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1940s to 1970s*

*LEE R. MARTIN,  
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**PART IV. Organization and Performance  
of Agricultural Markets**

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W.D.D.

## Organization and Performance of Agricultural Markets

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This paper surveys the literature on agricultural marketing from the viewpoint of the field of industrial organization, giving major consideration to developments since World War II. Its scope and design are further delimited by describing the economic activities involved in agricultural marketing, defining the field of industrial organization, and identifying criteria used in judging the importance of contributions to the literature.

The economic functions performed by the agricultural marketing sector can be seen by comparing and contrasting the nature of farm production with the requirements of final consumers. The farm sector is composed of many interrelated farm industries. In sharp contrast with manufacturing, practically all these industries have atomistic structures. The biological processes involved in production also tend to distinguish farm industries from other industries. Farm outputs are peculiarly subject to the vagaries of weather. Seasonal patterns of production are of utmost importance in raising crops. The use of land in the production process gives rise to spatial dispersion of farm outputs. Quality may be costly to control during the production process and hard to determine after the process is completed. Perishability is usually an important factor. Production decisions are often made many months, and sometimes several years, before output prices are determined. Uncertainties abound everywhere. Farm products are often inputs used in food manufacture.

In contrast to farm production, consumption activities are largely concentrated in large metropolitan areas. Consumers demand a steady flow of food and fiber products throughout the year. Increased affluence has increased demands for uniformly high quality products, convenient packaging, and a multitude of processing and other marketing services.

The task, then, of the agricultural marketing sector is the transformation of the outputs produced seasonally by millions of relatively small farms scattered over wide geographic areas into the thousands of finished products which consumers are able to buy at any time of the year in any shopping center in the country.<sup>1</sup> The food marketing job involves collection and assembly, grading and sorting, cleaning, packaging, processing, transportation, storage, and wholesale-retail distribution. The pricing of outputs and inputs all through the marketing channels is of profound importance to farmers and consumers alike.

In 1978 consumers spent \$208 billion for domestic farm food products. The marketing bill amounted to \$141 billion (USDA, ESCS [1979]). Labor alone accounted for 32 percent of marketing costs and with packaging materials and transportation accounted for 68 percent. Corporate profit before taxes was \$9.5 billion, about 6.7 percent of total costs. The farmers' share of retail price varies considerably across products. During the period 1975-77, the percentage going to the farmer ranged from 8 percent for corn flakes to above 60 percent for pork, butter, and eggs. (USDA, ESCS [1978]). The farmers' share also varies somewhat over time and tends, on the average, to be about 40 percent. The share of total marketing costs accounted for by processors has been steadily declining from 41.5 percent in 1947 to 28.6 percent in 1976. The share accounted for by retailers rose from 22.0 to 26.4 percent over the same period.

Table 1 provides some basic data on the food production-distribution system. In 1972 value-added in food manufacture of \$21 billion amounted to a little over 7 percent of value-added in all manufacturing and easily exceeded value-added in the farm sector as well as in such industries as motor vehicles and petroleum refining. Whereas value-added increased by 38 percent over the period 1958-72, the number of establishments fell by the same percentage. The decrease in number of establishments was especially strong in dairy and bakery products. Number of employees in food manufacturing fell by 10 percent. These changes doubtless reflect increasing economies of size in production, the continuing substitution of capital for relatively high-priced labor, and the increasing size of markets brought about through improvements in transportation.

In spite of increased sales by the retail and wholesale grocery trades, largely because of increased population and per capita income, the number of

Table 1. U.S. Food Manufacturing and Distributive Industries, 1958, 1963, 1967, and 1972

| Industry                          | No. of Establishments | No. of Employees | Value Added, (in millions of dollars) by |                    |
|-----------------------------------|-----------------------|------------------|--|--------------------|
|                                   |                       |                  | Manufacturing <sup>a</sup>               | Sales <sup>a</sup> |
| Food Manufacturing                |                       |                  |  |                    |
| 1958                              | 30,397                | 1,370,000        | 15,134                                   | —                  |
| 1963                              | 26,823                | 1,305,000        | 15,973                                   | —                  |
| 1967                              | 23,167                | 1,300,000        | 19,249                                   | —                  |
| 1972                              | 18,847                | 1,227,000        | 20,916                                   | —                  |
| Percentage Change,                |                       |                  |  |                    |
| 1958-72                           | -38                   | -10              | 38                                       | —                  |
| Wholesale Grocery Trade           |                       |                  |  |                    |
| 1958                              | 40,189                | 347,739          | —  | 54,421             |
| 1963                              | 40,525                | 497,311          | —  | 59,730             |
| 1967                              | 37,902                | 515,922          | —  | 72,230             |
| 1972                              | 38,531                | 579,531          | —  | 84,962             |
| Percentage Change,                |                       |                  |  |                    |
| 1958-72                           | -4                    | 67               | —  | 59                 |
| Retail Grocery Trade <sup>b</sup> |                       |                  |  |                    |
| 1958                              | 356,754               | 1,188,730        | —  | 56,842             |
| 1963                              | 319,433               | 1,274,395        | —  | 57,251             |
| 1967                              | 294,243               | 1,444,469        | —  | 70,252             |
| 1972                              | 267,352               | 1,722,486        | —  | 80,734             |
| Percentage Change,                |                       |                  |  |                    |
| 1958-72                           | -25                   | 45               | —  | 41                 |

<sup>a</sup> Deflated by consumer price index, 1967=100.

<sup>b</sup> Excludes eating places.

Sources: U.S. Bureau of the Census [1962a, 1967a, 1971a, 1976a]: *1958, 1963, 1967, 1972 Census of Manufactures, Final Report, Vol. I, Summary and Subject Reports*. U.S. Bureau of the Census [1962b, 1967b, 1972b, 1976b]: *1958, 1963, 1967, 1972 Census of Business, Final Report, Vol. I, Retail Trade—Summary Statistics (Subject Reports), Vol. II, Wholesale Trade—Summary Statistics (Subject Reports)*.

establishments declined. The dramatic decrease in the number of retail stores reflects the demise of the small, family grocery stores as a result of the rapid growth of supermarkets. Employment in food production and distribution in 1972 amounted to 5 percent of total employment in nonagricultural establishments.

The nature of production of farm-based raw materials is reflected in the marketing arrangements, institutions, channels, problems, and policy issues that often are of peculiar importance and sometimes unique to the agricultural sector. As a result, the literature on industrial organization of the agricultural marketing sector has its own distinctive flavor and balance of emphasis.

At this juncture the meaning of industrial organization merits attention. Scherer [1970, p. 1] defined industrial organization as the field "concerned with how productive activities are brought into harmony with society's demand for goods and services through some organizing mechanism such as a free market, and how variations and imperfections in the organizing mechanism affect the degree of success achieved by producers in satisfying society's wants." Embodied in this definition are: (1) the basic economizing problems of any society; (2) the mechanism adopted to generate solutions; and (3) the acceptability of actual solutions. This definition appears to include the entire discipline of economics, and tempts one to agree with Stigler [1968] that an industrial organization field of economics does not exist.

Still, there are numerous courses offered under this rubric, and, if nothing else, the similarity among their reading lists suggests a body of hypotheses, empirical observations, research methods, and policy issues constituting a literature somewhat different from that of other traditional fields. In our opinion the determinants of the nature and extent of competition in the myriad markets comprising an economy and the consequences of competition in terms of the success with which basic economizing problems are solved constitute the core subject matter of industrial organization. The boundaries between this and other fields are elusive, but as one journeys away from this core, one encounters new countryside where other fields of expertise flourish. It is important to recognize that this field includes a good deal more than the study of monopoly problems. Industrial organization scholars' considerable interest in monopoly can easily give a distorted view of the scope of the field.

Much of the work on agricultural marketing readily falls within the boundaries of industrial organization, in contrast with that centering attention on the inner workings of the plant or firm and particularly on the question of productive efficiency. This latter work forms the subject matter of the survey paper by French [1977]. The subject matter of interest herein backs away from the details of the inner workings of firms and looks toward the manner in which the resulting activities are coordinated, integrated, and made mutually



consistent through a market mechanism.<sup>2</sup> The literature surveyed here is largely aggregative and seeks to explain how and with what success a competitive pricing system, within a legal framework, coordinates farm and other production activities with the ultimate demands of consumers for food and fiber. Many studies surveyed here would not be judged by their authors to be examples of industrial organization literature. This is so because of the narrow interpretation frequently given to the field. We believe that both the field and aggregative marketing research would benefit from the recognition of existing common elements among research objectives and procedures.

We turn next to the question of how to evaluate progress in the corresponding literature. Progress may be assessed in much the same way as in any other field of inquiry. As applied to agricultural marketing, two important questions are: First, to what extent have the recent additions to the literature contributed to our knowledge of and ability to understand the phenomena that comprise agricultural marketing? Second, to what extent does the evolving literature serve as the basis for government policy aimed at increasing social welfare? The first question calls attention to development of economic theory and methods of research and to empirical research on actual causal relationships. The second question draws attention to the relevance of whatever scientific advances are achieved. Although the purist might embrace the goal of knowledge for the sake of knowledge, it is abundantly clear that society expects much more. Advances in knowledge are sought mainly because they support higher levels of living. With agricultural marketing, an important consideration is the impact of research on the welfare of farmers and consumers.

The above considerations have a definite bearing on the present survey. We give major emphasis to the literature on the webs of causal dependence that determine performance of the marketing system. Literature that is mainly descriptive, containing facts and figures with little or no analysis, is given short shrift. By conscious choice, we strive to go beyond mere cataloguing and summarizing; we recognize that interpretation and evaluation invite controversy and alternative points of view.

Now we may usefully outline the remainder of the survey. Attention is first focused on the industrial organization framework with special attention given to concepts and hypothetical relationships that are of particular importance to agricultural marketing research. Thereafter the following areas are taken up in turn: (1) competition in agricultural markets; (2) cooperative enterprise; (3) market information; (4) grades and standards; (5) markets in the spatial dimension including transportation issues and problems; (6) markets in the temporal dimension including futures markets; and (7) vertical coordination. The final section is an overall appraisal.

Many of the above areas have already been the subjects of survey efforts. Rather than duplicate previous work, we simply summarize the main highlights of prior surveys, updating them for the intervening years and occasionally adding our own points of view.<sup>3</sup> Of considerable importance in this connection is the excellent survey of marketing literature by Breimyer [1973] which became available to us after our own survey was well under way. The attention Breimyer gives to historical and foreign developments as well as to certain other areas in the field of marketing tends to complement rather than compete with the present survey.

### *The Framework of Industrial Organization*

The literature on agricultural marketing is here surveyed from the point of view of industrial organization. Understanding this point of view requires knowledge of the conceptual framework of the field. Terms like structure, conduct, and performance appear everywhere in the literature, and an understanding of these terms and why they are often used in the same breath is crucial to this survey. Because industrial organization is concerned mainly with partial equilibrium analysis, industries and markets merit brief definition at the outset.

A *selling industry* is defined as a group of economic agents selling products that are viewed as close substitutes by a common group of buyers.<sup>4</sup> The economic agent, a firm or resource supplier, stands willing to give up possession of various quantities of a good or service in exchange for money. If every buyer is completely indifferent between the product of any one seller and that of any other, the products are said to be perfect substitutes. However, it is unnecessary that the substitutes be perfect within an industry. Some buyers might be willing to pay a modest price premium for the product of a certain seller, whereas others might buy the product only at par or at a discount. Further, the product of any one seller in an industry is, relatively, a distant substitute for the product of a seller in any other industry. A diversified firm may be a seller in many industries. Presumably, then, the products must perform similar functions for buyers (sugar can be used to sweeten foods and beverages), and the sellers and buyers must be in the same spatial-temporal domain in light of transportation and storage costs. Bread bakers in San Francisco do not compete with bakers in New York. In California early plum producers for fresh market do not compete with late plum producers.

A *market* is defined to include a selling industry plus the buyers of the product and its substitutes. It consists of more than an aggregate of buyers and sellers; certain exchange expectations and traditions relating buyers and sellers together are included. In what follows we will be mainly concerned

with markets in which the selling industry is composed of firms as opposed to laborers or capital suppliers. The buying industry might represent ultimate consumers and/or firms. Definitions of a market are not very precise and the applied work is the weaker for it. Efforts to develop a more operational definition have been largely unsuccessful (Cochrane [1957]).

### Market Performance: Definition, Evaluation, and Research Approaches

Workers in the field of industrial organization, though greatly concerned with the performance of individual firms, industries, and markets, are not always in agreement of exactly what performance means (Waugh [1954, pp. 235-243], Sosnick [1964, pp. 82-86]). A noneconomic example may clarify some of the issues involved. The performance of a student on an examination may be viewed as the set of answers rendered or, alternatively, as the grade received. The determination of the grade received depends not only on the determinants of the answers given (how hard did the student study?) but also on standards of comparison or norms which allow evaluation of quality. The distinction between results and the evaluation of those results is important both in the above example and in considering the meaning of performance in economics.

In his influential book *Industrial Organization* Bain [1968] adopted a definition of performance akin to a grade received on an examination; most workers in the field including Brandow [1977a], Clodius and Mueller [1961], and Marion and Handy [1973], have followed in his footsteps. Bain [pp. 10-11] argued that it is inappropriate to define performance in terms of results such as employment and output because what counts are adjustments of firms "to whatever effective demands are present for their outputs." In identifying the principal dimensions of performance, he cited costs relative to minimum costs obtainable, price relative to long-run marginal cost, and output relative to that which equates price and long-run marginal cost. Clearly norms are built into his definition, but, as we shall see shortly, the norms are controversial and are not very operational. Another performance dimension, again citing Bain [p. 11], is "the size of sales-promotion costs relative to the cost of production." Why bring in cost of production? Does this represent a feeble effort to include a norm when in fact no norm exists? Regarding product quality, Bain [p. 11] asserted that "the character of the product, or products, including design, level of quality, and variety" is a dimension of performance. Performance in this dimension consists of "results"; nothing whatever is said about a norm. In our view, Bain's definition of performance is thoroughly muddled, and those who have followed his lead have done so uncritically.<sup>5</sup> It is advisable to seek firmer ground.

In this survey we adopt a definition of performance akin to the answers given on an examination rather than to the grade received. The definition and measurement of performance, on the one hand, and its evaluation, on the other, are simply different tasks. By performance of a *firm* we mean the *ex post* values of the choice variables appearing in the profit function of the firm as envisaged in economic theory. (Real world income statements are far too aggregative to reveal much about firm performance.) Levels of all outputs are a vital part of performance, as are any prices either determined or appreciably influenced by the firm. Performance of a household is determined by the *ex post* values of the choice variables entering its utility function. Outputs and input (consumption) levels are again of vital importance. Prices viewed as parameters by the firm (household) are not viewed here as dimensions of firm (household) performance. By *market* performance we mean the total of the performances of all its participants (buyers and sellers), including all prices that vary with the level of industry output.<sup>6</sup> Price of wheat, though a parameter from the viewpoint of a wheat farmer, is determined in the market by supply and demand. In our terminology, price of wheat is not a performance variable for a single farmer, though it is for the market.<sup>7</sup> Aggregate market levels of outputs and inputs would doubtless be of special interest in many cases. In others, product differentiation or other phenomena might preclude aggregation. Clearly, the actual answers to the basic economizing problems of an economy could be determined from performance as here defined.

Presumably a bevy of clerks could tabulate performance in whatever detail is desired, including the contributions made by individual firms and markets. Such a tabulation would be necessary but far from sufficient, however, to establish whether the system or any part thereof is performing in an efficient or optimum manner. (For the moment we lay aside the question of equity and income distribution.) What is required are *norms that specify optimality* for each of the many dimensions of performance. Importantly, norms may be specified in terms of optimal values for all variables or in terms of conditions, such as price equals marginal cost, that must obtain if the variables are to be optimal. Such conditions or criteria are required in order to specify optimal values for performance variables. Performance norms are required for determining for an industry whether output is excessive or unduly restricted, whether outputs are produced in an efficient manner, whether advertising expenditures are appropriate, whether sufficient resources are used in research on new products and processes, whether all social costs (benefits) are reflected in private costs (benefits), and so on. Both space and time need to be taken into account.

When considering performance norms it is important to distinguish between ideal and operational norms. The former are based on welfare theory in

which it is shown rigorously that under alternative sets of assumptions, alternative sets of conditions must be satisfied if social welfare is to be maximized. These conditions may then be viewed as ideal norms. Operational norms, on the other hand, recognize that conditions assumed in theory, such as perfect knowledge, may not be found in the real world, and that in the real world appropriate allowance must be made for the disturbing influences not recognized in the theory. We hasten to add, however, that theories of market failure are of considerable importance in the identification of those influences.

Recognizing that the typical assumptions of welfare theory may characterize an imaginary world, several industrial organization writers have attempted to develop criteria that make allowance for real world complexities. The result is the theory of workable competition, which Sosnick [1958] suggested in his seminal critique "is best understood as an attempt to indicate what practically attainable states of affairs are socially desirable in individual capitalistic markets." His emphasis on "practically attainable states" called attention to Markham's [1958] suggestion that performance is workable if there is no clearly indicated change that can be effected through public policy measures that would entail greater social gains than social losses. This suggestion points straight toward benefit-cost analysis in which net benefits become an operational measure of economic efficiency. In such analysis, the sensitivity of benefit-cost measurements to the distribution of income is not always recognized. The implicit assumption of much benefit-cost analysis appears to be that policy issues relating to income distribution and equity can be separated from issues relating to efficiency.

Sosnick [1964] proposed twelve criteria for evaluating market performance: production efficiency, technological progressiveness, product suitability, profit rates, level of output, exchange efficiency, cost of sales promotion, unethical practices, participant rationality, conservation, external effects, and labor relations. Criteria related to inflationary and deflationary effects were not provided. Income distribution was given little attention. One cannot do justice to all twelve criteria in short compass, but a detailed discussion of one of them may suffice to show that evaluating the workability of market performance in its manifold dimensions may be chasing a will-o'-the-wisp.

The level of industry output is an important aspect of performance, and Sosnick devoted considerable effort to its evaluation. One of the fundamental results of welfare theory is that the levels of industry outputs are optimal if and only if price equals marginal cost in each industry. From the theory of the second best, if not on the basis of common sense, price equals marginal cost is not necessarily an optimal condition for any one industry if price-marginal cost gaps of various and unknown magnitudes exist in other industries. Confronted with this and other practical difficulties, Sosnick [p. 110] developed

a number of criteria the most important of which asserts "output is (ultimately, though not necessarily immediately) insufficient if it would be greater at lower prices and if ratios of price to long-run marginal (social) cost regularly are greater than in identifiable competing industries." Sosnick's debt to welfare theory is worth stressing, for clearly he was concerned with shifting inputs from industries in which price-marginal cost gaps are relatively large to those in which the gaps are relatively small. If this process were pushed far enough, we would indeed approach the competitive ideal in which price equals marginal cost everywhere. The question to be asked, however, is whether this criterion is operational. We are unaware of a single application. Moreover, Sosnick was silent on the question of how in a market system the "needed" reallocation of resources can be engineered and at what cost.

