of 10% and a real rate of interest of 3%. An annual cost of software maintenance and evolution is added to the annual-

ized software investment to encompass the programming expense item depicted in Table 1. The annual cost of software maintenance and evolution is estimated at $5000 at the 3% level of trade and $25,000 at all higher levels of trade. Thus, the annual computer cost of using a time-sharing system ranges from $44,584 to $384,989, varying with level of trade, Table 1.

As an alternative to utilizing the services of a computer time-sharing company, a marketing organization could purchase a system of computer hardware. Such a computer would be located on the premises of the marketing organization and used in its marketing activities. Projected costs of this alternative are given in Table 2.

Table 2. Projected costs of an owned potential multicommodity computerized exchange for various levels of trade for six commodities

| Item | Levels of Trade | | | |
|---|---|---|---|---|
| | 3% | 15% | 50% | 75% |
| | dollars | | | |
| **Initial Investments:** | | | | |
| Room Renovation | 21,000.00 | 21,000.00 | 21,000.00 | 21,000.00 |
| Software Creation | 60,000.00 | 60,000.00 | 60,000.00 | 60,000.00 |
| Hardware Purchases | 310,155.00 | 543,400.00 | 574,800.00 | 574,800.00 |
| Subtotal | 391,155.00 | 624,400.00 | 655,800.00 | 655,800.00 |
| Investments Annualized Over 5 yrs. @ 13% | 111,211.23 | 177,526.29 | 186,453.78 | 186,453.78 |
| Room Rent @ $7.00/ sq. ft./yr. | 7,000.00 | 7,000.00 | 7,000.00 | 7,000.00 |
| Annual Programmer Expense | 42,000.00 | 67,000.00 | 67,000.00 | 67,000.00 |
| Monthly Expense to Marketing Organization: | | | | |
| Computer Maintenance | 1,060.50 | 1,310.50 | 1,350.50 | 1,350.50 |
| Telephone Lines @ $19.00/line | 475.00 | 1,045.00 | 1,140.00 | 1,235.00 |
| Software Maintenance | 2,091.00 | 2,091.00 | 2,091.00 | 2,091.00 |
| Subtotal | 3,626.50 | 4,446.50 | 4,581.50 | 4,676.50 |
| Yearly Expense (Monthly Expense X 12) | 43,518.00 | 53,358.00 | 54,978.00 | 56,118.00 |
| Telephone Expense to Buyers & Sellers | 3,192.10 | 22,118.00 | 87,685.68 | 131,685.50 |
| Total Annual Expense | 206,921.33 | 327,002.29 | 403,117.46 | 448,257.28 |

Sources: A major telephone company and a systems specialist for the University of Georgia.

Initial investments include room renovation, software creation and purchase of the computer equipment. Included in room renovation are a separate air conditioning system, raised floor, and electrical service. In addition to these initial investments, the costs of purchasing the computer equipment (included stand-by equipment), a stand-by electrical supply system, and the initial software development are amortized over five years at an interest rate of 13%. No salvage value is imputed on these initial investments. Additional annual costs are included for personnel to program and operate the computer facility and for room rent and utilities. At the 3% level of trade, annual personnel expense includes $30,000 for a computer operator-programmer-manager and $12,000 for a secretary-clerk-file builder. At greater levels of trade, an additional $25,000 is allotted for an additional programmer. Monthly items of cost include hardware maintenance, telephone lines for users' accessing the computer, and software expense. These items of expense are annualized and combined with personnel, software, and telephone costs and the amortized equipment investment. This gives total annual expenses of equipment for a multi-commodity exchange using its own computer (Table 2).

Telephone expense in Table 2 to buyers and sellers include charges for a combination of dial-up service and WATS lines. The mixture of WATS and dial-up service varies with amount of connect time to reflect a minimization of estimated communications expenses based on a major telephone company's rate schedules. Annual expenses for an owned computer system vary with level of trade through the system and range from $206,921 to $448,257 (Table 2). These differences result from the use of more expensive CPUs as greater demands are placed on the system. The purchase prices are higher, and the maintenance expense rises also. As participation through this system increases, the number of telephone lines needed expands. This is the other projected cost increase as level of market participation rises. Personnel expenses for programming and operating the computer are not expected to rise after reaching the 15% level of trade.

