MARKET INFORMATION AND PRICE REPORTING IN THE FOOD AND AGRICULTURAL SECTOR

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AGRICULTURAL INPUT MARKET INFORMATION: SOME RESEARCH ISSUES AND METHODOLOGICAL PROBLEMS

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INTRODUCTION

Two current research interests in agricultural input market information are being addressed at the University of Minnesota. The first is a study of fertilizer market information as part of an ESCS-USDA contract to investigate the market structure and performance of the U.S. agricultural chemical system. The second is an involvement with AMS-USDA to aid in the evaluation of an "experiment" of collecting, summarizing, and disseminating market news (prices) about feeds and fertilizer.

This paper was written to (1) present some theoretical and research considerations encountered, (2) review the nature of the market news experiment and the hypotheses tested, and (3) propose a method for examining the value of a market news service for certain farm inputs.

RESEARCH ISSUES

We undertook two initial activities as a first step in defining areas important to the question of market information. One of these was a review of relevant economic—both theoretical and applied—and related technical literature on the general theory of market information,[1] and, in a separate review we examined the structure and operation of the fertilizer industry.

We examined to what extent the general problem of agricultural input market information had been addressed. The subset of economic literature on the theory of information in regard to input markets has tended to concentrate on one input, labor, and the role of information in the job search. The relevant agricultural economic literature has concentrated on product prices or on uncertainties in the production process usually unrelated to input prices. In general, that literature appears to deal with four areas:

1) The problem of profit maximization under uncertainty in the product price;
2) The role of information in the learning curve segment of the firm's and the industry's production and long-run cost functions;
3) The welfare aspects of product price stabilization; and
4) Consumer search behavior.

However, there are a few studies of other agricultural input markets that illustrate some important input market information inadequacies. There is a tendency among price analysts and econometricians to assume that average prices reported by the U.S. Department of Agriculture and other price reporting organizations represent a distribution of prices that can be largely explained by geographic, temporal, or product differences, and/or that these averages represent an attained market equilibrium price. Examination of primary price data for a defined product at a single point in time and space show this assumption to be in error.

Studies of the dispersion of prices for farm inputs at a point in time and space were investigated at the University of Minnesota over a period of five years. The first study was reported in the doctoral dissertation of R. Clyde Greer.[2] Greer surveyed 62 dairy farmers in a nine-township cluster north of Rochester, Minnesota to determine the "effective price" of dairy feeds purchased by them. Greer defined "effective price" as the final price paid after adjusting for a variety of "terms of trade," including mixing, delivery, credit, and other costs. While experiencing analytical difficulties in his adjustment formula, Greer found considerable differences in the "effective prices" paid by these farmers for the same dairy feeds. Feed products such as soybean meal showed price dispersions of 37 percent (the highest price paid was 37 percent above the lowest price), and more brand-differentiated feeds of similar nutrient content registered dispersions of 60 percent.

In an effort to explain these differences, Greer hypothesized that they existed, in part, because of a lack of knowledge of market prices by the farmers involved. Accordingly, he questioned the farmers to ascertain their knowledge of market prices. Two questions were posed: (1) Do you believe that dairy feed prices vary from one dealer to the next in this area? and (2) Did you compare prices offered by more than one dealer in making your last dairy feed purchase? Of the farmers surveyed, *not one* of them felt that there was an effective price difference among dealers, and *only one* farmer among the 62 surveyed actually "shopped around" for other prices for his last purchase.

While these results were only a part of the Greer analysis, they were persuasive enough to encourage Robert J. Rathjen to explore the possible existence of similar price dispersions in fertilizer products.[3] Rathjen's doctoral dissertation focused on fertilizer retailing structure and behavior, in an effort to judge the future organization of the retail fertilizer industry in Minnesota. In part of his study, Rathjen determined the adjusted price dispersion for anhydrous ammonia sold to farmers in a three-county area of southwestern Minnesota. He found that a price dispersion of 11 percent existed after various terms of trade were considered.