Several students of agricultural marketing have been less cautious than Sosnick in urging that researchers use welfare theory in the evaluation of performance.<sup>8</sup> Shepherd [1946], Bressler [1966], and Hassler [1959], among others, have been quite explicit in urging that the performance of the perfect market in the dimensions of time, space, and form be used as an ideal for this purpose. In such a market, prices are interrelated through space by transfer costs, through form by costs of production, and through time by the cost of storage. Bressler and King [1970] suggested that actual performance be examined from the point of view of its correspondence to the competitive ideal. If in a particular market the correspondence is quite close, there is no "problem." If a "problem" is perceived, research can be directed toward finding causes and remedies. Implicitly, Bressler and King proposed that the norms of an ideal market concept can be used with empirical research in deriving operational norms.

Because the development of operational norms is exceedingly difficult, one might argue that evaluation of performance by the economist is inappropriate and destined for controversy, that evaluation is the task of the politician and the democratic process. An alternative approach, receiving considerable attention in the literature on economic policy, is the development of hypotheses about the performance consequences associated with alternative public and private policies, leaving actual choices to the relevant decision makers. Testing and quantification are, of course, vital to this approach. Benefits and costs may be defined operationally (as willingness to pay, for example) and included in the analysis, but the controversy over the meaning and development of performance norms and whether competition is "workable" could be dispensed with entirely. Using this latter approach, the researcher might develop certain hypotheses on the basis of theory and past accumulated evidence. The researcher seeks new evidence to test these hypotheses for empirical relevance without asking whether this or that pattern of performance presents a

"problem." The results of analysis could be presented to policy makers without expressions of approval or disapproval of the demonstrated economic effects.

While positive analysis obviates the need for operational norms, the fact remains that economists must choose among alternative research projects since they do not have sufficient resources to study them all. How are these choices to be made? We believe that many researchers will choose to study areas in which performance problems are perceived and in which, it is felt, some progress toward solutions can be made. The previous discussion of the meaning and role of norms becomes relevant not so much to the manner in which research is done as to what is researched.

### What Determines Market Performance? Structure, Conduct, and Many Other Things

The profit for a firm may be expressed as a function of choice variables and of variables beyond the control of the firm. Since we are mainly interested in market as opposed to firm performance, we will treat all endogenous prices (prices determined within the market) as choice variables. (Choice and performance variables are essentially equivalent.) Nonchoice variables include, for example, exogenous prices, fixed inputs, and environmental variables such as rainfall and the like. Scherer [1970, pp. 4-6] referred to nonchoice variables along with technological data and demand characteristics as basic conditions. The distinction between choice and nonchoice variables and the role these variables play in decision making apply with little modification to households. Where buyers are ultimate consumers, for example, utility functions, population, and income become part of the basic conditions.

In the typical articulation of the industrial organization paradigm it is asserted that market structure strongly influences market conduct which, given basic conditions, determines market performance. Market conduct refers to the manner in which firms (households) assign values to choice variables. According to Bain [1968, pp. 302-303]:

market conduct refers mainly to two closely interrelated phases of the business enterprise behavior. For the firms in any industry acting as sellers, these are:

1. The manner in which, and the devices and mechanisms by which, the different sellers in the industry coordinate their intrinsically rivalrous decisions and actions, adapt them to each other, or succeed in making them mutually consistent—as they react to demands for their products in a common market.
2. The character of pricing policies and related market policies that the sellers in the industry adopt, assessed in terms of the individual or collective aims or goals that they pursue as they determine their selling

prices, their sales-promotion outlays, the designs and qualities of their products, and so forth.

So construed, market conduct is exceedingly complex, encompassing as it does virtually all human decision making within business organizations and, by extension, households. Scientific explanation of market conduct in the flesh would presumably entail several social sciences in addition to economics. This explains in part why some economists have turned toward organization theory and psychology in efforts to evolve more powerful economic theory.

What does market structure have to do with market conduct? Again following Bain [1968, p. 7]: "market structure for practical purposes means those characteristics of the organization of a market that seem to exercise strategic influence on the nature of competition and pricing within the market." Dimensions of market structure usually stressed in the literature are buyer and seller concentration, product differentiation, and barriers to entry. The list can be extended, however, by invoking hypotheses found in the industrial organization literature. Corporate conglomeration is a further illustrative example. Moreover, the distinction between structure and basic conditions is not always clear-cut. Elasticity of demand may affect the ability of oligopolists to collude but may have no effect on the conduct of sellers in an atomistic industry. In the latter case, conduct is independent regardless of the elasticity of demand. Thus the elements of the environment to be included in market structure may vary from one market to another.

Although Bain did not define what is meant by "the nature of competition," he presumably meant market conduct, judging from other passages in his book. Our own view is that most writers use the term "competition" in the much narrower sense described below.

A well-known theorem of price theory states that maximization of joint profit for all firms in an industry, or monopolization, calls for equating the industry marginal cost of production to the industry marginal revenue from the sale of the output. The potential payoff from monopolization is extant in every market. That is to say, if marginal revenue does not equal marginal cost, industry profit may be increased through either a small increase or decrease in output. Except in a monopoly situation, however, no firm will have complete control over industry marginal revenue or cost, and to ensure the appropriate equality requires that sellers coordinate their behavior. The *degree of seller competition* in a market is inversely related to the extent to which competing sellers coordinate (tacitly or expressly) their profit policies in order to garner some, if not all, of the fruits of monopoly. Where each firm in the industry sets its profit policy completely independently of all other established and potential firms, competition among them is said to be independent. (For competition to be perfect or even pure, other requirements, to be noted



shortly, must be met.) Where firms coordinate their policies so as to arrive at the pure monopoly solution, competition is said to be nonexistent or, alternatively, that collusion is perfect.<sup>9</sup>

The notion of the purity or perfection of competition is important in evaluating a considerable amount of agricultural marketing research. Independence is a necessary but not sufficient condition for pure (or perfect) competition. Pure competition requires in addition a completely standardized output sold by the various sellers. If the outputs of the various sellers are differentiated, the result is Chamberlin's case of monopolistic competition. Perfect competition is even more demanding.<sup>10</sup> For competition to be perfect, it must be independent,<sup>1</sup> the product must be standardized,<sup>2</sup> there must be no barriers to entry, and<sup>3</sup> market participants must have perfect knowledge. The latter assumption is particularly suspect in terms of its correspondence with human behavior, and much agricultural marketing research may be viewed as an effort to increase the knowledge of participants and therefore to increase the perfection of the market.

The above discussion makes basic use of the marginal cost-equals-marginal revenue condition for the maximization of industry profit. Other marginality conditions are required where profit policies of firms involve product promotion, research and development, and product differentiation. Although there is not enough space to go into these matters in detail, we should note that it is quite possible that firms coordinate their profit policies in some dimensions to a much greater extent than in others. Thus a firm may be loath to attempt increasing its market share by price cutting but think nothing of increasing its advertising to accomplish the same end. Because of such complications, statements about the competitiveness of this or that industry are difficult to interpret. The measurement of the degree of competition is fraught with complications. A good discussion of the definition and measurement of competition and monopoly can be found in Machlup [1952].

In his definition of market structure, Bain said that structure influences conduct; he did not say that structure determines conduct. This obviously leaves the door open for consideration of other variables that might affect conduct. Two further categories of determinants are important. The first of these pertains to the internal organization of business enterprise. The second refers to the legal environment.

The predictions of price theory rest in no small way on the assumption that economic agents are maximizers. The behavioralists Cyert and March [1963] repeatedly argued that theoretical predictions might go away because human decision making is far more complex than the maximizing postulate would have us believe. This is perhaps particularly true for the firm, where the large modern corporation stands in sharp contrast to profit-maximizing entrepreneurs.

There is a likelihood that organizational characteristics of large corporations affect the competition among them. Organizational characteristics include human personalities, especially of top management, lines of authority and communications, and knowledge of participants. As Mason [1957, p. 62] argued many years ago, "firms are not, regardless of what economic theory may suppose, undifferentiated profit-maximizing agencies which react to given market situations in ways which are independent of their organization." In spite of Mason's early caveat, industrial organization researchers have paid little attention to the impacts of organization variables on the degree of competition; behavioralists have been interested mainly in other matters. In this regard, Grether [1970] pleaded for a convergence of the two rather distinct approaches to the explanation of business behavior. Extension of conventional theory to cover special types of economic agents has been necessary in some fields. Labor unions, hospitals, and cooperatives are examples of such agents.

Regarding the legal environment, the United States has a long history of encouraging competition, although there are many notable exceptions such as labor union legislation and marketing orders. Some legal prohibitions look toward making certain forms of competition, such as price-fixing agreements, illegal. Other laws and provisions involve structural remedies that foster market structures deemed favorable to competitive outcomes. Merger policy is an example. Where neither behavioral nor structural remedies are thought to suffice, direct regulation of market performance has been imposed. Some government programs are geared toward making markets operate more efficiently or perfectly. Grading, inspection for sanitary conditions, statistical reporting service, and prohibitions of unethical practices and fraud are examples. In summary, with exceptions the government has tried to: (1) forestall anticompetitive practices and policies; (2) establish structural and other conditions favorable to competition; (3) provide information; and (4) regulate performance directly in order to secure social ends.

#### Summary and Implications for Agricultural Marketing Research

Drawing together the strands of the foregoing discussion, we see that market conduct and basic conditions determine market performance. Market structure influences market conduct in the context of a legal framework specified by law. The nature of organizations also affects market conduct, given that people are not nearly as knowledgeable as assumed in much of price theory. The flow of causality assumed in this framework is unilateral, flowing from structure to conduct to performance. In a dynamic context, competitive behavior and performance at one point in time might determine or influence both market structure and basic conditions in subsequent periods. The general

consensus seems to be, however, that structure, especially in mature industries, tends to be relatively stable over time; short-run changes in performance are due mainly to changes in basic conditions.

Evaluation of performance involves comparing performance variables with operational norms. Performance norms are difficult to develop, but it is uncertain whether they are required in economic research. An alternative is to identify and measure cause-and-effect relationships in the real world without passing judgment on whether performance of a given market is satisfactory.

The theoretical underpinnings of the industrial organization paradigm can be traced to price theory, but the latter also contains a reservoir of hypotheses regarding the associations between structure and performance. One cannot do justice to the many and varied hypotheses of price theory in short compass. The more relevant ones will emerge in due course.

Two examples might further explain and illustrate the nature of the industrial organization paradigm. Profit-maximizing duopolists in an industry where entry is not possible might decide to engage in perfect collusion in light of the obvious interdependence. Actual decisions regarding choice variables such as levels of capacity and output vary over time in light of changes in demand, technology, and input prices. The resulting pattern of observed market performance reflects not only structure, which leads to collusive conduct, but also the goals of the duopolists and the changes in basic conditions. The second example involves a great many relatively small sellers of a homogeneous product. Although competition is pure in that every seller views price as a parameter, performance might be greatly affected by the knowledge of market participants. In a recursive economic system, with substantial elements of ignorance and uncertainty, the level of output could be very unstable over time. Cobweb theory provides a possible explanation.

In both of the above examples, market performance reflects basic conditions, market structure, and the goals and knowledge of decision makers. Potential defects in performance are conspicuous. Possible public policy measures might include in the first example breaking up the duopolists into several firms and in the second a program of market news and intelligence. Accurate estimates of the benefit-cost distributions associated with these programs could be of great interest to policy makers.

The marketing problems and issues of interest in this survey may now be delineated with greater precision than was possible in the introductory section. How competitive are the markets that comprise the channels for farm outputs and inputs? What are the structural characteristics of these markets, and how have these characteristics changed over time? What influence, if any, does market structure have on conduct and performance? What are the implications of cooperatives, futures markets, market news, and grading for

performance in both temporal and spatial dimensions? How successful have researchers been in estimating benefit-cost distributions associated with new and old public policy measures? Have instances of unworkable performance been clearly documented? The remainder of this survey focuses on literature that addresses these issues.

### *Competition in Agricultural Markets*

The concern over the quality of competition in a marketing system is an ancient one and has played a remarkably important role in the political economy of U.S. agriculture. Justification for the concern can be found in elementary texts on economics. Much of the emphasis is on the alleged lack of competition associated with collusion, oligopoly, or monopoly, which can be shown to give rise to output restriction and price enhancement. Malallocation of resources among competing products and the redistribution of income toward the initial owners of monopoly or oligopoly positions are widely held in contempt. More specifically, farmers have often supposed that their lack of power in markets for outputs and inputs has contributed to their price and income problems, a view sometimes shared by economists. (See Brandow [1977b] for a brief survey.)

Economists' interest in the monopoly problem was greatly stimulated in the 1930s by the classic works of Chamberlin [1933] and Robinson [1933]. E. S. Mason led the way in empirical research at Harvard by championing the in-depth industry case study approach, and a generation of Harvard graduate students in industrial organization studies a plethora of industries. Mason believed that studying carefully the organization of many industries would ultimately yield sufficient knowledge to warrant generalizations about the relationship between industrial structure, competitive behavior, and performance. The earliest and still one of the classic industry studies was completed by Wallace [1937].

Not surprisingly, among the earliest and best inquiries into the competitiveness of agricultural markets were those of two Harvard-trained agricultural economists, A. C. Hoffman and William H. Nicholls. The first comprehensive examination of the organization of the food manufacturing industries was Hoffman's Ph.D. dissertation, subsequently published as a TNEC monograph, *Large-Scale Organization in the Food Industries* [1940]. The study was a descriptive analytical examination of past and prospective structural changes in the food industries. Although short on empirical support, the study forecast as inevitable an increasing concentration of the food manufacturing industries because of economies of large scale, a forecast largely borne out by subsequent events. In addition to his empirical work, Hoffman's study included an important theoretical appendix in which he demonstrated the kinds of perfor-

mance resulting from successive monopoly in a marketing system. We return to this subject below in our discussion of vertical integration and coordination.

Nicholls's work was both theoretical and empirical. His greatest contribution was the adaptation of the new theories of imperfect competition to agricultural markets. His *Imperfect Competition within Agricultural Industries* [1941] exposed an entire generation of agricultural economists to imperfect competition theory, though the mainstream of agricultural marketing research was not influenced perceptively by it for nearly twenty years. Although Nicholls's book was not empirical in the sense of testing rigorously the theories of imperfect competition, it incorporated a wealth of interesting factual information, mainly from antitrust cases, that suggested the potential relevancy of these theories in explaining behavior in agricultural markets.

Nicholls's own empirical work involved the in-depth industry study approach, his most important study being a meticulous examination of *Price Policies in the Cigarette Industry* [1951]. In making this study, Nicholls was fortunate in having access to the records of a large antitrust case. Indeed, most of the more successful industry studies involved industries in which antitrust actions had made public much information not otherwise available to industrial organization researchers. The virtual drying up of big antitrust cases and the absence of alternative sources of reliable "inside" data have made it increasingly difficult to conduct in-depth industry analyses in recent times.

Joe S. Bain [1968], himself a follower of the Mason tradition, more than anyone else was responsible for the decline in the industry-study approach. He stressed the importance of the need for generalizations and pioneered analyses involving cross-section data. As Weiss [1971, p. 362] suggested, "the case study approach had yielded a great richness of special consideration," but had provided little basis for the hoped generalization.

At about the same time that Mason and his colleagues were initiating in-depth studies of competition in American industries, Hotelling [1938] laid theoretical groundwork for a famous paper by Harberger [1954]. In this paper, Harberger concluded that the welfare loss associated with market power in the United States is trivial. Leibenstein [1966] and Schwartzman [1960] found support for Harberger's conclusion. Scherer [1970] reviewed this area of work. He criticized the procedures employed and provided his own estimate of the efficiency loss due to monopoly power. His estimate for 1966 equaled 6.2 percent of GNP. More recently Bergson [1973] proposed refinements in the analysis of welfare losses attributable to monopoly. He concluded that further knowledge of parameters is required before such losses can be measured with accuracy but was concerned that such losses could be very substantial. Carson [1975] and Worcester [1975] took issue with Bergson and argued on the basis of his approach that the welfare loss, though above that of Harberger, is still very modest—less than 5 percent of national income.

Although the debate will likely continue, there is little doubt but that the work by Harberger and others has raised a serious question about the practical importance of the efficiency loss due to market power. Impacts on other dimensions of performance like the redistribution of income may, aside from the issue of efficiency, make the monopoly issue important for policy and research.

Turning attention to the post-World War II literature on the competitiveness of agricultural markets, we first consider studies based on cross-section analysis. Attention then shifts to case studies and to a general appraisal of the work on the extent and consequences of competition in agricultural markets. The final topic in the section is government policy and recommendations.

### Market Structure—Performance Relationships Based on Cross-Section Data: Interpretation and Estimation

The number of studies centering on estimation of the relationship of market structure and market performance using cross-section data has increased dramatically since World War II. Most of this work has involved estimation of the relationship between structure, especially industry concentration, and any one of several alternative rates of profit. The work on progressiveness in terms of the development of new products and processes and on other aspects of performance has received less attention.<sup>11</sup> Only a few studies have focused on the agricultural marketing sector *per se*, and excellent surveys of the more general literature are available elsewhere. (See Weiss [1971], 1974), Vernon [1972], Markham [1974], and Collins and Preston [1968].)

In this survey, attention is first focused on the conceptual underpinnings of the work on structure-profit rate relationships, for it is here that previous researches and surveys have been notably weak. Data, estimation procedures, and econometric results, particularly as regards agricultural marketing, are then briefly considered. A few suggestions are offered for further research. We discuss, finally, the work on the relationship between structure and progressiveness in agricultural marketing.

#### WHAT IS A STRUCTURE-PERFORMANCE RELATIONSHIP?

It is important that the meaning of market structure-performance relationships be clearly understood. For this purpose, consider an industry selling a standardized product to purely competitive buyers. The only important structural variables of the selling industry are concentration,  $K$ , and barriers to entry,  $B$ . Let  $K$  be measured as the sum of the squared market shares of all sellers. This is the Herfindahl index of concentration which, though appealing from a theoretical point of view, is rarely used in research for want of data. Following Bain [1956], let  $B$  be measured by the maximum ratio of the

selling price to minimum long-run production cost without attracting entry of new firms. In the spirit of an intellectual experiment, assume that some variation in  $K$  and  $B$  is compatible with basic determinants of market structure, holding demand, input supply functions, and technology constant. Values of structural variables that are inconsistent with minimum optimal-sized firms are ruled out as not feasible. Consider the long-run equilibrium level of output,  $Q$ , for all feasible values of  $K$  and  $B$ . Of interest is the shape of the function  $Q = Q(K, B)$ . Although oligopoly theory has many shortcomings, we agree with Weiss [1974] that the various formal and informal theories that have been proposed offer valuable suggestions about the shape of  $Q = Q(K, B)$ . More specifically, the works of Stigler [1964], Bain [1968], Chamberlin [1962], Fellner [1949], and others suggest that for any given value of  $B$  (or  $K$ ),  $Q$  falls with increases in  $K$  (or  $B$ ). The motivation for monopoly pricing is ubiquitous, and with increased concentration, for example, the impediments to collusion wither away. An illustrative shape of  $Q(K, B)$  is given in Figure 1.<sup>12</sup> Importantly, the graph of the hypothesized function would shift in predictable ways with changes in basic demand and cost conditions. Other performance variables of interest would include product and input prices and the aggregate levels of inputs. The graphs of the structure performance functions for these latter variables could be drawn consistent with Figure 1. As output falls, for example, price clearly increases. On these arguments industry costs, revenues, and profits could also be graphed against  $K$  and  $B$ .