A third alternative for bringing computer power to bear in marketing involves the use of a leased computer. A marketing organization would once again have a CPU located at its marketing headquarters. However, expenses are delineated for leasing rather than buying computer equipment (Table 3).

Similar requirements would be met in terms of programming, climate control, and reserve computer capacity and electricity supply. The biggest difference is that monthly lease payments would replace the amortized initial investment and monthly maintenance cost required in purchasing computer equipment.

As with an owned CPU, the marketing organization would be required to make an initial investment in room renovation, software creation, and emergency electricity supply capacity. Yearly personnel, additional room rent, monthly telephone, and software expense items would be the same as those for using an owned CPU. The amortized purchase price of hardware and the monthly maintenance expense for an owned system would be replaced by a monthly rental fee with use of a leased CPU.

In estimating costs, the pieces of equipment are the same as those used in ascertaining the cost of a purchased computer system. The estimated annual costs range from $218,587 to $475,832, varying with levels of trade (Table 3).

At all levels of trade, expenses for a leased system are estimated to be

Table 3. Projected costs of a leased potential multicommodity computerized exchange for various levels of trade for six commodities

| Item | Levels of Trade | | | |
|---|---|---|---|---|
| | 3% | 15% | 50% | 75% |
| | dollars | | | |
| Initial Investments: | | | | |
| Room Renovation | 21,000.00 | 21,000.00 | 21,000.00 | 21,000.00 |
| Software Creation | 60,000.00 | 60,000.00 | 60,000.00 | 60,000.00 |
| Hardware Purchases | 30,900.00 | 30,900.00 | 30,900.00 | 30,900.00 |
| Subtotal | 111,900.00 | 111,900.00 | 111,900.00 | 111,900.00 |
| Investments Annualized Over 5 yrs. @ 13% | 31,814.85 | 31,814.85 | 31,814.85 | 31,814.85 |
| Room Rent @ $7.00/ sq. ft./yr. | 7,000.00 | 7,000.00 | 7,000.00 | 7,000.00 |
| Annual Personnel Expense | 42,000.00 | 67,000.00 | 67,000.00 | 67,000.00 |
| Monthly Expense to Marketing Organization: | | | | |
| Hardware Lease | 8,649.00 | 15,570.00 | 16,460.00 | 16,535.00 |
| Telephone Lines @ $19.00/line | 475.00 | 1,045.00 | 1,140.00 | 1,235.00 |
| Software Maintenance | 2,091.00 | 2,091.00 | 2,091.00 | 2,091.00 |
| Subtotal | 11,215.00 | 18,706.00 | 19,691.00 | 19,861.00 |
| Yearly Expense (Monthly Expense X 12) | 134,580.00 | 224,472.00 | 236,292.00 | 238,332.00 |
| Telephone Expense to Buyers & Sellers | 3,192.10 | 22,118.00 | 87,685.68 | 131,685.50 |
| Total Annual Expense | 218,586.95 | 352,404.85 | 429,792.53 | 475,832.35 |

Sources: A major telephone company and a systems specialist for the University of Georgia.

greater than the costs of owning the computer hardware. Consequently, this alternative is also consistently more expensive than use of a time-sharing network (Table 4). Use of a time-sharing network is expected to be less expensive than ownership of a computer system.

At no level of trading does the cost of an owned computer system exceed that of a leased system. However, an organization may be attracted toward a leased system because of the much lower initial investment required when compared to an owned system. Also, a lease would be expected to last only two years after which the marketing organization would be free of any further financial obligation in terms of computer equipment. This could be important for a marketing firm experiencing growth and requiring greater computing power (thus different computer hardware).