The line of analysis was much more pointed in the doctoral dissertation work of Calvin Brints.[4] Brints concentrated on determining adjusted price dispersions in feed and fertilizer, as well as testing information hypotheses that would explain these dispersions. Brints surveyed Minnesota farmers in three township clusters. One cluster was in the cash crop intensive area of the Red River Valley, another was in the dairy farm intensive area of south central Minnesota, and the third was in the north central part of the state, where small diversified farms are prevalent.

Brints' questionnaire was designed to elicit three types of information: (1) data on the price and quantity of feed and fertilizer purchased, (2) demographic characteristics and input purchasing behavior, and (3) a series of two multiple-choice tests, developed by staff in soil science and animal nutrition, suggested the level of technical knowledge farmers possessed regarding the use of fertilizer and feed in agricultural production.

Price dispersions similar to the Greer and Rathjen findings were discovered in each of the three areas. Regression analyses showed that (1) dispersions for both feed and fertilizer were greatest in the area where small, diversified farms were characteristic; (2) dispersions were lower for fertilizer in the crop area and lower for feed in the dairy area; (3) lower prices were paid by farmers operating larger farms, younger farmers, and by those with higher formal education; and (4) significant negative correlation existed between those who were tested to have higher technical knowledge and those who paid lower prices for feed and fertilizer.

Brints also studied the levels of price dispersion recorded by the Minnesota Crop and Livestock Reporting Service (the state-federal arm of SRS-USDA) for farm inputs and farm products. He found that greater dispersions existed for inputs than for outputs. This supported his hypothesis that farm outputs are less differentiated and tend to be purchased by knowledgeable buyers, in contrast with differentiated agricultural inputs which are bought by farmers of varied technical and economic knowledge.

At the beginning of this decade, SRS contracted the University of Minnesota to study selected input markets and prices in the U.S. The study was intended to provide updated knowledge about the quantities and values of inputs purchased by farmers through alternative outlets and the appropriateness of the price-reporting questionnaires used, as well as to gather information that might suggest reweighting of the Prices Paid Index. With access to primary data on prices paid by farmers, a range of statistical and economic hypotheses was tested. Among these was an attempt to explain reported price dispersions for feed, fertilizer, machinery, building and fencing materials, and hardware. The technique employed was to identify price reports in the higher and lower segments of the distribution *by reporting organization,* and then to survey the reporters to determine why such dispersions existed. About one-third of those surveyed did not understand the requested price. The majority, however, did report actual prices charged to farmers and gave such reasons as "it's only a sideline with me, so I give it to them at cost" to "I'm the only one around here and I need all I can get."[5]

Our second step was to develop a classification of users, uses, and kinds of information relevant to the fertilizer industry and its associated markets. The resulting taxonomy is in Appendix A. By dividing the "fertilizer world" into five sectors, we were able to highlight the specific kinds of "information" that one might be concerned with, as well as efficiently examine the extent of the availability of each quantum of information. This analysis also underlined the complexity of what could easily be misinterpreted as a relatively standard problem for market analysis.

In examining the structure of the fertilizer industry, attention is immediately focused on two characteristics. The first is the oligopolistic organization of the fertilizer producer sector. The second is retail market performance. The production of fertilizers is quite highly concentrated (in the United States, there are less than 100 primary producers); access to information is limited;[6]

and the market is significantly affected by international price movements resulting from both input price variations (e.g., petroleum and natural gas) and expanding worldwide capacity and demand (for example, construction of fertilizer production capacity in oil-producing countries).[7]

Traditionally, concern in the area of fertilizer retail market performance has focused on consumer behavior, as related to the individual farmer's cost of production.[8] The general theory (with implicit assumptions of classic profit-maximizing behavior) relates variations in fertilizer prices to variations in fertilizer use and consequent variations in final crop production levels. It is generally assumed that there is some degree of analogy between analysis of the farmer's decision problem as that of a utility-maximizing consumer and as that of a profit-maximizing firm. This comparison presupposes all of the required assumptions with respect to continuity, differentiability, and comparability of utility, cost, and production functions.