#### STRUCTURE AND PROFIT RATES

On the basis of definitions given earlier, absolute profit and profit rates (profit expressed as a percentage of sales or of equity capital) are determined by market performance but are not themselves performance measures. *A basic question, then, is of what value, if any, is a knowledge of a structure-profit rate relationship in understanding the relationships between structure and the several dimensions of performance?*

Since Bain more than anyone is responsible for the proliferation of structure-profit studies, it is appropriate to consider what he thought we might learn from such studies. Bain argued at considerable length that the relationship of structure and profit rates has important implications for assessing the impact of structure on allocative efficiency. He wrote [1968, p. 375]:

Because long-run marginal costs are usually not directly measurable, and also because the long-run average cost is typically about the same as the long-run marginal cost, the allocative efficiency of an industry is in practice best judged by the relationship of its long-run selling price to its long-run average cost of production, and the most convenient available indicator (if properly interpreted) of this price-average cost relation

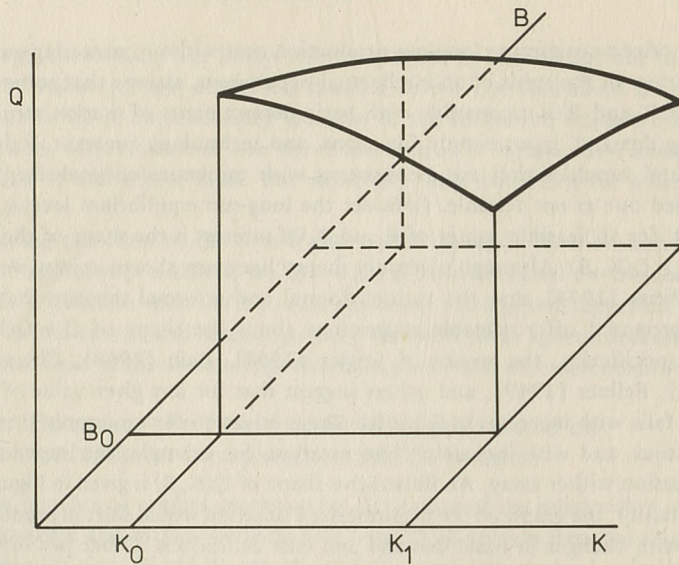


FIGURE 1. Illustrative relationship among industry output  $Q$ , industry concentration  $K$ , and barriers to entry  $B$

is the long-run average rate of profit that firms in the industry earn on owner's investments.

Accepting Bain's contention that profit rate is an "indicator" of allocative efficiency, we construct in what follows a conceptual bridge between statistical structure-profit relationships and the relationship of structure and allocative efficiency. The latter relationship is very difficult to estimate in practice, but is of considerable interest from the viewpoint of public welfare and policy. Other motivations for estimating structure-profit relationships will be considered as the analysis is developed.

Continuing our previous intellectual experiment, we find it convenient to hold  $B$  constant at, say,  $B_0$  in Figure 1. We assume a profit function that shows industry profit for various alternative levels of industry production and suppose that this function is held constant over the course of the experiment. We rule out levels of output that are more (less) than the competitive (monopoly) level,  $Q_c$  ( $Q_m$ ).

Under these controlled conditions we imagine that the researcher can observe variation in concentration,  $K$ , and any associated variation in industry profit,  $\pi$ , but that industry cost and demand function parameters are unknown to him or her. If there is no relationship or a negative one between  $K$  and



profit, the researcher can relegate much of price theory to the trash can and move on to other matters. Our interest here, however, centers on the possibility of finding a relationship,  $\pi = \pi(K)$ , that is positively sloped.

We take as our measure of allocative inefficiency due to monopoly the familiar triangle-shaped area (see Figure 2) above the industry average cost (AC) curve, below the demand (D) curve, and between competitive and actual output,  $Q_a$ . Average cost is here defined to include any rents to factors of production. The area may be mathematically described as.

$$(1) W = \int_{Q_a}^{Q_c} [D(Q) - A(Q)] dQ$$

where  $Q$  equals the level of output,  $P = D(Q)$  is the industry demand function, and  $A = A(Q)$  is the industry average cost function. In the absence of knowledge of demand and cost function parameters, the researcher would be unable to estimate the relationship between  $W$  and  $K$ ,  $W = W(K)$ . Would a knowledge of the parameters of  $\pi(K)$  shed light on the nature of  $W(K)$ ?

On the above assumptions, we have a system of three equations which are given below along with certain restrictions on the nature of the functions. For convenience (1) can be expressed as  $W = Z(Q)$ .

$$(2) Q = Q(\pi); \frac{dQ}{d\pi} < 0, \frac{d^2Q}{d\pi^2} < 0.$$

$$(3) W = Z(Q); \frac{dW}{dQ} < 0, \frac{d^2W}{dQ^2} > 0.$$

$$(4) \pi = \pi(K); \frac{d\pi}{dK} > 0.$$

If  $\pi$  is a monotonically decreasing function of  $Q$  over the relevant range of  $Q$ , we are justified in using the inverse function given by (2). Assuming that  $d^2Q/d\pi^2 < 0$  involves some loss of generality, but not much in light of second-order conditions for profit maximization. If the demand function is (and the average cost function is not) downward sloping, function (3) will have the assumed curvature properties. The sign of the second derivative of  $\pi$  with respect to  $K$  is left open.

Expressing  $W$  as a function of  $K$  and using the chain rule in differentiating  $W$  with respect to  $K$ :

$$(5) W = Z(Q(\pi(K)))$$

$$(6) \frac{dW}{dK} = \frac{dW}{dQ} \frac{dQ}{d\pi} \frac{d\pi}{dK}, \text{ and}$$

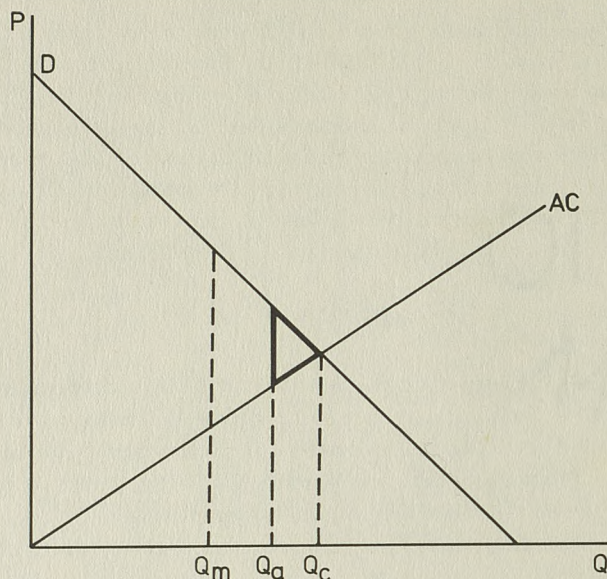


FIGURE 2. Efficiency loss associated with the restriction of output caused by market power, assuming actual output equals  $Q_a$

$$(7) \quad \frac{d^2W}{dK^2} = \frac{d^2W}{dQ^2} \left[ \frac{dQ}{d\pi} \frac{d\pi}{dK} \right]^2 + \frac{d^2Q}{d\pi^2} \left[ \frac{d\pi}{dK} \right]^2 \frac{dW}{dQ} + \frac{d^2\pi}{dK^2} \frac{dQ}{d\pi} \frac{dW}{dQ}.$$

Taking advantage of the restrictions placed on equations (2), (3), and (4), we find that  $dW/dK > 0$ . This result is neither surprising nor unimportant. What is perhaps surprising is that if  $d^2\pi/dK^2 \geq 0$ , then  $d^2W/dK^2 > 0$ . If  $d^2\pi/dK^2 < 0$ , the sign of  $d^2W/dK^2$  cannot be determined without additional information. Using analysis similar to the above, it can be shown that  $d\pi/dK > 0$  implies  $dQ/dK < 0$  and  $dP/dK > 0$ . Further,  $d^2\pi/dK^2 \geq 0$  implies  $d^2Q/dK^2 < 0$  and  $d^2P/dK^2 > 0$ . If  $d^2\pi/dK^2 < 0$ , the signs of  $d^2Q/dK^2$  and  $d^2P/dK^2$  are indeterminate. We conclude that under the conditions of our controlled experiment, knowledge of  $\pi = \pi(K)$  could explain much about the curvature properties of the relationship between structure and each of the variables—allocative efficiency, output, and price. Generalization of the above analysis to include other structural variables is straightforward. Analyzing the impacts of barriers to entry on  $W$  would, for example, merely involve holding the other structural variables, including  $K$ , constant.

The results are illustrated in Figure 3 where  $Q_c$  = competitive output,  $Q_m$  = monopoly output,  $\pi_m$  = monopoly profit and where it is assumed that a

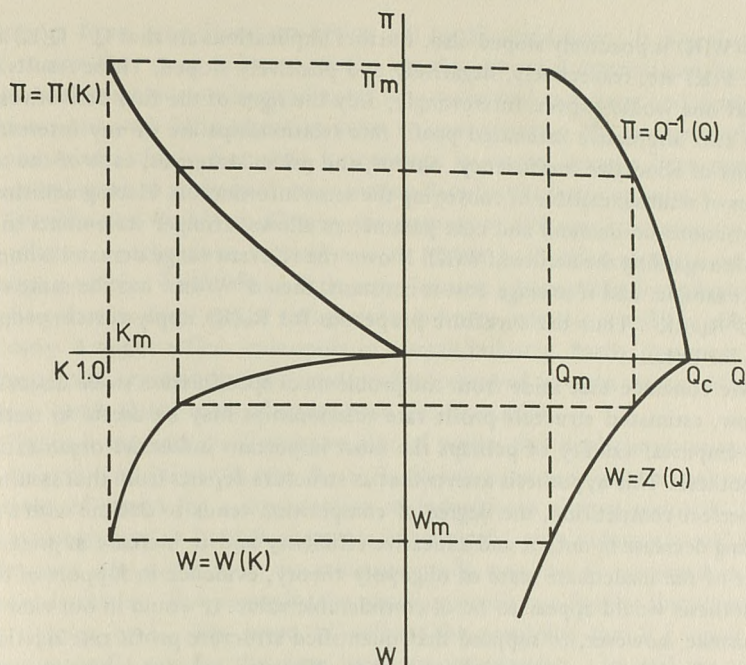


FIGURE 3. Graphical derivation of the functional relationship between the efficiency loss W and concentration K

Herfindahl measure of concentration (defined above), K, equal to one defines monopoly. If  $\pi$  increases with K at a constant or increasing rate within the relevant range, the general shape of  $W(K)$  in the third quadrant can be deduced. The result is a threshold hypothesis which suggests that increases in K have relatively modest impacts on W at low levels of K. One might well argue that for policy purposes, mere knowledge of the signs of the first two derivatives of W with respect to K is far from satisfactory but better than no knowledge at all. Clearly estimation of the parameters of  $W(K)$  would require econometric analysis of data that would be very hard to come by in the real world. It should be emphasized that the shape of  $\pi(K)$  in Figure 2 is merely illustrative.

Next suppose that the researcher could not observe  $\pi$  but could only observe profit divided by sales,  $R_S$ , or profit divided by net worth,  $R_V$ . Under these circumstances, the controlled experiment would be much less fruitful. Either  $R_S$  or  $R_V$  could be plugged into equations (2) and (4) instead of  $\pi$ . It is by no means clear that the sign of the second derivative of Q with respect to either  $R_S$  or  $R_V$  can be assumed with any certainty. About all that can be derived is that if  $R_V = R_V(K)$  and/or  $R_S = R_S(K)$  are positively sloped,

$W = W(K)$  is positively sloped also. Further implications are that  $Q = Q(K)$  and  $P = P(K)$  are, respectively, negatively and positively sloped. These results are what one would expect. Interestingly, only the signs of the first derivatives of the two alternative estimated profit rate relationships are of any interest in terms of allocative inefficiency, output, and price. Moreover, each of the two rates of return is capable of conveying the same information. Placing additional restrictions on demand and cost parameters allows stronger statements to be made regarding the nature of  $W(K)$ . If over the relevant range demand is linear, for example, and if average cost is constant, then  $d^2W/dK^2$  has the same sign as  $d^2R_V/dK^2$ . Thus the curvature properties for  $R_V(K)$  imply certain properties for  $W(K)$ .

We conclude that aside from the problems of specification to be discussed below, estimated structure-profit rate relationships may be useful in testing the empirical validity of perhaps the most important industrial organization hypothesis. This hypothesis asserts that as structure departs from that assumed in perfect competition, the degree of competition tends to decline with a resulting decrease in output and allocative efficiency and an increase in price. In light of the inadequate state of oligopoly theory, evidence in support of this hypothesis would appear to be of considerable value. It would in our view be a mistake, however, to suppose that quantified structure-profit rate relationships tell us how quantitatively allocative efficiency, output, or price varies with market structure. That is to say, knowing that a 10 percent increase in concentration, *ceteris paribus*, causes profit rate to increase by 2 percent, for example, does not tell us by what percentage quantity and allocative efficiency fall and price increases. Allowing for product differentiation, advertising, and progressiveness would further complicate the drawing of implications of a positive relationship between profit rate and concentration.

There may be motivations for estimating structure-profit rate relationships in addition to those considered above. For example, such relationships may be useful in assessing the income redistributive effects of changing market structure. Understanding the rationale of labor union activities and the role of administered pricing in inflation are other possible areas for fruitful application.

How might the structure-performance surface illustrated in Figure 1 be quantified? If  $K$  and  $B$  vary over time, with demand and cost conditions remaining constant, one could use multiple regression analysis. The trouble is that in the real world as opposed to our intellectual experiment, market structure tends to be stable whereas demand and the cost conditions often vary a great deal.<sup>13</sup> Industry studies are rarely very helpful except when dramatic structural change occurs over a short period of time. This might happen, for example, because of vigorous antitrust action. The McKie [1955] study of the metal container industry is an excellent case in point. (A few

examples from agricultural marketing will be discussed later.) It is probably fair to say that most industry studies use the industrial organization framework to further our understanding of how individual industries and markets perform but with little attention given to quantification of structure-performance relationships. As noted, researchers in recent decades have turned more and more to analysis of cross-section data for the latter purpose.

*Specification Problems.* Clearly, the outputs of different industries cannot be plotted on the same vertical axis in Figure 1. Plotting absolute profit, though possible, would make little sense because a large profit for industry A might reflect a large rather competitive industry, whereas a small profit for industry B might reflect monopoly in a small industry. Partly to correct for industry size researchers have used profits expressed as a percentage of sales or net worth. Other rates of return have also been used.

Figure 4 provides an illustrative plot of points that might be encountered in the real world if profit rate,  $R_v$  or  $R_s$ , in any given year (or averaged over a number of years) for a cross-section of industries is plotted against  $K$ . It is again convenient to hold  $B$  constant. Importantly, each industry would provide only one point from its structure-profit rate line as envisaged in the above discussion. For example, the structure-profit rate line for the *itb* industry is given by  $L_i$ . The error "e" reflects the possibility that  $R_{vi}$  is not the long-run profit rate for the given level of concentration. Although we might expect the lines for different industries to be upward sloping, there is no basis for believing the lines would all be the same in light of differing basic data and organizational characteristics of firms in different industries. Even a monopolist can make at most a normal return on investment if the demand is tangent to the long-run average cost curve. Actual quantification through multiple regression analysis assumes an "average" or representative surface (see Curve L in Figure 4) with an error component arising out of the omission of variables and because of a possible multitude of lines, one for each industry. Omitted variables may be structural or firm-related, or they may pertain to basic demand and cost conditions. Heteroskedasticity is likely in that all excess profit rates converge to zero, at least in the long-run, as structure approaches the competitive extreme. Moreover, with higher levels of concentration, fewer firms are involved. The averaging of firm-related error is diminished, and this, too, could cause heteroskedasticity (Imel, Behr, and Helmberger [1972]). For some samples, the representative line could be downward sloping even though the line for each of the industries in the sample is upward sloping. These possibilities stress the importance of a large sample and of including as many relevant variables as possible. For example, researchers often include demand growth variables on the supposition that rapid growth gives rise to higher than normal profits if such growth is not anticipated by

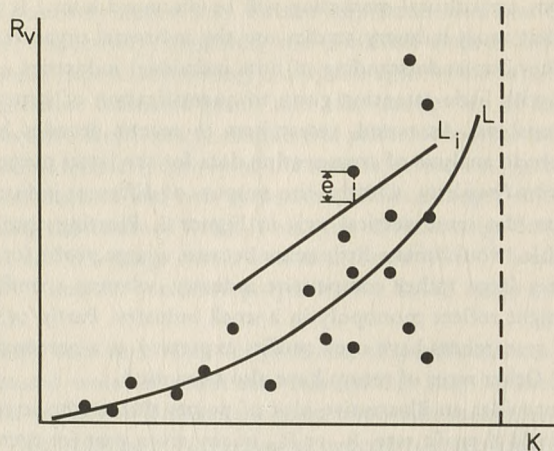


FIGURE 4. Illustrative scatter of points representing rate of return to equity  $R_v$  and level of concentration  $K$  for a cross-section sample of industries

established and new firms. Even so, the assumption that omitted variables, especially those reflecting basic demand and cost conditions and the "average quality of management" across industries, are uncorrelated with included variables is of crucial importance and as yet untested.

Turning to other problems of quantification, we find alternative rates of return, including returns to sales, net worth, and assets, have been used as the dependent variable. The considerable controversy over which rate of return is the most appropriate is largely sterile. Combatants have lost sight of exactly what it is that makes structure-profit relationships relevant to policy.

Profit rates may be computed for divisions of diversified firms, firms, industries, and groups of industries. Depending on the choice of the dependent variables, the analysis may be more or less aggregative. Profit data are usually derived from corporate reports or Internal Revenue Service data. The data have been subject to serious criticism in light of the many different accounting conventions in vogue. Moreover, some conventions are at odds with economic criteria. The pricing of assets at historical cost in periods of inflation is an important example. As one might expect, researchers often make adjustments in accounting profits in order to make them conform more closely to economic profits.

The concepts of industries and markets are basic to analysis, but their empirical delineation is extremely difficult. Fortunately, the Standard Industrial Classification of the Census divides manufacturing into various aggregates that conform more or less to economic criteria. Bain [1968] provided a discussion

of the problems encountered in attempting to distill a set of economic industries out of the various Census aggregations.

Given a set of industry definitions, concentration is nearly always measured by concentration ratios that show the percentage of industry sales accounted for by the four, eight, or twenty largest firms. Other variables occasionally used to reflect structure are the ratio of advertising outlays to total sales, barriers to entry, extent of imports and exports, optimal plant size relative to industry output, buyer concentration, and measures of geographic dispersion of economic activity, and several others. Nonstructural variables are most often ignored except for sales growth. In firm-level regression studies, firm market share, leverage, size, and diversification are often used.