Table 4. Comparison of projected computer costs for a potential multicommodity computerized exchange using three alternative systems and four levels of trade

| System | Levels of Trade | | | |
|---|---|---|---|---|
| | 3% | 15% | 50% | 75% |
| | annual dollar expense | | | |
| Leased Computer | 218,586.95 | 352,404.85 | 429,792.53 | 475,832.35 |
| Owned Computer | 206,921.33 | 327,002.29 | 403,117.46 | 448,257.28 |
| Time-Sharing | 44,584.15 | 118,990.15 | 270,666.40 | 384,989.40 |

Sources: Tables 1, 2, and 3.

However, examination of a time-sharing network reveals a yet lower initial investment requirement, operating costs lower than those with a leased system at all trading levels, and no financial obligation beyond a month at a time. Consequently, a leased computer system is viewed as inferior to the time-sharing alternative considered here in terms of both cost and flexibility.

An additional advantage to using a time-sharing network lies in the growth potential. A major computer time sharing company, for example, provides a worldwide network to potential users. This suggests vast potential for growth in scope and quantities of trading to the point of a global multicommodity computerized exchange.

## Cost Comparison of the Telephone and Computerized Systems

A computerized multicommodity exchange would be expected to be more complicated than a telephone system. With the greater complexity, a computer system should have greater flexibility and be able to offer its users additional features. The cost figures detailed earlier dispensed with these alternative features and dwelt solely on the computerized marketing function.

Concerning the telephone and computerized systems, comparison for four of the six commodities considered in this study is possible. Table 5 examines the charges to users for marketing corn, soybeans, feeder cattle and slaughter hogs through a Georgia marketing association's telephone system and the estimated costs of marketing the same commodities through the three computerized systems. The costs for the computer systems were calculated at the 15% level of trade which approximates in general the volume of trade being transacted through the telephone system.

In order for this comparison to be compatible it must be assumed that charges for the telephone system represent actual costs of the system. Also, for purposes of comparison, computerized marketing costs from Tables 1-3 were recomputed on a per unit basis by commodity. In addition, overhead and commodity inspection costs were added to the computerized marketing costs for purposes of comparability. Overhead includes costs for administrative personnel, building rent, utilities, office supplies and telephone service, while direct inspection costs pertain to travel and coordination expenses surrounding inspection and/or grading of commodities.

Table 5. Cost comparisons among alternative computerized systems and a telephone marketing system by commodity at the 15% level of trade

| Commodity | Unit | System | | | |
|---|---|---|---|---|---|
| | | Telephone | Owned computer | Leased computer | Time-Sharing computer |
| | | cost/unit | | | |
| Corn | bu. | 4.0¢ | 3.6¢ | 3.8¢ | 2.0¢ |
| Soybeans | bu. | 5.0¢ | 4.7¢ | 4.9¢ | 3.1¢ |
| Feeder Cattle | head | $5.00 | $6.60 | $6.84 | $4.63 |
| Slaughter Hogs | head | $1.25 | $1.41 | $1.44 | $1.16 |

Sources: A marketing organization operating in Georgia, survey data, a computerised time-sharing company, and a systems specialist for the University of Georgia.

Examination of Table 5 reveals that of the three alternative computerized exchanges, use of only the time-sharing network would be expected to consistently result in costs lower than charges currently incurred from use of the telephone system for commodity marketing. Except in the case of soybeans and corn, the use of an owned or leased system of computer equipment would be more expensive than use of the presently successful telephone commodity exchange system. These results stem from the fact that no savings in telephone charges would be expected with the owned and leased computer systems. Furthermore, additional expenditures for computer equipment would be required, resulting in higher costs than those being experienced with the telephone exchange.

Use of a time-sharing network would be expected to result in lower marketing costs to users. In this case, much of the telephone expense would be eliminated, resulting in overall savings to the marketing organization.

Successful implementation of a computerized multicommodity exchange would result from concerted effort. The results to be expected are low/unit cost of marketing, greater market information present during trading, prices more accurately established, and availability of valuable auxiliary features to market participants.

## Implications

This study used primary agricultural commodities as a basis for cost comparisons among alternative computerized marketing systems. However, the results of the analysis are readily transferable to any potential electronic exchange regardless of commodities, volume, or stages of distribution. In fact, the systems outlined could encompass any number and volume of commodities and stages of distribution from the raw product to the consumable good, involving spot and/or future transactions.

## References

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