What would be the consequences of major imperfections in the retail market structure and violations of the standard assumptions for fertilizer market performance? Imperfections in the retail market structure result from (1) spatial variation, (2) a high degree of nonintuitive product differentiation, or (3) variations in retail firm structure, costs, and optimizing criteria. Specific cases of each of these are readily evident. For example, low rural population densities contribute to limits on the number of fertilizer retailers in a given area, to the extent of creating localized oligopolies and even monopolies. The large number of mixes, blends, and forms (e.g., liquid, granular, suspension) of fertilizers, and the fact that they are *not* perfect substitutes are obvious sources of product differentiation. But, the addition of a wide range of ancillary services and credit arrangements offered by different retailers (and even variation in services between one retailer and a variety of clients) establishes a second level of product differentiation that is extremely difficult to measure. In general, three types of firm organizations dominate the retail market: fully independent firms, co-op-related firms, and industry-related firms. Differences between their internal organization and internal linkages to primary fertilizer producers result in variations in costs and marketing objectives and strategies. These variations, as well as the generally broad mix of products and services these firms provide in addition to fertilizer, greatly affect the nature of the firm's overall optimizing decision.[9]

These market imperfections on the side of the retail sector are matched by complications in the consumer's (i.e., the farmer's) own objective function. While there is some substitutability between fertilizers, there is not an immediate, independent substitute for fertilizer in the production process.[10] Whether realistic or not, fertilizer may be viewed by the farmer as having a relatively fixed proportion constraint. Since fertilizer is only one of several components of the farm production function, its utilization is not independent of other input prices. The farmer therefore, may view the fertilizer purchase/use decision as being inherently limited in choice.

These consumer and retail market imperfections introduce significant differences between the analysis of fertilizer market performance and the study of relatively "perfect" agricultural product markets. The relationship between, and movements in, the most easily observable price and quantity variables may not be expected to provide the same kinds of signals, with respect to market performance and consumer behavior. Price is no longer an easily interpreted market signal, and the price dependence of demand and supply may not operate in the classic, perfect competition mode.

THE MARKET NEWS EXPERIMENT

Relatively large variations in fertilizer prices and the importance of fertilizer to national agricultural production have made the fertilizer market a matter of popular interest in recent years. Additionally, the observation of significant fertlizer retail price dispersion within narrowly defined markets supports the conclusion that one or more market imperfections hamper the operation of prices as market signals.[11] It has been generally assumed that success in narrowing this price dispersion in the farmer's favor would result in welfare gains.

The body of information theory offers the plausible hypothesis that information imperfections can indeed yield such price dispersion as may be observed in the fertilizer retail market. This theory, in a competitive equilibrium framework, argues that price dispersion is a phenomenon of market disequilibrium. If the cost of information acquisition is low enough, consumers will gravitate to the lower-priced firm; other firms will be obliged to lower their prices to regain customers; and the price dispersion will effectively disappear. This, of course, presumes that rational consumers will seek information when the cost is low enough and act on it, if it is favorable.

This line of reasoning has led the USDA Market News Service to consider establishing a news service for farmers on agricultural input prices, similar to the product market news now available. In the case of feeds and fertilizers, the existence of price dispersion has been documented. In addition to benefits hypothesized from narrowing this dispersion, it is generally assumed that additional input-related information will be an overall advantage to the farmer in reaching various production decisions.

The Market News Service solicited the interest of several states and obtained the cooperation of New York and South Carolina in establishing a pilot market news service for two groups of inputs, feeds and fertilizers. Strong support for the prospect of success for such a service came from a pre-trial survey. Conducted by the State of New York's Department of Agriculture, the survey found that 87.7 percent of the farmers interviewed felt that such information would be useful to them.[12]

Several aspects of the pilot programs raise serious questions as to their value as an indicator of the potential for an agricultural input market news service. Partly because of the short time interval between the decision to go ahead with such an experiment (November, 1978) and the deadline for getting usable fertilizer information to farmers (before spring planting), in-depth, pre-experiment testing and gathering of baseline data was not carried out.[13]

Secondly, each state acted independently in designing its own experiment, effectively precluding any significant interstate comparisons of post-trial results. Thirdly, the experiments appear to have been designed without any clear concept of how they might be subsequently evaluated, or even exactly what outcomes might be expected as a sign of "success" or "failure." Finally, it is highly questionable that either New York, with its low fertilizer use and dominant dairy industry (particularly in the test counties), or South Carolina, with its relatively low fertilizer consumption, provide a representative sample for the case of fertilizer.