Ordinary least squares regression is normally used to obtain parameter estimates. By breaking down the error into component parts, Imel et al. [1972] showed that heteroskedasticity and autocorrelation may be present depending on the extent and nature of aggregation. This study, with others, suggests that the method of generalized least squares often provides efficient statistical estimates.

*Empirical Findings.* The relationship between structure (especially concentration) and profits is one of the most thoroughly tested hypotheses in economics. According to Weiss [1974], "the bulk of the studies show a significant positive effect of concentration on profits or margins. . . . In the years where there is a great deal of overlap, the wide variety of profit or margin indexes, of concentration indexes, of other variables controlled for, of units of observation, of universes, and of the data sources indicate that the relationship was quite robust." We agree with this overall summary conclusion, recognizing the continuing controversy over the importance and interpretation of the results.

Of the many studies of structure-profit relationships, only a few have focused on the food processing and retailing sectors. A Federal Trade Commission study (Kelly and Parker [1969]) focused on a sample of the 97 largest food manufacturing companies. Two profit rates were considered, net income after taxes expressed as a percentage of year-end shareholders' equity and the total return to both debt and equity capital divided by the sum of equity and long-term debt. Simple five-year averages of annual profit rates were computed for the period 1949-53. Major independent variables were seller four-firm concentration ratios, firm's relative market share, industry advertising-to-sales ratios, and changes in industry output. Since the companies are diversified across many product markets, the above independent variables were computed as weighted averages, using a firm's shipments in various industries as weights. Additional independent variables included firm diversification and firm size.

The major result was that concentration, relative market share, and advertising intensity were all positively related to company profits. The reported *t*-ratios are difficult to interpret in light of the likelihood of autocorrelation. Increasing the four-firm concentration ratio from 0.4 to 0.7 and the advertising-to-sales ratio from 0.01 to 0.05 increased the estimated net firm profit as a percentage of stockholders' equity from 6.3 to 15.9. Results for diversification, absolute firm size, and change in industry demand were largely inconclusive.

The FTC work was roughly replicated in a study by Imel et al. [1972]. This latter study focused on 99 large food processing companies over the period 1959-67. Company research and development expenditures divided by total industry sales was included as a measure of product differentiation along with advertising intensity. The statistical findings regarding concentration, product differentiation, relative and absolute firm size, and company diversification were similar to those obtained in the FTC study. Let the concentration ratio, the advertising-to-sales ratio, and the research and development expense-to-sales ratio equal 0.1, 0.005, and 0.001, respectively, for a "competitive" industry and 0.8, 0.04, and 0.03 for a high-order "oligopoly" industry. Using typical equations, we find that estimated profit expressed as a percentage of sales was roughly zero for the competitive industry and 5 percent for the oligopoly. Net profit as a percentage of net worth equaled 4 and 16 percent for the competitive and oligopolistic industries, respectively.

The research by Imel et al. [1972] also included a lengthy sensitivity analysis. Three alternative profit rate variables were used. Profit over sales was consistent with quantitative procedures and gave the strongest results. Three alternative sets of industry definitions were considered. The findings for the set of industry definitions judged to conform most closely to theoretic criteria for industry delineation produced the greatest consistency between expected and actual results. The overall errors in the regression equations were broken up into component parts reflecting omission of variables relating to company divisions, whole firms, and the markets in which the firms have operated. The breaking up of the error paved the way for using generalized least squares regression.

A study by Collins and Preston [1968] examined the relationship between concentration and price-cost margins over the four-digit Census industries in the entire manufacturing sector. A significant positive relationship was reported for the 32 food and kindred products industries. The senior author of this survey redid the Collins and Preston study and found a textbook example of heteroskedasticity in the residuals. This result squares rather nicely with the hypotheses implicit in Figure 3.

In a report on the fluid milk sector, Manchester [1974] examined the



effects of concentration along with several other variables on marketing margins in 144 markets. A positive relationship was found between concentration and margins with a *t*-ratio equaling 1.5. Resale price regulation and restrictive sanitary regulations also tended to raise marketing margins.

A recent study by Marion, Mueller, Cotterill, Geithman, and Schmelzer [1977] for the Joint Economic Committee measured the relationships between structure and profit rates and between structure and prices in grocery retailing. This study took advantage of the spatial separation of grocery retail markets and was important for two reasons. First, it provided one of the few thorough tests of the structure-profit hypothesis in the distributive trades outside banking. Second, the estimated relationship between structure and retail prices dealt directly with an aspect of performance rather than with an indicator of performance such as profit rate. Data submitted to the Joint Economic Committee by grocery chains allowed analysis for the period 1970-74 of the impacts of market structure on: (1) profit-sales ratios in 96 different divisions of 12 grocery chains; (2) profit-sales ratios of 6 grocery chains in 50 different metropolitan areas; and (3) grocery price levels of 3 chains in 36 metropolitan markets. Briefly, the various analyses showed that both profitability and price levels were positively and significantly related to the four-firm concentration ratio and the firm's market share relative to the share of the top four. Other independent variables included mean store size, market growth, market size, firm growth, and entry. Variables were also included to take into account the behavior of A & P in attempting to recover lost business with an aggressive price competition policy launched in 1972.

The findings of the Marion et al. [1977] study stand in contrast to those of Mori and Gorman [1966] and the U.S. National Commission on Food Marketing [1966h] (see Padberg [1968]). In the Mori-Gorman study, price levels in a sample of 22 cities were regressed against a four-firm concentration ratio. Little attention was given to potentially disturbing influences, and the levels of concentration tended to be uniformly high, above 0.6 in all but one case. Perhaps for these reasons no relationship between concentration and price levels was found. The NCFM study considered gross and net margins and price levels for 6,000 stores operated by the nine largest chains in 1963. One phase of the work centered on identification of the most important factors associated with store margins using step-wise regression. A firm's share of the market was of little (modest) importance in terms of its association with gross (net) margins. Concentration was not included in a host of variables considered. Little attention was given to conceptualizing and rigorously testing industrial organization hypotheses. Another phase of the work centered on hypothesized positive relationships between a firm's market share and prices charged. As we understand this phase, the tests used to discern the existence

of such a relationship were weak and did not control for disturbing influences. Concentration was again ignored. To sum up, the search for a relationship between structure and profit has probably been more intense in the food sector than in any other. Objections can and have been raised about the manner in which variables are measured, estimation techniques employed, specification error, empirical delineation of industries, and so on. Some scholars have grave reservations about the weak conceptual bridge that stretches between performance and profit rates. Moreover, the importance of the efficiency loss arising out of monopoly is in question as a result of the work of Harberger [1954] and others. Be that as it may, it does appear that the hypothesis that asserts a positive relationship between market structure (mainly concentration) and profit rates has been rather firmly established in food processing. The evidence for such a relationship in food retailing is supportive but more research may be needed.

Without doubt, the quantification of structure-profit relationships needs further sophistication and refinement. Analysis of new sets of data, particularly in the distributive trades, would be useful. Possibly, more emphasis should be given to research that involves actual performance dimensions. Knowledge of industry demand and cost relationships might allow, for example, the estimation of competitive and monopoly outputs (prices). The ratio of actual to competitive (or monopoly) outputs for a cross-section of industries could then be regressed against structural dimensions. Information of this type might allow more precise estimates of the efficiency and redistributive effects of oligopoly structure and power than are presently available. It should be clear, however, that this suggestion calls for much high quality econometric research.

#### STRUCTURE AND PROGRESSIVENESS

The concern over the output and price effects of market power is based in part on the results of comparative static models. These models are not very useful in developing hypotheses about many other aspects of market performance. One of these aspects is progressiveness in terms of the development and commercialization of new products and processes. Various studies suggest that progressiveness is very important in an explanation of rising per capita incomes. Doubtless for this reason researchers have sought to understand the origins of progress even though available theories and data are woefully inadequate.

On the basis of informal theorizing and conjecture, many hypotheses on progressiveness are available for empirical analysis and testing (Kamien and Schwartz [1975]). Easily the most famous of these is attributable to Schumpeter [1942, p. 82] who wrote, "As soon as we go into details and inquire

into the individual items in which progress was most conspicuous, the trail leads not to the doors of those firms that work under conditions of comparatively free competition but precisely to the doors of the large concerns . . .” There is some agreement that Schumpeter had in mind the firm with market power rather than the firm that is large in an absolute sense.

Two neo-Schumpeterian hypotheses merit brief mention. The first, from Galbraith [1956], asserts that because research and development is both costly and risky, it can only be carried out by firms that are large in the absolute sense. The second, from Nelson [1959], asserts that diversification is conducive to progress because the outcomes of research expenditures are unexpected and may be applicable in any one of several different industries.

Handy and Padberg [1971] embraced the above hypotheses in developing an informal model of behavior in the food industries. They argued that the large diversified food manufacturers seek strategies that increase brand meaning and impact. The necessary functions, advertising for example, are expensive and probably have significant scale economies. They concluded [p. 183], “Therefore, larger firms have a competitive advantage in the introduction and marketing of new products.” They also cited the study by Buzzell and Nourse [1967] which suggested that increasingly the large food processors were responsible for major innovations.

Regarding empirical research, progress or technological change is difficult to measure. Researchers using regression analysis have correlated either research and development (R&D) expenditures by private corporations, R&D employment, or number of patents received with market structure and other explanatory variables. Another approach involved identification of major inventions and innovations and detailed historical studies of origins, size of companies involved, role of patents, and so on. To some considerable extent, Markham [1974], Scherer [1970], and Kamien and Schwartz [1975] agreed in their respective surveys of the resulting literature. Although the data and tests are subject to severe criticism, the results tend, by and large, to confirm the Schumpeter hypothesis. The three surveys embraced a threshold hypothesis which suggests that up to a point market power may be conducive to progress but that beyond this point increases in concentration have a deleterious effect. Scherer [1970, p. 378] concluded “What is needed for rapid technical progress is a subtle blend of competition and monopoly, with more emphasis in general on the former than the latter, and with the role of monopolistic elements diminishing when rich technological opportunities exist.” Kamien and Schwartz found support for believing that good management, with excellent interrelationships among R&D, production, and marketing departments, is very important in explaining progressiveness. This conclusion emphasizes the role of business organization in explaining market performance.

In a study by Imel et al. [1972], company R&D expenditures and patents received, both expressed as a percent of sales, were used as alternative measures of technological progressiveness. Independent variables included four-firm concentration ratios, extent of company diversification, absolute firm size, advertising intensity, and total nonfood sales divided by food sales. Both concentration and diversification were positively related to each of the two measures of technological progress. Firm size and advertising intensity, on the other hand, were negatively related to technological progress, but the t-ratios were small in several equations fitted for different industry definitions and with alternative statistical specifications. Bigness and product differentiation, correcting for other disturbing influences, did not appear to be positively related to progressiveness in the food manufacturing business. The Handy-Padberg hypothesis is supported only insofar as the association between diversification and progressiveness was positive. Their hypothesis also received mixed support in a careful study by Manchester [1974]. Manchester found that innovativeness in fluid milk distribution was retarded by concentration, isolation, and resale price regulation. The operations of integrated supermarket chains and national and regional companies tended to favor innovativeness.

Two issues relevant to assessing the importance of the association between concentration and progressiveness are performance evaluation and nonstructural determinants. Suppose it was established fact that for some particular industry, R&D expenditures increase with increased levels of concentration. The question of the *evaluation* of market performance still remains. What is the optimum level of R&D expenditures? Until this question is answered, one cannot be sure but that increased concentration might cause excessive expenditures to be incurred. Many writers seem to assume that a higher level of R&D expenditures is preferred to a lower. We question this assumption, agreeing with Bain [1968] that establishing the optimum levels of R&D expenditures for various industries may be impossible.

Second, it may well be true that the nonstructural determinants of progressiveness are of much greater importance than is market structure. Total R&D expenditures other than those on defense and space programs increased from \$3 billion in 1955 to \$22 billion in 1975. This sevenfold increase was accompanied by small changes in market structure. Federal and state research expenditures, size of the scientific community, the state of basic knowledge, and other determinants of progressiveness may together dwarf that associated with modest changes in market structure.

#### Case Studies of Market Organization, Market Structure, and Competition

There are a great many case studies of industries and markets in the agricultural marketing sector. Relatively few strive seriously, however, to assess

the nature of competition and its impacts on market or industry performance. The emphasis is often placed on changes in what we have called, following Scherer, basic conditions (input prices, technological change, etc.) and the consequences of these changes for marketing channels, institutions, and performance. These latter issues are important, but they are somewhat tangential to the main problems addressed in the industrial organization literature. For this reason we will provide a few illustrative examples of marketing changes caused by changing basic conditions, turning thereafter to studies of competition.<sup>14</sup>

(1) Livestock marketing has become increasingly decentralized, with packing plants located in production areas rather than in large cities and with a concomitant decline in the importance of terminal markets. Major reasons for these trends include changes in the transportation system, livestock production, and geographic patterns of wage rates (U.S. National Commission on Food Marketing [1966h], McCoy, Goetzinger, Kelley, and Manuel [1963], Kohls and Downey [1972], and Williams and Stout [1964]).

(2) Rapid technological progress in poultry breeding, nutrition, housing, disease control, and in other production phases has paved the way for the transformation of traditional poultry marketing. Poultry feed manufacture, egg hatching, and production have become highly integrated operations through the use of contracts, especially in broilers. Large-scale production is on the increase in broilers, turkeys, and eggs. The transformation of the poultry industry was associated with significant gains in efficiency and with sharply lower prices (Rogers [1971], Rogers, Conlogue, and Irwin [1970], Roy [1972], and Tobin and Arthur [1964]).

(3) The decline of terminal markets has raised questions about their continuing usefulness as sources of price information. This is especially true as regards livestock, poultry, and fresh fruits and vegetables (Breimyer [1976], Frahm and Schrader [1970], and U.S. National Commission on Food Marketing [1966a]).

(4) The markets for purchased inputs in recent years can be characterized as having (a) decentralized the manufacturing operations, locating them closer to raw material sources and users, integrated manufacturing and distribution; (b) placed more emphasis on merchandising products as part of a service-product package; (c) continued product diversification by development of new products and mergers (USDA, ERS [1968], Dahl and Hammond [1977], and Minden [1970]).

Turning to case studies of competition in agricultural marketing, we first consider a few broad-gauged attempts to assess competition and its economic effects in the food sector as a whole. We then consider in turn food retailing, livestock, dairy products, poultry and eggs, grain and grain products, and fruits and vegetables. Farm machinery and fertilizer are considered on the

input side. The intention here is not to review all the many studies that have been done. Rather, we hope to provide illustrative examples that serve as supporting evidence for a concluding evaluation of the case study approach.

Table 2 provides weighted average (by value-added in 1972) four-firm concentration ratios in 57 food and tobacco product classes. Importantly, no significant trends in concentration levels are discernible for the 57 classes (industries) taken as a whole. The data indicate, however, that increases in concentration are positively associated with the extent of product differentiation. This would appear to be a bad omen for the degree of competition in the more highly differentiated industries. Weighted concentration appears to be slightly less for food than for all manufacturing. Greater refinements would entail delineation of local markets and consideration of the role of imports.

A report by the staff of the Federal Trade Commission as a contract study for the U.S. National Commission on Food Marketing [1966i] examined structure, conduct, and performance in food manufacturing. The study identified six major structural changes which the staff believed to have had significant competitive effects. These were: (1) a decline in the number of companies; (2) an increase in concentration; (3) further conglomeration among leading firms; (4) increased acquisitions by large companies; (5) increased product differentiation expenditure by large companies; and (6) increased profitability of large firms vis-à-vis those of medium and small size. The decline in number of companies need not be inimical to competition but may be necessary in light of economies of size. The figures in Table 2 are not consistent with the alleged increase in concentration. Increased product differentiation is of concern and merits further research. The FTC staff reports that since World War II, food advertising has risen at a one-third faster rate than has total advertising. A perceptive paper by Shaffer [1964] is useful in assessing the welfare implications of increased advertising. Factors that might have received greater attention by the FTC staff report include the increases in market sizes and the changing market power positions of retail-wholesale distributors.

The FTC staff analysis of conduct and performance was limited to evidence gleaned from antitrust cases involving price fixing, market allocation, price discrimination, and other unlawful forms of behavior. An important conclusion was that oligopolies characterized by small numbers of firms and/or selling highly differentiated products generally have not been involved in anti-trust cases. This suggests that high-order oligopoly in the food business is beyond the reaches of laws intended to promote competition. The work on performance involved mainly a regression analysis of structure and profit rates (pp. 202-10) that has been rendered obsolete by the more recent works reviewed above.

Table 2. Weighted Average Four-Firm Concentration Ratios by Categories of Advertising Intensity for 57 U.S. Food and Tobacco Product Classes, 1954 to 1972<sup>a</sup>

| Year               | All Product Classes <sup>a</sup><br>N = 57 | Advertising-to-Sales Ratio of Product Classes <sup>b</sup><br>(mean A/S for category) |                            |                            |                                    |
|--------------------|--|---|----------------------------|----------------------------|------------------------------------|
|                    |  | 0<br>(0)<br>N = 15  | 0 to 1%<br>(0.5)<br>N = 13 | 1 to 3%<br>(1.8)<br>N = 11 | Greater than<br>3% (7.7)<br>n = 18 |
| 1972               | 47.1%                                      | 40.4%   | 27.9%                      | 50.2%                      | 70.1%                              |
| 1967               | 43.7                                       | 39.5  | 24.5                       | 47.6                       | 65.5                               |
| 1963               | 43.5                                       | 41.7  | 24.7                       | 45.0                       | 64.4                               |
| 1958               | 44.3                                       | 44.4  | 27.8                       | 44.0                       | 62.4                               |
| 1954               | 46.6                                       | 48.0  | 32.8                       | 45.7                       | 61.6                               |
| Change,<br>1972-54 | +0.5                                       | -7.6  | -4.9                       | +4.5                       | +8.5                               |

<sup>a</sup> All 5-digit product classes in the two-digit Standard Industrial Classification (SIC) Major Groups 20 (food) and 21 (tobacco) where the data are comparable from 1972 to 1954, excluding 7 local market product classes (in SICs 2024, 2026, and 2051). These 57 product classes account for 59 percent of the total value-of-shipments of SICs 20 and 21. The weighted average four-firm concentration ratios are weighted by the value of shipments in 1972 for each product class.

<sup>b</sup> The advertising-to-sales ratios (measured in percentages) are constructed from the 1967 advertising expenditures in eight measured media and the 1967 value of shipments for each product class. The basic advertising data were prepared by the late Robert Bailey of the Federal Trade Commission. For a more complete discussion of the data see Mueller and Rogers, "The Role of Advertising in Changing Market Concentration," forthcoming in *The Review of Economics and Statistics* and available as Working Paper No. 17, May 1978, from N.C. Project 117, Studies of the Organization and Control of the U.S. Food System, Madison, Wisconsin.

Source: Statement of Willard F. Mueller, University of Wisconsin, Madison, before the Subcommittee on the Antitrust and Monopoly, Committee on the Judiciary, U.S. Senate, April 6, 1979.