In each state, small experimental and control zones were selected on the basis of agricultural similarities (each zone consisted of three counties in South Carolina and one in New York). Weekly high- and low-price data are collected from cooperating dealers and are disseminated through local radio and newspaper outlets (and by telephone recording in New York). A fairly wide range of feed and fertilizer blends and mixes are covered. An example of weekly data for New York is in Appendix B.

After only a few weeks of operation, it is difficult to make any positive evaluation of the effectiveness of the news reporting in altering farmer behavior. However, a brief examination of the experiment design points up so many problems that it is not at all unfair to presume that either state's price-reporting effort by itself will provide much valid or useful information in which to base broader generalizations.

Even a rough examination of the fertilizer retail market yields the observation that, unless a good deal of pretest analysis and monitoring of many variables is carried out during the test, in addition to monitoring over-the-counter retail prices, price movements during the tests cannot be safely attributed to the availability or lack of information. What is one actually observing if a price dispersion is seen to narrow during the trial? Several possibilities are diagrammed in Figures 1-5.

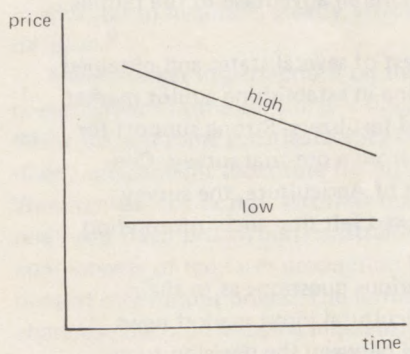

Figure 1

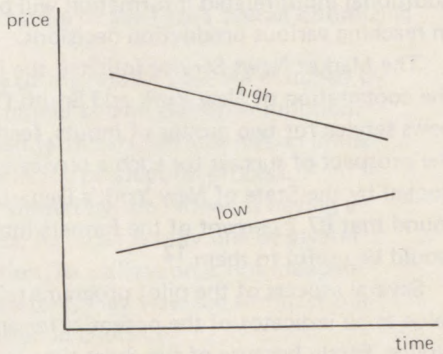

Figure 2

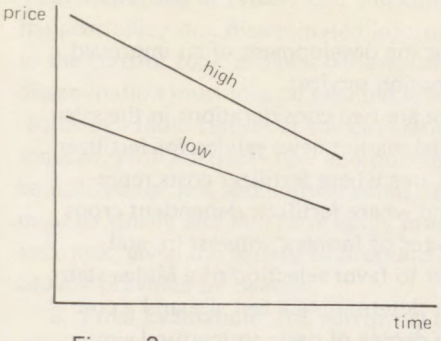

Figure 3

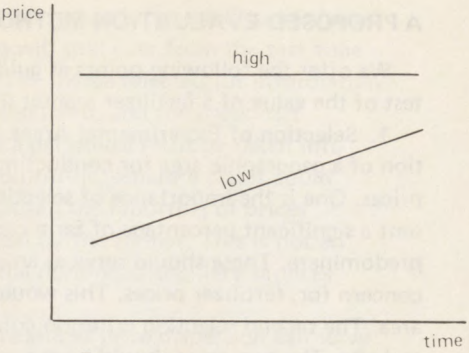

Figure 4

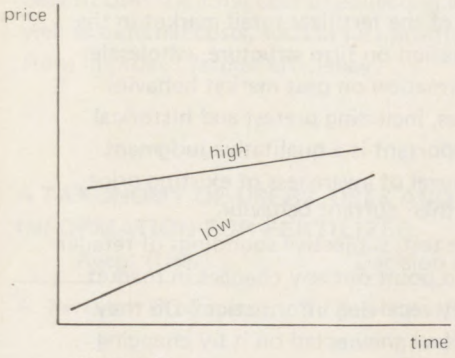

Figure 5

At what point is one observing supply-related price changes versus demand-induced ones? When do constantly observed prices fail to indicate that a dealer may be adding or reducing nonpriced services to clients as a "back-door" form of competition? At what point does the linkage of a dealer to a dominant supplier dictate a price independent of local consumer behavior? Without considerable examination of the test environment, price dispersion is of limited value as a measure of changes in consumer behavior in this market. The current experiments do not provide such an examination.

What about the farmer? Work in Minnesota[14] seems to indicate a failure on the part of "rational" farmers to engage in information search activity (i.e., look for lower prices), even in an area where a high (37 percent) price dispersion existed. The phenomenon may be explained by several factors: imperfections of the market structure, a failure to fully evaluate the "cost of search" to the individual farmer, "irrationality" of the farmers, or even by the failure of the posited dual utility/profit-maximizing model to adequately explain the farmer's decision-making process. Given the complicated nature of farm management decisions and the special role of fertilizer in those decisions,[15] it might be most profitable to start with a re-examination of this process.

A PROPOSED EVALUATION METHOD

We offer the following points as guides for the development of an improved test of the value of a fertilizer market information service:

1. **Selection of Experimental Areas.** There are two considerations in the selection of a geographic area for conducting a trial market news service for fertilizer prices. One is the importance of selecting an area where fertilizer costs represent a significant percentage of farm costs and where fertilizer-dependent crops predominate. These should serve as an indicator of farmers' interest in, and concern for, fertilizer prices. This would tend to favor selection of a Midwestern area. The second selection criterion concerns determining a test site and a control site. The two areas should have a certain degree of basic agricultural similarity, but, between two high fertilizer use areas, such similarities become progressively less important, if data on all other variables (as outlined below) are adequately monitored.

2. **Pretest Surveys.** An in-depth analysis of the fertilizer retail market in the area should be conducted, including information on firm structure, wholesale relationships, and marketing methods. Information on past market behavior should also be obtained for comparative uses, including pretest and historical data on prices and quantities. Especially important is a qualitative judgment on past farmer fertilizer-buying habits and level of awareness of existing price dispersion, as well as subjective *reasons* for their current behavior.

3. **Test Monitoring.** During and after the test, subjective soundings of retailer and farmer opinion should again be taken to point out any changes in market behavior. Farmers should be asked: Are they receiving information? Do they pay any attention to it? Why or why not? Have they acted on it by changing their buying habits? Why or why not? Dealers should also be asked if they notice any changes in farmer buying patterns. Consistently lower-priced dealers should be asked about the appearance of new customers. Higher-priced dealers may be reluctant to substantiate the loss of clients, but they may indicate if customers are beginning to engage in some form of bargaining behavior or apparent information search (more people stopping in or calling for price quotations, for example). It is this qualitative analysis that will support quantitative observations on prices and quantities.

4. **Monitoring of External Effects.** Everything from the weather to a wheat glut in the North Central States can have short-term effects on observed fertilizer prices. These conditions must be monitored, and local price variations examined for exogenous influences. If fertilizer is a strict complement used in relatively fixed proportions, fertilizer use may depend only minimally on fertilizer price, but movements in other prices can have a significant impact on fertilizer prices.

5. **Reporting of Prices.** Test and control zones must be selected to minimize the possibility that disseminated information will spill over from the test zone to the control zone and bias behavior there. The media selected for information dissemination must also be selected with this in mind, and the broadcast radius of a radio station or the circulation of a periodical must be taken into account. With adequate pre- and post-test monitoring, separate states could be utilized for test and control zones. In addition, the reporting of prices must be timely and in a form easily interpreted by the farmer. This is not an easy task, given the variety of products and the nonpriced ancillary services usually provided by dealers.

6. **Final Evaluation.** The narrowing of a measured price dispersion can serve as a sign of effectiveness, only if all possible exogenous causes of price movement have been accounted for and if ultimately supported by qualitative evidence of altered market behavior. Finally, it must indeed be shown that there is a net benefit over the total cost of collecting and disseminating the information, as well as external costs, such as lost profits to retailers, and external benefits from improved farmer efficiency.