On the basis of case studies and criteria of workable competition, Moore and Walsh [1966] judged the adequacy of market performance for 14 agricultural industries. Thus, for example, overall market performance was judged "adequate" for apple processing, "largely inadequate" for fresh meat packing, "inadequate" for farm machinery (tractors), and "very inadequate" for fertilizer.

A study by the Economic Research Service (USDA, ERS [1972]) provided valuable data and evidence on the market structure of the food industries.

The study made very little effort to assess the consequences of structure for competition and performance. An earlier description of levels of concentration in the food industry and in farm input supply led Lanzillotti [1960, pp. 1240-1241] to conclude that "leading firms possess considerable market power and are inclined to utilize such power to manage or administer their market situation." He further concluded that market power in farm product and input markets, has aggravated adjustments in farm prices and incomes.

#### FOOD RETAILING

Studies of competition in food retailing often distinguish between procurement and sales, with the emphasis usually given to the latter. A report by the U.S. Federal Trade Commission [1960] provided considerable detail on structure and organization but gave little attention to the effectiveness of competition or to the evaluation of performance. Much the same can be said for a study by Mueller and Garoian [1961]. The FTC report, covering the period 1948-58, documented the increased share of business accounted for by chains, growth of cooperative and voluntary wholesalers, and the nature and extent of vertical integration among food distributors.

The Mueller-Garoian study presented estimates of concentration in both grocery sales and procurement at the national level. They estimated that for 133 selected cities, the four largest retailers accounted, on the average, for 58.3 percent of total sales. Mergers were judged to be important, though not as much as internal growth, in explaining increased concentration. They found empirical support for their hypothesis that retailer integration into manufacturing is determined mainly by the structures of manufacturing industries and certain barriers to entry. The motivation for entry into highly concentrated, profitable manufacturing industries was stressed. The authors seemed to be concerned about the consequences of local concentration in sales, but on the procurement side, they concluded [p. 138], "for products sold nationally or in large regional markets, the structure of the buying side of grocery retailing appears to be characterized by a fairly large number of large and medium sized chains or affiliations of independents, and a very large number of smaller firms. Economic theory suggests that such market structures limit severely interdependent pricing behavior. . . ." As to performance, the authors raised some concerns about the increased rate of spending on advertising and sales promotion.

The study by the U.S. National Commission on Food Marketing [1966h] showed that chains and affiliated independents have increased their share of grocery store sales since 1958, continuing the earlier trends described by the



FTC. Mergers were particularly important in the growth of certain retailers in the period 1959-64. Price discrimination and predatory practices were thought to be more or less prevalent and, when present, gave advantages to large food chains. Trading stamps and sales gimmickry were judged to contribute unnecessarily to costs. Profits of food retailers were found to be high relative to other trade and manufacturing, but the gap narrowed with increased saturation of cities by supermarkets.

A book by Padberg [1968] drew heavily on the facts and figures marshalled by the U.S. NCFM [1966h] but exhibited greater readiness to evaluate performance. He concluded [p. 258] "that retail competition is an effective force limiting the opportunity of private firms to promote their self-interest at the expense of the public." He gave the food retailing sector high marks for its economic performance as seller-industries, but the basis for his evaluation tended, as the author recognized, to be subjective. In contrast to Mueller and Garoian [1961], Padberg seemed somewhat alarmed by the market power of buyers in the wholesale market. He wrote [p. 261], "Performance in procurement of merchandise probably results in lower than optimal prices and returns in the processing industries. This suggests that consumers are to some extent subsidized by the processing industries and ultimately the farmer." His hypothesis on the distributive effect of monopsony in procurement merits critical examination. On the basis of conventional price theory, monopsony in procurement in wholesale markets likely helps neither consumers nor producers unless it countervails the market power of large processors, in which case it may help both.

The cross-section analysis by Marion et al. [1977], discussed previously, examined briefly trends in concentration in local grocery markets. For a sample of 194 Standard Metropolitan Statistical Areas (SMSAs), the four largest firms controlled, on the average, 45.1 percent of grocery store sales in 1954. The average (unweighted) share had increased to 52.1 percent in 1972.<sup>15</sup> They also estimated that the monopoly overcharge, defined as prices above those in competitive markets (presumably multiplied by given quantities), amounted to \$662 million. Some will find this figure difficult to interpret in light of the fact that in 1974 profit after taxes expressed as a percentage of stockholder's equity for 15 leading food chains amounted to 4.7 percent. The inconsistency may be more apparent than real because the return to equity might have been even lower in 1974 if all SMSAs were competitively structured and in the absence of cross-subsidization among markets.

Other studies of competition in food retailing include those by Holdren [1960], Cassady [1962], and Bucklin [1972]. Holdren gave special attention to multiple-product pricing, use of loss leaders, and nonprice competition. He concluded [p. 182], "oligopoly agreement is virtually impossible and we are

left with a market form which is best described as monopolistically competitive. . . ." Cassady's book also focused on pricing in supermarket operations, with two chapters on legal restrictions to price making at the supplier level. Bucklin considered competition in the distributive trades generally, giving attention to antitrust cases, historical developments, and previous studies. He found good performance at the wholesale level, with occasional exceptions. Developments in retailing such as self-service have caused considerable competition, with sharply lower retail margins. He concluded [p. 169] that in light of intratype modes of competition, variable-price merchandising, private brands, thousands of products, and countless promotional combinations, "It is apparent that a role for vigorous price promotion has been retained within the system."

#### LIVESTOCK

The NCFM study entitled *Organization and Competition in the Livestock and Meat Industry* [1966b] and other studies made in the mid-1960s and early 1970s described many of the structural and other changes in livestock markets after World War II. Among the changes chronicled by the NCFM were a marked decline in concentration in meat packing, the emergence of greater selling cost advantages of the larger meat packers, the appearance of livestock pricing and exchange arrangements that bypassed established markets, and changes in scale economies in meat processing. Stout and Hawkins [1968], while recording changes in meat merchandising, pointed out that growth of food chains and affiliated groups, self service, and the desire for product standardization have encouraged evolutionary changes like greater use of private labels and federal grades for beef, increased direct shipments which bypass packer branch houses and the independent wholesalers, and the development of chain or affiliate-controlled warehouses which receive such shipments. National meat packers also have become relatively frequent suppliers of many products to large food chains, whereas regional packers predominate as suppliers of affiliated and independent retailers. Stout and Hawkins also concluded that fresh meat tends to be undifferentiated, with meat processors competing for the chain store business on the basis of price to a greater extent than previously.

Studies of the structure of livestock and meat industries are more common than those dealing with performance; but many livestock and meat studies touch upon performance. Simmons and Rizek [1966], for example, suggested that year-to-year variation in cattle and hog prices during parts of the 1960s was excessive and indicated that Commodity Credit Corporation sales and pricing policies for stored grains might be adjusted to counter cyclical swings in livestock production and prices. The relatively low profit rates in meat packing are frequently cited as indicating appropriate performance by the

industry. And studies of livestock pricing efficiency, or the lack thereof, are legion (see Stout [1970] as an example).

Love and Shuffett [1965] provided one of the few concrete examples of the effect of a change in market structure on performance. They documented the changes in producer hog prices which followed the emergence of a single dominant firm in the Louisville terminal market. Before the structural change which involved the exit of one of the major buyers from the market, the weekly Louisville price for 200-220 pound U.S. 1-3 hogs averaged 5.5¢ more than in Indianapolis and 9.5¢ more than the Chicago price. After the change, prices for hogs at the Louisville market declined by 22¢ per hundredweight relative to Indianapolis and 27¢ relative to Chicago.

Aspelin and Engelman [1966] examined how prices and supplies at a terminal market were affected by the actions of a packer-feeder who fed about 10 percent of the cattle he slaughtered. They found no evidence that this packer's cattle marketings stabilized supplies since the marketings failed consistently to offset fluctuations in the receipts of other cattle on the local terminal market. However, they found that the packer-feeder's actions depressed prices substantially (25¢ to 50¢ per hundredweight) at the terminal market relative to prices at other terminal markets. Aspelin and Engelman reported the surprising finding that a given increase in packer-fed supply transferred to the packer's own plant had more than ten times as much effect upon the local choice steer price as a comparable increase in the overall market supplies of choice steers. They argued that this large price effect might occur in a market where a very few large oligopsonistic buyers account for most of the market purchases.

O'Connor and Hammonds [1975] compared the efficiency of retail meat departments using centrally fabricated meat (which the authors described as being the first major technological change in retail meat handling since the 1920s) with departments using traditional carcass systems. They concluded that the traditional carcass system and the new fabricated handling system will continue to exist side by side, since no clear advantage existed for the fabricated system for the large-volume departments studied.

#### DAIRY

Perhaps the most extensive evaluation of the organization and competition of the dairy industries appeared in a book by S. W. Williams, Vose, French, Cook, and Manchester [1970]. Particular attention was given to changes in structure, conduct, and performance. Some implications of government programs for market performance were noted. The role of sanitary regulations in restricting the movement of milk is only one of many examples. Technological change, rising wage rates, and labor contracts have increased optimum volume of business of dairy companies. Cooperatives are playing an increasingly

important role in preventing monopsony pricing of milk. The seller structure in fluid milk markets is oligopolistic, with a few dominant processors and important barriers to entry arising out of product differentiation, economies of size, and various institutional factors. Price leadership is common, and price fixing is not unknown. For butter, nonfat dry milk, and natural cheese, structure appears to be competitive, with moderate to low barriers to entry. As manufactured products move through channels toward the food store, increased levels of concentration and product differentiation are in evidence.

Williams et al. concluded: (1) in most dairy marketing industries a substantial majority of the plants were of less than optimum size in the early 1960s; (2) the dairy price support program, by providing a highly elastic and stable market for the output of small plants, may have lengthened the life of some small firms; (3) labor productivity in dairy marketing firms during 1951-68 generally increased more rapidly than in agricultural industries dealing with meat products, bakery products, canned and frozen foods, sugar, grain and mill products; (4) dairy firms have exhibited relatively good progressiveness, although the rate of adoption of new technological developments was slower than it might have been; (5) during the 1950's and 1960's, the rate of return to net worth of dairy companies was about twice that of meat packers, larger than that of sugar companies, and approximately equal to that of baking and other food product industries; and, (6) during 1950-62 advertising expenditures in the dairy industry were well within the range of those in other food processing industries.

Cook, Blakley, Jacobson, Knutson, Milligan and Strain [1978] described milk marketing practices, milk pricing, government policies and innovations in organization and coordination of the U.S. dairy subsector. They pointed out that significant innovations in organization and coordination and innovation in the dairy industry have included: (1) the merger movement among cooperatives that has led to large regional organizations, (2) the trend toward vertical integration in fluid milk processing by food chains and to some extent by cooperatives; (3) the move to specialization in fluid milk processing plants, with the so-called white plants specializing in fluid milk processing and separate large-volume plants specializing in production of by-products; (4) the move to joint-venture types of operations between processors and food chains in the manufacturing and marketing of cheese and other dairy products. Their analysis of performance examined product progressiveness, profits, price variability, and underutilization of plant capacity in the U.S. dairy subsectors.

Babb [1966] described the decline in numbers of U.S. fluid milk processing plants—20 percent from 1958 to 1963. However, Babb noted that this development failed to reduce the number of competing handlers in many fluid

milk markets, since the exit of small handlers was often accompanied by entry into the markets of larger handlers with multi-city distribution.

Gruebele, Williams, and Fallert [1970] reported that the growth in bargaining power of the food chains has triggered mergers and other adjustments by milk processors. More than one-fourth of the 400 midwestern milk processors surveyed in their 1970 study and nearly one-half of those with monthly sales of 2 million pounds or more had been involved in consolidation or merger activities during the five years preceding the survey. Also, more than a quarter of the dairies surveyed either had diversified or planned to diversify into non-dairy product lines. According to Gruebele et al., the trend toward larger size, with increasing automation, has sharply increased efficiency of operation and kept unit cost of processing down in the face of increases in wage rates and rising input prices.

Beginning in 1956, legal actions were taken under the Celler-Kefauver Act of 1950, which amended Section 7 of the Clayton Act in an effort to greatly strengthen the merger law. The numerous mergers of several larger dairy processors were challenged under the act and the guidelines issued by the Federal Trade Commission covering future mergers. Mueller, Hamm, and Cook [1976] concluded that application of the merger law to the dairy industry did not prevent the sizable industrial reorganization toward large-scale operations necessitated by changing technological and market conditions. The policy also apparently accelerated the growth and increased the number of medium-sized dairies by enabling these companies to grow by merger without competing with the largest companies for acquisitions. Thus Mueller et al. concluded that the merger policy seems to have contributed to a more competitive and decentralized dairy industry than otherwise would have emerged. Parker [1973], who reached similar conclusions, argued for a continuation of policies that would prevent a resumption of mergers by large dairy processors.

Moore [1966] and Moore and Clodius [1962] studied competition in the marketing channels for fluid milk. They found: (1) levels of concentration in local markets that are high relative to other industries; (2) little product differentiation based on real as opposed to fancied product differences; and (3) considerable evidence of price fixing and price leadership. Their analysis of competitive behavior and policy alternatives represented a major departure from studies that merely describe market structure.

#### POULTRY

The U.S. NCFM [1966c] noted increasing concentration in the poultry industries. However, the general level of concentration among poultry processors and egg handlers remained relatively low. The Economic Research Service

(USDA, ERS [1972]) reported that in 1968 the four largest broiler processors accounted for 18 percent of federally inspected slaughter, whereas the twenty largest firms accounted for 47 percent. The four largest turkey slaughtering firms accounted for 30 percent of federally inspected slaughter, and the twenty largest firms accounted for 65 percent. A more recent estimate by Marion [1976, pp. 71-80] indicated that concentration was continuing to increase in both broiler and turkey processing.

The most complete attempt to assess the performance of the broiler industry was that of the Packers and Stockyards Administration (USDA, P&SA [1967]). In an investigation stemming from a complaint of southern poultry producers, P&SA found that in general there were no major barriers to entry at the integrator-processor level. Products were basically homogeneous. Economies of size in broiler processing occur at a level sufficiently low not to require high levels of concentration. The P&SA also indicated that at the grower level assets are relatively specialized, offering the grower limited flexibility. Growers may also face limited competition in contracts available to them. In many cases the P&SA found that growers had limited economic alternatives for their labor within their particular geographic area.

The P&SA also found that in the areas of cost, efficiency, and progressive-ness, the performance of the broiler industry has been quite impressive. They discovered that net returns of processors have generally been more than for meat packers but less than for meat and turkey processors. In addition, poultry processor returns are highly variable from year to year. The P&SA found that grower incomes have been increasing over time in the Maine and Delmarva industries but have declined on Georgia farms. In general, growth of income on specialized broiler farms has not been as great as that of diversified farms.

Marion and Arthur [1973, p. 45] studied the broiler industry as a vertical commodity system. They observed:

One of the ironies of the broiler system is that although individual integrators have developed tightly coordinated vertical networks, the system in the aggregate has continued to have coordination problems, if relatively stable prices and profits are used as criteria. . . . The responsiveness of the total system in shifting resource allocations still depends upon the composite effects of many individual decision-makers as they try to outguess the market and their competitors. To date, the result has been mercurial prices and profits, with consumers the main beneficiaries.

This general conclusion has been drawn by several observers of the broiler and other highly integrated systems. It is clear that vertical control without horizontal control does not lead to any substantial decline in output or price variation.

## FRUITS AND VEGETABLES

The U.S. NCFM [1966e] reported that since World War II the fruit and vegetable industries have shown a reduction in the number of farms and increasing geographic specialization. This trend has been accentuated by the trend toward greater processing of fruits and vegetables with processing firms tending to locate in dense production areas and to attract further production.

The NCFM concluded that competition among first handlers for grower supplies of fresh vegetables generally took the form of nonaggressive, differentiated service competition. This was fostered by a market structure in which many grower-sellers were faced with a core of buyer-shippers and a competitive fringe of grower-shippers. The ease of entering production allowed the core of shippers to follow a generally nonaggressive price policy. Competition among first handlers for sales appeared to be aggressive as a result of substantial excess capacity at shipping points. The NCFM found generally stable buyer-seller relations between shipping points and destination buyers owing to the desire of direct purchasing retailers to gain reliable supplies of quality products. The impact of direct purchasing by retailers has also been felt in the decline of terminal wholesale markets and has led to a major change in the functions of nonintegrated wholesale market participants. This includes the merger of receiving and jobbing functions into single firms as well as the shifting toward nonretailer clientele. The greatest impact has been on price making. The shipping point has become the major center for price making, increasing the difficulty of collecting and reporting accurate price information. The nature of direct purchasing also removed much of the pricing and movement information from public view.

Processed fruits and vegetables come in three main forms—canned, frozen, and dried. In general, the canning industry is relatively competitively structured. Although local concentration in procurement is quite high, the relevant market for distribution is a national one with relatively low concentration. Seldom would four-firm concentration ratios exceed 60 when considering the major individual product classes. An added element affecting competition in canned fruits and vegetables has been the tendency for large chain retailers to develop private label products through vertical integration or contract procurement. At the retail level competition in most canned fruits and vegetables is between a limited number of canner national brands and retail private labels. Most private label merchandise is secured from small canning firms which are unable to sustain economically the promotional programs necessary to maintain a differentiated product national brand image.

The U.S. NCFM [1966e] reported that the canning industry in general (based on a sample of 61 firms) had relatively low and highly variable returns.

This generally supports the notion that for those portions of the industry consisting of commodity-type products (peas, sweet corn, snap beans, etc.) the industry is relatively mature, with strong levels of competition.

The wide use of freezing as a major technology for consumer food products has appeared since the early 1950's. The most extensive freezing of fruits and vegetables is done in the Pacific and Southeastern regions. Concentration in the freezing industry could generally be called moderate. The NCFM found that at all levels the freezing industry was more concentrated than the canning industry.

The freezing industry also evidences relatively high concentration in procurement. At the processor-retailer level there is again a tendency for competition to be between private label packers and national brand firms. In recent years there has been a tendency for national brand processors to attempt to increase product differentiation through the creation of new product forms such as premixed and specially seasoned combinations of fruits and vegetables.

The NCFM reported that, among 55 freezing firms surveyed, profits appeared to be relatively modest and somewhat lower than those of canning firms on a profit-as-percent-of-sale basis. As with canning, firms specializing in fruit and vegetable freezing had lower returns than diversified firms that did some fruit and vegetable freezing.

Dried fruits and vegetables are of relatively minor importance in fruit and vegetable processing. About 90 percent of dried fruits are produced in California. Potatoes are the primary dried vegetable product. As one might expect in a relatively small industry, concentration is quite a bit higher than in other segments of fruit and vegetable processing. Four-firm concentration for the dried and dehydrated fruit and vegetable industries in 1963 was 37 (1972 = 33), with fifty-firm concentration at 94. The NCFM found that profits in fruit drying were low relative to those in fruit and vegetable canning and freezing.