A TAXONOMY OF USERS, USES AND KINDS OF MARKET-RELATED INFORMATION FOR FERTILIZER

Agent (User)	Decision (Use)	Kind of information Needed
A. Fertilizer Producers	1. Select profit-maximizing level of production of a given product	a. Production costs (e.g., prices of raw material inputs, availability, etc.) Excess capacity considerations
		b. Current prices and consumption levels for product and substitute
		c. Acreage projections for fertilizer-affected crops
		d. Seasonal nature of demand for fertilizers
		e. Costs of storage
		f. Aggregate supply conditions

	2. Marketing and storage decisions, including geographic distribution decisions	a. Location and size of current stocks at all levels
		b. Acreage projections by region
		c. Transportation availability and costs
		d. Storage capacity and location
		e. Storage costs
		f. Marginal cost to company of increased storage capacity
		g. Seasonal nature of demand for fertilizers
	3. Least-cost production formula	a. Raw material costs for substitute inputs
		b. Other related production costs
	4. Plant location	a. Transportation availability and costs
		b. Demand variables (location, size)
		c. Aggregate supply conditions
		d. Economies of scale in plant size
B. Distributors	1. To the extent that distributors serve as secondary producers or processors of fertilizers, decisions A.1, A.2, and A.3 may be repeated.	a. Information needs are similar to those listed in A.1.a-d, A.2.a-f, and A.3.a-b.

	2. Portfolio mix: A dealer may be in a position to invest or disinvest in the fertilizer component of his business by expanding or diminishing capacity or services, or by moving to an altogether different activity.	a. Projected demand (acreage projections and crop production functions) b. Production costs c. Stocks on hand d. Relative profitability e. Price expectations
C. Farmers	1. Overall crop mix (profit maximizing)	a. Crop-specific production functions in terms of fertilizer usage b. Fertilizer prices c. Costs of substitutable and complementary agricultural inputs and activities d. Fertilizer availability (stocks) e. Farm-specific agronomic information (soils, hydrology, etc.) f. Crop prices (expectations, government subsidies, etc.)
	2. Production level of a given crop (to the extent this can be determined by varying levels of fertilizer use)	a. Fertilizer price and availability b. Costs and availability of substitutable and complementary agricultural inputs and activities c. Farm-specific agronomic information d. Price expectations

	3. Investment in fertilizer capacity	a. Availability and cost of contract services
		b. Machinery and storage unit costs
		c. Costs and production effects of alternative product forms (granular, liquid, etc.), including variations in machinery and storage costs related to product form
		d. Potential for cost sharing or contracting services to others
D. Regulators (various levels of government)	1. Incentives or disincentives to produce fertilizer	a. Fertilizer demand projections
		b. Fertilizer use "multiplier" effect on farm income and agricultural output
		c. Macro-economic needs for increased or decreased crop production
		d. Issues related to alternative uses of raw materials used to produce fertilizers (e.g., opportunity costs, availability, etc.)
		e. Level and location of stocks
		f. Fertilizer production costs
		g. Fertilizer prices
		h. Estimates of "political" impacts of such decisions
		i. Relative world prices

2. Incentives or disincentives to alter the geographic distribution of fertilizer supplies
   a. Size and location of current stocks
   b. Projected regional demand
   c. Social welfare considerations of increased or decreased fertilizer use in a given region
   d. Transportation and distribution costs
   e. Storage capacity by region
   f. Fertilizer prices and effect of supply changes on prices
   g. Estimates of "political" impacts of such decisions

3. Incentives or disincentives to consume fertilizers
   a. Macro-economic considerations relative to increased or decreased crop production
   b. Farm income and agricultural output "multipliers" for fertilizer usage
   c. Fertilizer prices
   d. Market prices for fertilizer-affected and substitute farm products
   e. Estimates of "political" impacts of such decisions

	4. Establish, maintain or alter crop price supports and ceilings	a. Fertilizer prices
		b. Crop production functions involving fertilizer use
		c. All other costs, prices, and macroeconomic considerations
		d. Estimates of "political" impacts of such decisions
	5. Establish, maintain, or alter food stocks	a. Effects of fertilizer use on output
		b. Projected fertlizer availability
		c. Fertilizer prices
		d. Projected acreage
		e. Required level of stock (for price support, export, food supply guaranty, etc.)
		f. Other crop-related costs, prices, and considerations (storage costs, ease of storage, etc.)
		g. Estimates of "political" impacts of such decisions
E. Researchers	1. Facilitate decision-making	a. Accessible, accurate, and sufficiently detailed data on all of the above kinds of information