The U.S. Federal Trade Commission [1962, 1965] also conducted inquiries into the canned and frozen fruit, juice, and vegetable industries in the early 1960s. Each of these studies examined structure, marketing patterns, and merger patterns in the two industries. In both industries the presence of both packer-label and buyer-label products produces some unique marketing patterns. In the freezing industry, the FTC found the following asymmetry [p. 4]: "In the packer-label segment, a few large sellers depended primarily upon smaller retailers; in the customer-label segment, a few large buyers purchased most commonly from smaller suppliers." In the canning industry the FTC discovered that the largest canner-brand sellers were also very important in customer-brand sales. Cannerys with sales in excess of \$10 million accounted for



one-half of customer-brand sales. This "dual" branding of the leading canners was believed to be an important competitive weapon.

Large grocery chains were an important force in both the canning and freezing industries. In the freezing industry, direct purchases by leading retailers were concentrated in the customer-brand market, whereas packer-label products generally flowed through brokers and frozen food distributors. In the canning industry, the ten largest chains accounted for 55 percent of all direct purchases and nearly 71 percent of all customer-brand purchases. In 1959, eight grocery chains operated fruit and vegetable canning plants, accounting for 9.4 percent of customer-brand sales.

Profits for both canners and freezers were associated with sales size class. In the freezing industry, return (before taxes) on investment ranged from a high of 28 percent for the largest size class to a low of 13 percent for the smallest class. The freezing industry average was 26.3 percent. In the canning industry, profits before taxes on stockholder equity for the largest firms (\$100 million in assets) averaged 22 percent in 1961. For firms with assets of less than \$100 million, before-tax profits as a percent of stockholders' equity were between 8.7 and 15 percent for the period 1951-61.

Sales promotion expenditures were important for both canners and freezers with packer-brand sales. In 1959, the five largest advertisers in canned fruits and vegetables spent 5.7 percent of their sales on advertising. Advertising was highly concentrated, with 4 percent of the firms reporting advertising expenditures that accounted for 83 percent of all reported advertising. The five leading packers of nationally advertised brands of frozen foods spent 6 percent of their packer-label sales on advertising. "Customer Promotion Deals" were also concentrated among the five leading packers who accounted for 71 percent of total industry purchases on such promotional devices.

In discussing the future of competition in the canning and freezing industries, the Federal Trade Commission [1962, 1965] found two factors of common concern. First, in both industries, the extensive use of advertising and promotional allowances among packer-brand sellers create substantial barriers to entry to all but the largest food manufacturers. Second, the growth in concentration in the food retailing industry appeared to be reducing the number of outlets for both packer- and customer-brand products. In this case, the most significant impact of oligopsony power appeared to be on the customer-brand segment of the canning and freezing market which appeared substantially more vulnerable.

Both the canning and freezing industry studies by the FTC [1962, 1965] provide an exhaustive analysis of the structure of these industries in output markets. In this sense, these studies supplement the material provided by the

National Commission on Food Marketing. Neither the NCFM nor the FTC studies addressed adequately the analysis of structure-performance linkages. They generally provide basic foundations for understanding the structure of the industries and offer numerous hypotheses for further testing.

Helmberger and Hoos [1965] studied the competitiveness of fruit and vegetable processors in procurement of raw products in local markets. For several reasons they concluded that competition is vigorous in spite of occasionally high levels of concentration in procurement. First, for major vegetables, such as peas, green beans, corn, and tomatoes, supply elasticities are likely to be very high. Producers of these crops have many crop alternatives, and buyers of vegetables compete with buyers of other farm products. Second, for certain major fruits, the fresh market outlet represents an important alternative to the processing outlet. Finally, farmer cooperatives have been playing an increasingly important role in processing fruits and vegetables and in representing farmer interests in contract negotiations. The Helmberger-Hoos study contains many references to the literature on procurement in local markets.

#### GRAIN AND GRAIN PRODUCT INDUSTRIES

Local markets for grain have been the subject of several researches that describe channels, functions, and provide limited information on structure (Berger and Anderson [1972], Driscoll and Martin [1967], Heid, Martin, and McDonald [1965], Hill [1975], Jones, Sharp, and Baldwin [1975], and Velde, Taylor, and Hammond [1966]). Although the extent of competition and its implications for performance are rarely treated, an exception is a paper by P. L. Farris [1958]. He found frequent day-to-day variations of several cents per bushel in elevator paying prices for wheat in two areas in Indiana. No elevator consistently paid a high or low price throughout the season. The tendency was for prices paid by sample elevators in an area to be grouped and to follow wheat futures prices. He also found [p. 623] "considerable room for increasing the effectiveness of the pricing system for wheat at the country elevator level through more accuracy in grading and price discounting."

Farther up the marketing channel one encounters the mixed feed, milling, breakfast cereal, cookie and cracker, and baking industries. Padberg [1966b] provided a rather general view of competitive behavior and performance in mixed feeds. Performance in terms of product variations and innovative activity was found to be satisfactory. Structure precludes exploitive pricing in procurement of inputs by the mixed feed industry; exploitive pricing has not been a problem in sales of mixed feed. Excess capacity may represent a type of unnecessary cost.

*Flour Milling.* The U.S. NCFM [1966f] found that one-half of the flour mills operating in 1948 had closed by 1964. Judging from changes in various

concentration ratios, no important trend in the level of concentration can be discerned since World War II. As of 1972, the top four companies in the flour and other grain mill products industry accounted for 32 percent of the value of shipments. Integration into manufacture of end use products, such as cookies and crackers, has been increasing. The profits of flour millers as a percentage of net worth have typically been low relative to manufacturing generally. The NCFM study did not appear particularly concerned with lack of competition in the milling industry.

*Breakfast Cereals.* A U.S. NCFM study [1966g] indicated high-order oligopoly in breakfast cereals manufacture. Concentration in breakfast cereals has increased slightly in the post-World War II period, with the largest four firms accounting for 84 percent of the business in 1972. The NCFM reported that in 1964 advertising expenditures, mainly for network television, amounted to 15 percent of sales. Retailers are virtually compelled to carry a wide assortment of cereals; private labels have met with little success. Entry into both the ready-to-serve and to-be-cooked segments of the industry has been nil. Profit rates have been very high. After-tax return on stockholders' equity was 18 percent in 1964. Development and marketing of new cereal products is a dominant mechanism for increasing or maintaining market shares.

*Cookies and Crackers.* Concentration in cookies and crackers has not varied much in recent years. In 1972, the four-firm concentration ratio equaled 0.58. According to the U.S. NCFM [1966g], advertising expense has been relatively low, amounting to 1.7 percent of sales in 1964. In 1963, private labels and production in retailer-owned facilities amounted to roughly 8 percent of sales. Entry was judged to be relatively easy. Profit after taxes, expressed as a percentage of stockholders' equity, equaled 12.7 in 1964.

*Perishable Bakery Products.* Galbraith [1956] once popularized the notion that strong market power on one side of the market is largely neutralized by strong power on the other. Application of this hypothesis to food marketing suggests that big retailers, especially chains, might countervail the power of large food processors, with market results close to competitive results. Studies by Walsh and associates (Walsh and Evans [1963], Walsh, Evans, and Birch [1964], and Walsh and Evans [1966]) challenged the empirical validity of the above hypothesis as it applies to the baking industry and raised the important question whether the hypothesis applies anywhere else.

Because bread and related products are perishable and bulky, markets for fresh bakery goods must be local. According to Walsh, Evans, and Birch [1964], there are 100 separate and semi-independent bakery markets in the United States. Seller concentration is high, with the top four typically accounting for more than 65 percent of the sales. (Also, see the U.S. Federal Trade Commission [1968] and U.S. NCFM [1966f].) In this structural dimension,

the buyer industry, in part composed of large chains, is very similar to the seller industry. The most favored entrants into baking are the large chains; considerable backward integration has occurred. Moreover, many bread baker-wholesalers also bake for the private label trade. Severe demand inelasticity probably enhances the effect of concentration, in that price cutting leads to very little expansion of quantity demanded. The substantial excess capacity in many markets is not so much a barrier to entry as an incentive to refrain from entering. In this setting of bilateral oligopoly has the emergence of big buyers improved market performance? Walsh and associates seem to answer in the negative.

They argue that the increasing market power of retailers and their control over shelf space has backed brand-name bakers into a corner. Larger baker-wholesalers believe they must increase promotion through advertising and services by driver-salesmen to stave off retailer encroachment. Increases in advertising outlays on wholesaler brands has more than offset the corresponding decreases linked with sales of chain brands and private labels. The ratio of advertising expense to sales for the U.S. bakery industry increased from 1.6 percent in 1947 to 2.8 percent in 1957. In the Pacific regions, unlike the United States as a whole, price differentials between wholesaler and chain brands have been a good deal less than the corresponding cost differentials. Inefficient distribution systems and rigid price leadership are held to have protected high-cost producers.

Although the hypothesis set forth by Walsh and associates is important, more evidence is needed. Advertising intensity has increased for many food manufacturing industries; the baking industry is not unique in this regard. As with many industry studies, corrections for disturbing influences have been neglected. The evidence cited on price discounts between wholesale and chain brands does not support the Walsh-Evans hypothesis as much as it does the contrary hypothesis that chain brands offer a low price alternative to consumers, reflecting lower chain production and distribution costs; the Pacific region may be an exception to the rule. According to the U.S. NCFM [1966f, p. 109], private label bread sells for 2 to 6 cents per loaf less than advertised bread. The decline in both the number of bakeries and in the profit rates of those remaining indicate that not all high cost producers are receiving protection. Finally, although Walsh and his associates and others may well have identified performance problems in the baking industry, they have not set forth a program to solve these problems. The performance of the baking industry may be "workable" for want of government programs that could secure improvements.

In an earlier study Storey [1962] arrived at many of the same conclusions reached by Walsh and his associates. Interestingly, Storey also expressed

concern that chain store integration into baking and the use of private labels by retailers could not be taken to mean necessarily that performance of bakery markets has improved.

Mueller [1970a] documented the effects of bread price-fixing conspiracy in the state of Washington. The conspiracy involved bread bakers and retailers. Average retail price of white bread in Seattle relative to the United States began to increase in 1954 during which year the conspiracy commenced. Seattle prices remained high relative to the United States until the conspiracy was broken up in 1964 at which time Seattle prices plummeted below the national average. Mueller [p. 137] estimated that "had a similar nationwide bread price-fixing conspiracy been in effect during 1955-64, and had it increased prices comparable to the increase in the state of Washington, American consumers would have paid over \$2 billion more for bread than they actually did." Rarely does the economic system provide an experiment in which cause and effect can be so clearly seen and measured as in this case.

#### FARM MACHINERY

The structure of the farm machinery industry (or sector) suggests a high order of oligopoly. According to Census figures, the top four firms in the United States accounted for 46 percent of total production in 1972, but concentration is much higher in certain important product lines. For wheel tractors and harvesting equipment, the 1972 four-firm concentration ratios were 0.81 and 0.71, respectively. Levels of concentration have not varied much in the last decade. Barriers to entry, especially in tractors and other expensive, complex machines, are high because of economies of size, the need for international business to stabilize sales, and product differentiation including a geographic network of dealerships (Bain [1968]).

W. G. Phillips [1956] concluded that farm machinery manufacturers kept prices rigid, allowing quantity of sales to vary with demand. Price leadership by International Harvester declined after World War II. On the basis of low profit rates relative to total manufacturing, progressiveness in product design and invention, and economies of size, Phillips concluded that the performance of the farm machinery industry is at least satisfactory. He suggested [p. 354] that "public policy measures are not at present urgently needed."

Perhaps the most thorough analysis of the farm machinery business resulted from the work of a Royal Commission in Canada beginning in 1966. In 1973, Barber summarized the results of several monographs published by the commission. He [p. 821] reported estimates that suggested much higher economies of size than those given by Bain, concluding that "three plants of a reasonable efficient size could supply all of North America's current annual requirement for wheeled tractors." Barber charged the industry leaders with

following high price policies which, rather than showing up in the form of high profits, protected inefficiency and high costs. According to Barber, Deere has become the price leader in North America for tractors and numerous other farm machines. Lack of price competition has led to development of improved models, increased size, options, and better repair service. In fact, product differentiation and variation may have gone too far in light of economies of size. The Barber appraisal poses a classic dilemma. Achieving economies of size in the production of tractors and in other complex machinery may entail even higher levels of concentration than those observed today. Would higher levels of concentration cause prices to fall and/or returns to stockholders in machinery manufacturing to increase? Perhaps because of this dilemma, the recommendations suggested by Barber for new government policy seem addressed to minor issues. Phillips's position that no new government policy is urgent seems to have received some implicit support by the work of the Royal Commission.

#### FERTILIZER

One of the better industry case studies available is Markham's *The Fertilizer Industry: Study of the Imperfect Market* [1958]. Aside from providing considerable detail on fertilizer technology, marketing history, and channels of trade, Markham focused on two distinct sources of market imperfection, viz., monopoly power and irrational demand for fertilizers by farmers. As to the first, he concluded that most of the basic materials used in fertilizer manufacturing are purchased under a high order of oligopoly. Prices, production patterns, cost-price relationships, and profits in these industries have reflected market structure. The two largest producers of sulphur, for example, have historically accounted for 90 percent of domestic production. Crude sulphur and sulphuric acid prices have been among the most inflexible prices in the American economy. Profit rates have also been very high. Public policy toward monopoly power in the fertilizer industry has consisted of frequent application of antitrust law, strategic disposal of wartime-constructed nitrogen plants, and policies designed to strengthen farmer cooperatives. Competition apparently has increased substantially in the synthetic nitrogen industry in recent years.

The second major source of imperfection has to do with lack of information. The fertilizer industry has traditionally produced and farmers have purchased low-analysis fertilizers that contain useless fillers like sand. The evidence strongly suggests that as plant nutrient content of mixed fertilizers and straight fertilizer materials increase, the cost per unit of plant nutrient to the farmer decreases. Markham estimated that in 1949, the costs of irrational production and procurement amounted to \$61 million, or 10.5 percent of the

nation's total mixed fertilizer bill. The waste associated with filler has fallen since 1949 as the plant nutrient content of mixed fertilizer has increased dramatically, but apparently substantial waste still persists.

Although Markham did not consider very carefully the degree of competition in local farmer markets, a few studies are available. Berry, Smith, and Rudd [1965] found that higher orders of buyer knowledge and deliberativeness, fewer seller firms, and cooperative purchasing were all significantly associated with lower at-farm fertilizer prices in eight Kentucky retail markets. High levels of seller concentration were justified on the basis of economies of size. The role of cooperatives in engendering greater competition in the retailing of fertilizer was also emphasized by Walsh and Rathjen [1962] who found high levels of seller concentration in Nebraska counties.

#### STUDIES OF COMPETITION—APPRAISAL

A number of conclusions seem warranted on the basis of our survey of case studies of competition in agricultural marketing. First, most studies do little more than describe market structure, often citing as justification the structure-performance hypotheses of price theory.<sup>16</sup> Although data availability is a real problem, we expect that more careful searching of secondary sources plus collection of primary data are feasible and would allow better analysis.

Second, the case study approach is better adapted to measuring the performance consequences associated with changes in basic economic data than with changes in market structure. Copious examples can be found in which researchers have assessed the impacts of exogenous influences such as population growth, increased per capita income, new technologies, changes in transportation systems, and changes in government policy on such performance variables as output, price, costs, and product development. This is not surprising in light of the stability of market structure and the instability of basic economic conditions.

Third, if the research objective is to evaluate performance in its several dimensions, as urged by Bressler [1966], for example, case studies would seem to be the best approach. Importantly, however, it is not sufficient to evaluate observed performance without at the same time assessing what performance would be under alternative government policies. The latter stresses both the importance of hypotheses drawn from theory and previous evidence, and the tentative nature of performance evaluation.

Fourth, in the absence of total independence and explicit collusive agreements, as documented in antitrust cases, say, it is difficult to observe and record the nature of competitive processes. Thus we are largely sympathetic with the position of Bain that the degree of competition may best be inferred

from its structural determinants and its performance consequences. Even so, we believe that researchers can, through interviews and in other ways, do a much better job than has been done to date on market conduct and competitive behavior.

Finally, if performance is to be judged satisfactory in the absence of concrete, practical proposals for reform, then, judging from the literature, agricultural markets are performing by and large in a satisfactory manner. Many of the criticisms of performance arising out of a lack of competition are not coupled with remedies and seem to reflect the view that things could be better if only certain companies maximized welfare instead of profits and stopped advertising so much, lowered prices, improved products, labeled contents, and so on. The U.S. NCFM's [1966h, p. 99] criticism of alleged wasteful advertising expenditures in the food processing sector is a case in point. Its policy recommendations are silent by and large on remedies for reducing wasteful expenditures. Performance evaluation must consist of more than wishful thinking. It may well be that to accept a capitalistic system as an organizing mechanism is to accept a tradeoff between "goods" and unavoidable "bads."

### Economic Policy and Competition

Agricultural marketing takes place in a legal environment specified by laws of different levels of government. The most important laws dealing with competition are the Sherman Act (1890), and the Clayton Act and the Federal Trade Commission Act, both passed in 1914 and significantly amended thereafter.

Appraisals of antitrust policies are plentiful in the general industrial organization literature. Bain [1968] and Scherer [1970] are basic references. Recent policy recommendations receiving the most attention in the field pertain to deconcentration of American industry. The three main proposals can be found in a book by Kaysen and Turner [1959] and in two proposed pieces of legislation, the first being the "Concentrated Industries Act" by the so-called Neal Committee, the second being Senator Hart's Industrial Organization Act. Regarding these recommendations, the book edited by Goldschmid et al. [1974], provides descriptions and evaluations both pro and con, and many references to the relevant literature.

As noted, agricultural marketing researchers have not devoted much attention to framing new policy toward competition. This may reflect satisfaction with the current legal framework and the associated performance consequences. Be that as it may, a few studies merit brief survey. The summary report by the U.S. NCFM [1966a] contains a set of policy recommendations some of which pertain to the degree of competition. Out of concern for the implications of high levels of concentration, NCFM embraced a vigorous policy for



controlling mergers and acquisitions by food firms. This policy includes pre-merger notification and provisions to allow regulatory agencies to issue cease and desist orders. Support was given for the strengthening of various provisions of the Clayton Act as amended by the Robinson-Patman Act. These provisions pertain to price discrimination and the various defenses available to buyers who obtain discriminatory prices and to sellers who discriminate among geographically separated markets. Other policy proposals by the NCFM are discussed at later points in this survey.

A second study consists of a collection of papers (Garoyan [1969]) spawned by the merger wave of the 1960s. Among those favoring strong measures, Hoffman [1969] proposed outright prohibitions against mergers and acquisitions by firms above a certain size in absolute terms or relative to industry size. Weiss [1969], on the other hand, warned against major merger bills which he thought would probably have serious long-run effects. He recognized that the merger boom had about run its course (as of 1969) and argued that certain accounting and tax reforms were in order quite aside from the then current flap over mergers.<sup>17</sup> In one of the papers, Rhodes [1969, p. 71] made a telling point about the deconcentration proposals, identified above, when he asked, "If Jimmy Ling of LTV or Eli Block of AMK can rearrange the shape of many firms almost at will, why then should the Justice Department and federal judges quiver with fear at the thought of doing a bit of the same?"

As a final example, Mueller [1970b] briefly described a policy agenda for the promotion of competition. Among the items on his agenda were: (1) support for antitrust enforcement; (2) control of conglomerate mergers; (3) fuller disclosure of conglomerate operations; (4) some restructuring of high-order oligopolies; and (5) promotion of international trade.

In addition to antitrust policy, a variety of trade practice regulation aims at effecting competition by controlling market conduct. The Federal Trade Commission is responsible for enforcing a variety of rules prohibiting "unfair" trade practices throughout the economy. In agriculture the Packers and Stockyards Act and the Perishable Agricultural Commodities Act serve to protect traders from unfair practices. In addition, the Agricultural Fair Practices Act prescribes rules of conduct in collective bargaining. Breimyer [1973] questioned whether trade practice regulation protects primarily traders and businessmen or consumers. As he admitted, this is not an easy question to answer. In our review we have not found prominent examples of research on this question. It seems apparent, however, that in the "deregulation atmosphere" of the 1970s current and future trade regulations are ripe for study and will likely become a more prominent topic in agricultural economics. Trade practice regulation also may become more prominent if antitrust policy is not successful in stemming tendencies toward increasing concentration.

### *On Cooperative Enterprise*

The extent of cooperative enterprise is a structural dimension of many agricultural markets because the extent of farmer cooperation may affect the degree of competition. This hypothesis arises out of the motivation for the organization of cooperatives as opposed to profit-seeking firms. The latter firms are organized by investors in order to make, and possibly even maximize, profit. As is well known, cooperatives are organized on a nonprofit basis to provide patrons with products or services at cost, presumably minimum cost. Although somewhat overdrawn, a paper by Robotka [1947] provides a useful comparative description of cooperatives and profit-seeking firms.

Much of the literature on cooperative enterprise has an intrafirm orientation and is designed to assist cooperatives in overcoming financial problems, achieving economies of size, upgrading management, and improving channels of communication among managers, directors, and members. Although important, these studies fall outside the purview of the present survey. Also, many publications are descriptive, discussing principles and practices (Abrahamsen and Scroggs [1957], and Valko [1966]), types of associations (Roy [1976]), organizational procedures, and cooperative growth (Mueller [1974a], Garoian and Cramer [1968]). The Farmer Cooperative Service published many such studies. Knapp [1969, 1973] has completed two volumes of a planned three-volume history of U.S. cooperatives going back to 1620. Hulbert [1976] described succinctly the legal phases of farmer cooperation, and a study of Lipson, Batterton, and Masson [1975] for the Federal Trade Commission focused on recent antitrust problems. A book by Roy [1976] provides a comprehensive view of cooperative history, legal bases, organization, and financial and management problems. A whole host of bulletins describe the number, size, and operating and financial characteristics of cooperatives involved in the marketing of farm products and inputs in local areas. Examples are R. W. Cox [1951], Manning and Koller [1953], and Downey, Kohls, and Wilson [1965].

In this survey of cooperative literature attention is first centered on farmer cooperatives physically engaged in the processing and distribution of farm output. Brief attention is then focused on consumer and farm supply cooperatives. Consideration is finally given to cooperative bargaining associations whose major function is the negotiation of contract terms for the sale of members' output. The distinction between "operating" and bargaining cooperatives is not always easy to make in practice since some cooperatives perform both functions.

Cooperatives engaged in the processing and distribution of farm output, hereafter referred to as farmer marketing cooperatives, have been the subject of considerable marketing research. The extent of the attention received is

remarkable in that farmer marketing cooperatives have been mainly involved in performing elementary marketing functions just beyond the farm gate and, with the major exception of dairy processing, have made little headway in invading the food manufacturing sectors which serve agriculture. In 1967, according to the Census of Manufactures, farmer marketing cooperatives accounted for less than 5 percent of the value added by manufacture in the food and kindred products sector. With so small a share of food manufacturing, and in light of the limited role of farmer cooperatives in food distribution, it seems quite unlikely they could have much impact on the total marketing bill for farm products. For a survey of cooperative growth, see Abrahamsen [1973].

The nonprofit nature of a cooperative makes it quite unlike the firm envisaged in neoclassical theory. As a result, the theory of the profit-seeking firm is not directly applicable to the cooperative, and students of cooperation have for many years lamented the absence of a theory of cooperative enterprise. In response to this void, Emelianoff [1942] and R. Phillips [1953] evolved a theory in which the cooperative was not viewed as a firm. Their position was challenged by several writers including Helmberger and Hoos [1962] who argued that within an organizational framework the cooperative enterprise can quite appropriately be viewed a firm. They further showed how theory of the profit-seeking firm could be extended to include cooperatives as a special case. Many of their theoretical suggestions had been anticipated by Nicholls [1941] and Kaarlehto [1956] and were later rediscovered by Domar [1966] in a paper focusing on the economics of collective farms.

To see how the theory of the firm can be extended to include cooperative enterprise, consider a profit function for a firm in which profit equals the difference between total revenue from the sale of a single product and the total outlay on numerous inputs. When the suppliers of an intermediate good like milk organize a cooperative, cooperative surplus can be set equal to the difference between total receipts and the outlay on all remaining inputs. Maximization of cooperative surplus for alternative levels of milk allows the derivation of an average revenue product (ARP) function showing the highest possible price that the cooperative could pay for whatever level of output is ultimately supplied by members. The intersection of a horizontal or downward-sloping ARP function and an upward-sloping supply function for cooperative members gives cooperative equilibrium. Each member is producing the milk output that maximizes personal profit, and the cooperative is returning the highest price possible, given the aggregate level of milk production, and is retaining no profit. For further detail see Helmberger and Hoos [1962, pp. 281-290].

The impacts of farmer marketing cooperatives in various structural settings were further considered by Helmberger [1964]. He showed that the theory

of the firm, adapted to the peculiar nature of cooperatives, is a rich source of hypotheses on the performance impacts of cooperation. A few of the most important results merit brief mention. Consider an agricultural processing industry. If the structure of the industry tends to be atomistic both in the sale of final products and in the procurement of the farm raw material, with low barriers to entry and negligible product differentiation, then farmer processing cooperatives can be expected to have little effect on market performance. If, on the other hand, processors have monopsonistic power in procurement markets, say because of spatial considerations, the existence of efficient-sized cooperatives constitutes a powerful force which pushes performance toward the competitive extreme. The competitive outcome is even consistent with the existence of a single cooperative processor in a local procurement market. Many students of cooperation had reached a similar conclusion on informal grounds (Koller [1947]). A processing industry composed of a single monopolistic, monopsonistic firm and in which entry is blockaded is of interest as a limiting case. If the monopolist is motivated by profit maximization, the hypothetical results of output restriction, higher consumer prices, and depressed farm prices, all relative to competitive ideals, are well known. What happens if the single firm is a farmer cooperative? The welfare implications for this case depend on market circumstances and cooperative control over production. Helmberger [1964] emphasized the distinction between an open and closed membership cooperative, noting that control over membership may be a means for control over the level of production. If the average cost of marketing services is independent of (rises with) volume, cooperation with no production control leads to competitive equilibrium (output in excess of competitive equilibrium). Restricted membership may cause output to fall below the competitive output and the producer price to rise above the competitive price. The analysis of cooperatives with dominant market position has been strengthened by Eisenstat and Masson [1978] who considered the possibility of price discrimination with or without production control.

The theory of cooperative enterprise as articulated by Helmberger and Hoos [1962] was extended to include farmer supply and consumer cooperatives by Youde [1966] and Mather [1968], respectively. In their works long-run cooperative equilibrium is given by the intersection of the demand curve for member-buyers and the average cost function as derived in the customary way. Various structural situations were considered, and the resulting hypotheses are basically similar to those briefly sketched above for the farm output cooperative. A central hypothesis is that efficient cooperatives can be expected to increase competition in markets otherwise characterized by monopoly power.

Theory of cooperative enterprise as developed in the works cited above has focused for the most part on situations in which members supply (buy) a

single homogeneous input (product). Multiple product cases have also received some attention, but the theoretical issues involved cannot be adequately treated in short compass. A few brief comments will suffice. Many multiple product cases can be handled rather easily with existing conceptual apparatus. The case involving two inputs supplied by members and processed in separate plants is an example. Serious theoretical problems arise, however, if the two inputs are processed in the same plant and where "overhead" costs are substantial. Ian Hardie [1969] analyzed a situation in which the allocation of overhead among final products was assumed and in which supplies of several inputs supplied by members were given and fixed. A model was developed within a linear programming framework, and the allocation of cooperative surplus according to shadow prices of members' inputs was proposed. More particularly, the total returns to an input supplied by members was set equal to the quantity of that input times its shadow price. This proposal would seem to involve a substantial value judgment that the shadow price measures the value to the cooperative of an extra unit of the input. Total returns to an input thus computed could be extremely low, even though the "contribution" of that input to cooperative surplus is very large.

Although the theory of cooperative enterprise was developed several years ago, little attention has been given to the testing of the resulting hypotheses. Youde and Helmberger [1966] found some empirical support for the hypothesis that market power of a centralized cooperative can lead to restricted membership policies. Berry, Smith, and Rudd [1965] found some evidence that cooperatives charged lower prices and were "pace setters" in several Kentucky markets for fertilizers. Mather [1968] uncovered weak evidence that consumer cooperatives tend to lower prices of retail grocery products slightly. In spite of a rather extensive literature on operating cooperatives, little knowledge has been accumulated about their impacts on market performance.

In more recent years cooperative bargaining associations have captured the spotlight. The increased interest doubtless reflects the growth of vertical integration, the emergence of the National Farmers Organization, and the rather dramatic developments that have occurred in milk marketing. At the theoretical level, the bargaining problem has been a tough nut to crack; little progress has been made. Using conventional theory and assuming that bargaining associations cannot control production, Helmberger and Hoos [1965] showed how the potential range of bargaining outcomes can be delineated. Various strategic factors that likely affect the actual outcome within a range of outcomes were identified, and it was concluded that bargaining associations may be able to increase producer prices by disrupting the quasibargaining processes of oligopsonistic buyers. Where buyers are highly competitive in procurement,

with little excess profit accruing to them for that reason, potential price gains through bargaining were judged to be meager.

In a 1964 volume on agricultural bargaining, Ladd [1964] distinguished between Type I and Type II bargaining power. The first is the ability to make the bargaining opponent better off if one's offer is accepted. The second is the ability to make the opponent worse off if one's offer is rejected and if the opponent refuses to improve the counteroffer. Several factors were identified as being important determinants of bargaining power. Ladd and Hallberg [1965] considered various factors, such as mergers among handlers, thought to affect the bargaining power of dairy bargaining cooperatives.

A five-equation model of a bargaining cooperative that also sells a production input and that supplies members with a public-good type service was proposed by Ladd in 1974. Unfortunately the model appears to sweep many interesting bargaining problems under the rug. One of his behavioral equations states, for example, that the negotiated price for the raw material produced by members is a function of: (1) the total fixed supply of raw material available; (2) the proportion of this supply controlled by the cooperative; and (3) the level of "bargaining service" provided by the cooperative. How can the level of "bargaining service" be measured? If price is affected by the bargaining services of the cooperative, why should it not also be affected by the bargaining services of buyers? In the model, the number of members is essentially determined by the difference between prices received by members and prices received by nonmembers. The price received by nonmembers equals the negotiated price minus an important parameter that is beyond the control of the cooperative. How does the parameter get determined? Granted the five-equation model may be internally consistent from a strictly mathematical point of view, the basic problem seems to be that the behavioral equations are asserted rather than derived from assumptions about human motivations and endowments.

What impacts do cooperative bargaining associations have on market performance? A few associations claim substantial benefits accrue to members, but doubtless many of the claims are mere puffery. Moreover, although much has been written about the potential role of bargaining associations, little empirical research on actual outcomes has been completed. According to R. D. Knutson [1971, p. iii], "milk prices have been raised in the central United States largely by the efforts of farm regional producer cooperatives bargaining with milk processors. This bargaining experiment may be one of the first times cooperatives have succeeded in raising farm prices of a major agricultural product throughout a large area of the country." Cook [1970, p. 103] explained the role of the standby milk pool in the bargaining process. He concluded that "the cooperatives in high-priced markets, with little or no surplus, pay cooperatives in distant areas that have surpluses, to manufacture these supplies into

butter-powder and cheese where they are and to ship them in fluid form only when called for." Giving special consideration to legal aspects, Mueller [1974a] considered the role of full-supply milk contracts in the bargaining process. He concluded that such contracts may be powerful tools in the bargaining process but must be used with considerable discretion to avoid illegal restraints of trade.

The mystique surrounding the role of cooperative associations in the functioning of the nation's system of marketing orders, especially milk orders, has been dissipated largely by the work of Eisenstat, Masson, and Roddy [1975] and by other papers by Masson and associates (see Masson and Eisenstat [1978], Masson, Masson, and Harris [1978], Eisenstat and Masson [1978]). It appears that much of this work was initiated in response to *U.S. v. Associated Milk Producers, Inc.*, the antitrust suit brought by the Justice Department in 1972 and settled later through a consent decree. The theory and evidence presented in Eisenstat et al. [1975] paints a vivid picture of tactics that can be used by a milk bargaining cooperative in quest of market power. Drawing on the works of Jamison [1971], U.S. NCFM [1966e], and R. J. Smith [1961] and on their own further analysis, Masson and associates (see above) shed considerable light on the manner in which large farm marketing and bargaining associations might use marketing orders to raise producer prices at the expense of consumers.

In a study of cooperative bargaining in markets for fruit and vegetable canning crops, Helmberger and Hoos [1965] concluded that competition in procurement was keen largely because growers often have many crop alternatives. They found little evidence to support the view that cooperative bargaining in and of itself has increased grower returns. Helmberger and Hoos concluded that bargaining associations might play a useful role in developing contracts that better protect grower interests, that set up grievance procedures, and that play a modest but useful role of a trade association that collects and disseminates information. Breimyer [1971] also stressed the potential of bargaining associations in channels departing from open market systems and/or where contracts are extensively used in pricing. Babb, Belden, and Saathoff [1969] examined cooperative bargaining in tomato processing and concluded that processors were primarily concerned about quality factors and growers about price. Both processors and grower representatives underestimated supply-and-demand responses to higher prices.

Turning to future work on the role of farmer cooperatives in the U.S. economy, it should be clear from the above remarks that studies of the actual impacts of cooperatives on market performance are greatly needed. This is not to deny the importance of continuing work on the organizational and financial problems that cooperatives need to resolve if their effectiveness is to

be maintained or increased. Still much of the support that cooperatives receive from land grant institutions and various other public agencies seems to be predicated on the belief that cooperatives can be of substantial long-run aid to farmers and possibly even to consumers. The validity of this belief merits attention. The distribution of net benefits from farmer cooperation is of particular interest in regard to the issue of monopoly power.

Another important issue concerns the possible transformation of the traditional organization of farm production. When the Capper-Volstead Act and certain related pieces of legislation were passed, farm industries were atomistic; family farms were easily the dominant type of firm. The traditional form of organization appears to be withering, and as it does the rationale for much cooperative legislation will wither with it. The poultry industry is a case in point. An industry composed of a few relatively large corporations may not merit Capper-Volstead protection from antitrust laws regardless of the product that is produced. In our view the antitrust authorities are quite right in looking with suspicion at the National Broiler Marketing Association. (See *U.S. v. National Broiler Marketing Assn.*, 550 F. 2d 1380 [1977].) R. D. Knutson [1974, p. 19] may also be correct when he writes, "once agribusiness corporations come under the shelter of today's Capper-Volstead Act, it is only a matter of time until the act itself is either repealed or so severely restricted that its usefulness to family farmers is severely limited." The definition of agricultural producer appears to be a key issue.

### *Market Information*

The view is widely held that accurate, timely market information enhances market performance by improving the knowledge of buyers and sellers concerning supply, demand, and other factors affecting price. High quality market information also is said to foster competition which tends to eliminate high cost operations and inefficient firms (Williams and Stout [1964, p. 447]). In the United States, federal (especially USDA) and state agencies assume a major role in distributing agricultural market information. The distribution of market information to farmers by government agencies is frequently justified on the grounds that many farmers are too small to provide out of their own pockets the market news and statistics possessed by buyers of farm products and that without this information the farmer is at a competitive disadvantage in the markets (Kohls and Downey [1972], and Shepherd and Futrell [1969]).

Agricultural market information is of three basic types: (1) market news which firms use for short-run decisions such as when and where to sell agricultural products; (2) longer-term supply information (e.g., USDA crop and livestock forecasts); and (3) economic outlook information. The post-World War II literature that evaluates the adequacy of these three types of market



information will be considered in turn. Next, several general studies dealing with the overall adequacy of marketing statistics for agriculture will be examined. In the review, limited attention is given to studies dealing with the historical development of market information. Readers interested in the history of market information may wish to consult any of several marketing texts, other studies and review articles (USDA, AMS [1954], USDA, ARS [1952], USDA, SRS [1969], Upchurch [1977], Trelogan, Caudill, Huddleston Kibler, and Brooks [1977]). This review also does not cover many conceptual issues relating to the adequacy of the current agricultural data base for generating marketing and other types of agricultural statistics. Bonnen's review article [1977] should be consulted for a more complete discussion of these issues.

### Market News

Market news consists of current information on price, supply, and demand conditions which is used for short-run decisions such as when and where to sell products that are nearly ready for market (Kohls and Downey [1972]). Market news information is disseminated by the Federal Market News Service of USDA and by private organizations like the National Farmers Organization, American National Cattlemen's Association in *Cattle Fax*, in the Urner Barry egg and poultry product price quotations, and in the National Provisioner Yellow Sheet which is a compilation of privately collected wholesale meat market information. (See McCoy [1972, pp. 317-335] for a more complete description of private sources of market news.)

Studies relating to market news frequently include surveys to discover where farmers get market news, how they use this information, and how it might be improved. Farmers typically are found to have access to several different sources of short-term market news information (Dodds and Marvin [1954a, 1954b], and Gerald [1960]). Radio and, to a lesser extent, television are important sources of market news, especially for livestock producers (Bohlen and Beal [1967], Dodds and Marvin [1954a, 1954b], Guither [1970], and Purcell [1959]). Newspapers and information posted in local elevators assume considerable importance as sources of grain market news since radio coverage of prices at local grain markets is often inadequate. McCormick [1954] found that daily newspapers and information on bulletin boards were the dominant sources of grain market information for Ohio producers surveyed in 1950.