FOOTNOTES

[1] Stiglitz provides an excellent summary critique of the current state of theory, its general failure to offer a comprehensive explanation of observed behavior, and reviews several more promising theoretical constructs relating the phenomenon of price dispersion to market structure and informational imperfections. "Equilibrium in Product Markets with Imperfect Information," *American Economic Review,* Vol. 69, No. 2, May 1979, pp. 339-345.

[2] R. Clyde Greer, *An Analysis of Price Dispersion,* PhD Thesis, University of Minnesota, June 1970.

[3] Robert A. Rathjen, *An Economic Analysis of Fertilizer Retailing in Minnesota,* PhD Thesis, University of Minnesota, December 1970.

[4] Calvin L. Brints, *The Economics of Information in Purchasing Feed and Fertilizer in Minnesota,* PhD Thesis, University of Minnesota, June 1973.

[5] Dale C. Dahl, *Prices Paid Reporting and Indexing: A Summary Report,* Agricultural Experiment Station, University of Minnesota, September 1974, (Administratively Confidential).

[6] The only non-industry agency with access to detailed information concerning capacity, production costs, market shares and quantities, etc., is the National Fertilizer Development Center of the Tennessee Valley Authority. The agreements under which the fertilizer industry provides this information to NPDC preclude its use in anything but the most aggregate types of analysis, in order to protect firm identity, proprietary information, etc. John T. Shields and E. A. Harre, "Capacity and Ownership Trends Worldwide: 1967-1982," *Fertilizer Progress,* Vol. 9, No. 3, May-June 1978, pp. 10-12, 14-16, 34 (reprinted as TVA Publication No. X-406).

[7] John Douglas, "World Phosphate Supply Plagued by Questions," prepared for presentation at the Seventh Phosphate-Sulphur Symposium, Innisbrook, Florida, January 18-19, 1979 (reprinted as TVA Publication No. Z-89).

[8] Griliches, Zvi, "Are Farmers Irrational?" *Journal of Political Economy,* Vol. 68, No. 1, February 1960, pp. 68-71.

[9] See Stiglitz, op. cit., for a discussion of the potential for variation from the traditional price policy in such circumstances.

[10] Certain crop-specific agronomic processes can be adjusted to compensate somewhat for reduced fertilizer use, and a switch to nonfertilizer-dependent crops is also possible. Recent NFDC work has shown some important complementarities, however, between fertilizer and machinery use and equipment costs in southeastern U.S. agriculture.

[11] Calvin Leon Brints, "The Economics of Information in Purchasing Feed and Fertilizer in Minnesota," unpublished Ph.D. thesis, University of Minnesota, June 1973.

[12] Kathleen Hayes, "Input Market News Pilot Project NY 3-78" (mimeo), Division of Farm Products Services, Department of Agriculture and Markets, State of New York, Albany, March 8, 1979.

[13] A pre-trial telephone survey of 56 randomly selected farmers in the two New York test counties asked only the following general questions: 1. Why do you buy from your present supplier: (Choices: price, service, quality, credit, discounts, rebate, tradition, convenience) 2. Are you satisfied? (Choices: yes, no) 3. Do you buy from more than one supplier? (Choices: yes, no) 4. Would a weekly price report of those commodities sold at various dealers be useful to you? (Choices: useful, not useful) Hayes, ibid.

[14] Brints, op. cit.

[15] An interesting observation in the case of the New York experiment is the report that dairy farmers there listed feed as their largest production cost (33 percent), interest as second (9 percent), and fertilizer as only 6 percent. The test counties showed market value of livestock and its products sold as accounting for 69 percent and 90 percent of total agricultural products in 1979 (Hayes, 1979). These figures raise questions as to the importance of fertilizer in overall management decisions of these farmers.