Findings relating to how farmers use market news for decision making and the decision processes of farmers appear in numerous studies. Bohlen and Beal [1967] and Dodds and Marvin [1954a, 1954b], for example, reported that livestock producers believed that radio market news was most helpful for

selecting selling weight and time of sale. Telephone calls to livestock buyers, on the other hand, were the greatest help in deciding on the buyer. Kohls and Gifford [1957, p. 68] found that nearly one-half of the the Indiana hog producers surveyed obtained price information from only one market prior to sale. Dodds and Marvin [1954a, 1954b] reported a nearly identical finding for Iowa hog producers surveyed. P. L. Farris [1956, p. 18] found that most Indiana poultry and egg producers probably did not shop around, though pay prices differed. Kohls and Gifford [1957] concluded that producers are more interested in trying to time the sale properly than in ascertaining the relative advantage of different points of sale. Gerald [1960, p. 4] found that Michigan producers surveyed used market news more for after-sale evaluation of the price received than for deciding when or where to sell. J. C. Purcell [1959, p. 19] discovered that 40 percent of the Georgia producers surveyed sold livestock because the feed supply was exhausted or cash was needed for expenses, whereas 54 percent sold when they thought the market right or the livestock ready for market. An annotated bibliography by Kroupa, Burnett, and Johnson [1976] contains additional references on the use of market news and other types of market information for decision making.

In general, findings on the use of market news for decision making support a hypothesis that farmers fail to use some market information which is readily available to them and that factors other than purely economic considerations often dictate choice of markets.

Advanced in various studies were the following suggestions for increasing the value to users of market news information distributed by government agencies: (1) market news for local (nonterminal) markets should be increased (McCormick [1954], USDA, AMS [1954]); (2) reports of futures prices should be increased in areas where large-scale cash grain and livestock farms are becoming more important (Kroupa and Walker [1974]); (3) radio and television market news broadcasters should be better informed about agricultural markets to improve listener interest and comprehension; (4) written market news reports should be presented in an interesting and simple style to increase readership (USDA, AMS [1954]); (5) market news price reports should be given for the full range of product grades normally marketed, not just for the top grade; (6) ways should be found to increase farmers' knowledge of terms used in mass-media market reports; (7) outlook information could be included with market news to provide a comprehensive market information program; and (8) more market news could be provided for consumers.

Private market news services, especially the *National Provisioner* "Yellow Sheet," have received increased scrutiny recently. Cothorn [1978, p. 54] argued that the "Yellow Sheet," which is the dominant report for transmitting

wholesale beef price information throughout the United States, cannot accurately reflect the prices for the beef traded in the country for the following reasons: (1) A small sample of the quantity of beef sold is arbitrarily selected as the basis for determining "Yellow Sheet" beef prices, (2) prices for the "Yellow Sheet" are not weighted by quantity of beef sold, (3) closing quotations are used to determine "Yellow Sheet" prices, so that a heavy unknown bias may be given to the last trade of the day, (4) since only "verified" trades are used for collecting "Yellow Sheet" beef prices, the opportunity for collusion exists, and (5) the "Yellow Sheet" prices can be influenced by the four major packer-buyers who now dominate the Midwest. Breimyer related that "basing the price for the whole livestock and meat economy on [the "Yellow Sheet"] . . . which in turn rests on an ever thinner volume of trading, is so flimsy, so insubstantial, that it cannot be regarded as satisfactory" [1978, p. 30]. Schrader [1978] and Newsom [1978] described how some Urner Barry egg price quotations have been obtained from thin, and in some cases, potentially unrepresentative markets. There was no clear consensus in the literature regarding how to remedy the problems identified by the four authors, although there were suggestions for further study of the problems and greater involvement of the Federal-State Market News Service in collecting and distributing beef and egg market news information.

A few studies of market news contain prescriptions for improving market performance. Burnett and Clodius [1959], for example, found in a 1959 study that the degree of market knowledge possessed by northwestern Wisconsin milk processors was generally complete and accurate, whereas the opposite was true of the farmers shipping milk to them. There was widespread uncertainty among farmers about base prices, hauling rates, premiums, and accuracy of butterfat tests performed by different firms. Mass media serving the area also expressed little interest in collecting and disseminating detailed local price information, since they assumed that farmers were relatively well informed. Moreover, keeping farmers confused about price was seen to be a consistent strategy of firms that wanted price deemphasized as a competitive variable and nonprice variables emphasized. This situation produced a heavy network of overlapping procurement routes whereby a processor would not necessarily succeed in buying the milk of nearby farmers even if this processor paid a higher net price than competitors. Burnett and Clodius suggested that this was an obvious case in which more market information would improve the performance of the market.

Leuthold's [1970] econometric study traced daily hog price information flows among eight midwestern terminal hog markets. His analysis indicated that hog price information flows from east to west during the day. That is, western markets (e.g., Sioux City, St. Paul, Omaha, and Kansas City) set

prices partly on the basis of prices established in early morning at the eastern markets (e.g., Indianapolis). There is also the possibility, Leuthold reported, that prices established in the western markets are used as guides for setting prices in the eastern markets on the following day.

Leuthold found that the short-run daily price elasticity of supply for hogs was high (approximately 8.6). He concluded that in this market environment, which has the potential to produce volatile changes in marketings and prices, improved market news information would produce more stable and efficient hog marketing patterns.

Purcell [1969a, 1969b] analyzed communication as a process whereby a message is developed by a source and transmitted along a channel to a receiver. In the system, feedback loops typically extend from the receiver back to the source, providing the basic mechanism for adjustment. When the system was employed to analyze the beef market news system, the following prescriptions for improving market performance were produced: (1) relatively more concern should be shown for the value of a message as compared with the extent of its distribution; and (2) possibilities for feedback from users of market news should be more fully exploited.

### Crop and Livestock Forecasts

Farmers and processors use crop and livestock supply estimates for a broad range of production, marketing, and storage decisions. The figures also serve as a primary input for developing economic outlook information. Unlike market news which is mainly related to very short-run decision situations, the estimates typically provide information on longer-term, more enduring, supply conditions.

USDA, which began issuing crop and livestock figures in 1862 (Koffsky [1962]), is the major supplier of agricultural estimates. Crop and livestock estimates issued by USDA are developed by the Crop Reporting Board of the Economics, Statistics and Cooperatives Service, in conjunction with forty-four federal-state agricultural statistician offices. This network of offices of federal and state Departments of Agriculture provides a continuous flow of basic state-by-state statistics on crop acreages, yields and conditions, livestock inventories and marketings, crop and livestock prices, crop and livestock production, and marketing intentions. Typically there is a regular cycle for release of crop and livestock reports. For crops, the cycle begins each year with reports on intentions to plant, followed by crop acreage planted and yield forecasts during the growing season, and ending with information on harvested acres, production and final utilization of the crop (Trelogan [1963]). The cycle of estimates for livestock varies by commodity, but in general the figures can be used to monitor the status of production. For example, hog production

and marketing figures issued by USDA include farrowing intentions reports, reports of actual farrowings, hog inventories by weight groups, and initial and revised estimates of hog marketings. USDA issues its crop and livestock estimates in more than 700 reports each year (Trelogan [1963, p. 1500]).

Studies relating to crop and livestock estimates fall mainly into three classes: (1) empirical studies that measure the accuracy of government statistics and that examine the costs and benefits associated with increasing the accuracy of these statistics; (2) reports by information producers and information users describing the adequacy of existing crop and livestock series; and (3) a study (Free [1963]) that lists sources of supply information available to farmers and to marketing and processing firms. Only studies in the first two categories are discussed here.

#### EMPIRICAL ANALYSES

Hayami and Peterson [1972] examined whether it was socially beneficial for USDA to seek greater statistical accuracy in crop forecasting. In their investigation they used an inventory adjustment model, cost figures supplied by USDA on costs for sample surveys with varying sampling error levels, and other required data. They found that an extra dollar spent to increase the accuracy of statistical reporting would result in benefits ranging from \$20 to \$100. The authors therefore concluded that money invested in statistical reporting would produce social returns comparable to that for other high payoff investments such as agricultural research on hybrid corn.

Perhaps high payoffs would accompany larger expenditures for improving the accuracy of commodity production forecasts. However, this is uncertain since there is an additional factor relating to accuracy of crop forecasts which was neglected by Hayami and Peterson. Errors in crop forecasts result not only from sampling errors but also from changes in growing conditions after the crop surveys are taken. For example, USDA makes surveys to determine acreage and yield of crops at particular times in the growing season (e.g., August 1). A crop forecast is then developed assuming that weather and other growing conditions will be normal until harvest time. If the weather is abnormal after the survey is taken, the crop forecast may be inaccurate even if the survey data were completely accurate when collected. The Hayami-Peterson study leaves the reader uninformed about how much of the error in crop forecasts results from sampling error and how much of it results from abnormal conditions that occur after the sampling date. The reader also is left to ponder the extent to which crop forecasts might be improved by more accurate sampling and the extent to which improvement would be obtained from developing usable long-range weather forecasts which would permit adjustments to account for expected changes in conditions after the crop survey. Investigations

to consider questions that remain unanswered in the Hayami-Peterson study would appear to provide useful additions to the literature on the costs of and benefits from improving crop forecasts.

Other empirical studies focused primarily on examining the accuracy of USDA and other governmental crop forecasts. The most extensive of these studies, conducted by Gunnelson, Dobson, and Pamperin [1972] examined the accuracy of more than 1,100 USDA crop production forecasts for barley, corn, oats, potatoes, soybeans, spring wheat, and winter wheat for the period 1929-70. The study generally lauded the accuracy of the USDA forecasts, but a few persistent inaccuracies were found. Specifically, USDA tends to: (1) underestimate crop size; (2) underestimate the size of changes in production from year-earlier levels, especially when the changes are large; and (3) undercompensate for errors in previous forecasts when developing revised production forecasts.

Clough's [1951] research suggests that USDA's early indicators of corn production are fairly good predictors of corn crop size. He found, for example, that for 1929-50, more than 80 percent of the variation in corn *acreage* was accounted for by the March 1 planting intentions figures. However, during the same period, only about 60 percent of the variation in corn *production* was accounted for by July 1 indications of production. This means that 40 percent of the variation in corn production is accounted for by developments occurring after July 1. Thus decisions based on July 1 indications must allow for this substantial source of uncertainty.

A number of other empirical studies examined the accuracy of USDA crop and livestock forecasts. Generally, the studies revealed no serious inadequacies in the series studied. Lowenstein [1954], for example, found that early season forecasts of the cotton crop during 1915-52 were reasonably accurate indicators of final ginnings. Ferris [1962] and Dobson, Hughes, and Pamperin [1972] discovered that USDA farrowing intentions reports were moderately accurate indicators of hog farrowings.

Dietrich and Gutierrez [1973] examined the accuracy of cocoa and coffee production forecasts issued by several private and governmental agencies including FAS. Their chief findings were that: (1) FAS cocoa and coffee production forecasts were relatively accurate; and (2) production reports for Africa tended to be biased downward. It was suggested that the latter point reflected the tendency of African producers to underreport crop size with price considerations in mind.

#### CRITICAL EVALUATIONS OF CROP AND LIVESTOCK STATISTICS

This group of studies describes problems users have had with agricultural statistics issued by the USDA and the Census Bureau (Hurley [1957], B. W.

Kelly [1963], Simpson [1966], Wells [1958]), and reports suggestions for improving USDA crop and livestock statistical series. Users of the statistics recommended that USDA seek to: (1) employ weather data to improve crop forecasts; (2) provide additional information for specified commodities; (3) disseminate more information for county and smaller geographic units; and (4) undertake measures to make its statistics more accessible and usable.

When USDA forecasts crop size, it, as indicated earlier, makes the simplifying assumption that weather will be normal from the time of the forecast until harvest time. Morgan's research [1961] suggests that this assumption can lead to erroneous crop yield forecasts. Morgan found that for early season crop forecasts, precipitation after the forecast date accounted for the major portion of the variance in final yields per acre. In a related article, Bean [1966] argued that the notion that weather and weather-affected crop yields resemble unpredictable random numbers needs further empirical test. Tefertiller and Hildreth [1961] suggested that improved forecasting and managerial decisions would be possible if valid tests to detect bunchiness (two or three years of higher- or lower-than-normal rainfall in a row) in weather patterns could be found. It seems clear that reliable long-range weather forecasts would provide the basis for improving the accuracy of crop forecasts. However, none of the studies suggests that these forecasts will be forthcoming soon.

Kutish [1955], Ferris [1962], Ives [1957], and Luby [1957] critically evaluated the usefulness of certain USDA statistical series. Their observations and recommendations were that USDA cattle marketing intentions figures should be made more accurate or eliminated, a more precise definition of fed cattle marketings and more accurate figures on fed cattle slaughter are needed, priority should be given to improving the accuracy of USDA pig crop report data, cattle and hog slaughter figures should be segregated by sex to permit more accurate forecasting of changes in the size of the cattle and swine breeding herds, and a measure of quality of feed grains as well as quantity is needed.

Several authors (Bottum and Ackerman [1958], Butz [1966] and USDA, AMS [1954]) called for issuance of more USDA statistics for county and local units, especially statistics for specialty crops (forestry crops, fruits, vegetables, and poultry). These figures, it was said, were needed for county extension marketing programs, agribusiness plant location studies (D. D. Brown [1955]), and for solving the specialized storage, transportation, and marketing problems of the producer of specialized crops and livestock products (Wilcox [1956]). Gillett and Bond [1948] called for publication of a bibliography of statistical reports which would describe statistical information available. Participants in major USDA-sponsored market information workshops (Shoemaker [1962], USDA, ARS [1952], USDA, AMS [1954]) held

in 1952 and 1954 recommended establishment of an independent agency to evaluate the work of the (then) Statistical Reporting Service (SRS) and that USDA attempt to improve the readability of its reports which participants described as being unsightly and difficult to read. Thompson [1963] suggested that USDA should adopt multiple frame sampling techniques.

USDA has responded in a positive way to a number of the suggestions. For example, the agency adopted multiple frame sampling techniques, expanded coverage of the pig crop report to record quarterly data on production in fourteen major hog-producing states, made available bibliographies of statistical publications, and improved readability of USDA reports through techniques like using popular summaries of crop and livestock reports. However, it also seems clear that USDA needs to consider whether it has given adequate attention to the following questions: Can long-range weather forecast information be integrated into development of crop forecasts? Is it feasible to incorporate information on crop quality as well as crop quantity into its reports? Can cattle statistics be improved? The frequency with which cattle statistics are criticized, and the fact that a private source of cattle statistics (*Cattle Fax* distributed by the American National Cattlemen's Association) which parallels some USDA cattle statistics has emerged, suggests that the last question in particular merits attention.

#### Economic Outlook Information

Economic outlook information is information relating to future price and supply and demand conditions. It is used by farmers, marketing firms, and governmental agencies to make planning decisions. Major suppliers of economic outlook information to agriculture include USDA, land grant universities, and, to an increasing extent, private firms. USDA's outlook program is based upon its agricultural supply estimates and its regular demand and price forecasts. The core of USDA's program is a series of some ninety situation reports (Koffsky [1962]). USDA and land grant universities have a long history of cooperation in outlook work (e.g., joint participation in meetings with industry groups, joint sponsorship of conferences and workshops), which dates back to the first Agricultural Outlook Conference held in Washington, D.C. in 1923. Private firms serve audiences whose needs are apparently not adequately met by government and university outlook information sources; a number of private outlook reports provide specialized interpretations and forecasts for particular commodities and advice on commodity futures trading (Dobson, Hughes, and Pamperin [1972]). But, in numerous cases, the private suppliers merely capitalize on their ability to distribute timely, popularized interpretations of government reports.



## EVALUATION OF ECONOMIC OUTLOOK WORK

Performance of agricultural outlook information-generating systems has been under intermittent scrutiny since World War II. However, interest in improving economic outlook work increased during the volatile and uncertain economic period that began in 1972-73.

Fox's evaluation [1973] of government (primarily ERS) price forecasting work in 1973 represents one of the more comprehensive studies of the effectiveness of outlook programs. Fox indicated that government price forecasters made some large price forecasting errors in the 1972-73 period. ERS wheat, corn, and soybean price forecasts erred by amounts ranging from 50 to 60 percent in 1972-73 [p. 11]. He found that conditions unique to the 1972-73 period (opening of trade with the People's Republic of China and USSR, successive devaluations of the dollar, synchronization of business cycle upswings in most developed countries, and an unusual pattern of droughts) explained part of the poor price-forecasting performance. But Fox also identified fundamental deficiencies which he summarized as follows: "the economic intelligence system is operating far below the level permitted by the state of the arts. . . ." [p. 5]. Moreover, he said, "the whole federal establishment is ill-prepared in terms of data, models, and analytical procedures and patterns of interagency communication for the tasks of forecasting and policy formation in the 'open' economy of 1973" [p. 3]. To remedy some of these deficiencies, Fox called for the economic intelligence function to be given sharply increased status in the organizational structure of government and in the concern of the secretary of agriculture in particular.

Other post-World War II studies that evaluated the efficiency of the economic intelligence system for agriculture covered a broad spectrum of topics including: accuracy of USDA and land grant university outlook (Baker and Paarlberg [1952], Daly [1966], Ferris [1962], Heer [1954], and Norton and McCoy [1960]); quasitechnical forecasting problems (Futrell [1971]); sources of outlook information (Eisgruber [1973], Ross [1959]); ways to distribute outlook information more effectively (Shoemaker [1962]); and neglected areas of economic outlook activity (Dietrich and Gutierrez [1973], Ferris [1971], Sundquist [1971], and Timm [1966]).

Those who examined the accuracy of USDA and land grant university forecasts found that it was difficult to appraise adequately the accuracy of an economic outlook analyst's performance by any comparison of the analyst's forecasts with actual figures. This was because many forecasts were conditional forecasts, and it was difficult to determine how much economic conditions changed from those specified by the forecaster as needing to exist in order for the forecast to hold. Also, economic forecasts were often expressed

as ranges, or in nonprecise qualitative terms, making it difficult to compare forecasts with actual figures. However, it was found that selected economic forecasts issued by USDA, Iowa State University, and Kansas State University were substantially more accurate than forecasts that would be produced by chance or by use of naive models.

A few studies (Gillett and Bond [1948]) that describe quasitechnical forecasting problems contain findings that are potentially useful for improving forecasts. For example, it was found that: (1) naming of major turning points is a particularly difficult part of forecasting. Baker and Paarlberg [1952, p. 516] found that USDA's record for naming turning points in industrial production, demand, and price received by farmers was only about as good as would have been produced by chance; (2) USDA's forecasts of wheat prices and prices received by farmers were more accurate in years when demand was forecast accurately; (3) production forecasts tend to be more accurate than price forecasts; and (4) accuracy of price forecasting tends to be lowest when unusually large changes in supply occur, when supply levels change from abnormally large or small base levels, and when demand conditions are extremely buoyant or depressed.

Few studies have examined where farmers and marketing firms get outlook information, how they use it, and how it may be distributed to users more effectively. However, Eisgruber [1973] and Ross [1959] reported that farm magazines represent the primary source of economic outlook information for farmers. Ross, whose study involved a survey of fifty Illinois hog producers, also found that hog raisers made little use of economic outlook information in planning their future swine enterprises. Shoemaker [1962] and others suggested that the key to getting outlook information to users effectively is to issue timely, frequent (weekly or monthly) outlook reports. Shoemaker implied that media of distribution may not be a crucial determinant of success, since outlook information has been effectively distributed by radio, TV, letters, and written economic reports.

Studies that identified neglected areas suggested that outlook analysts needed to supply: (1) additional long-term outlook information (Bottum [1966], Butz [1966]); (2) forecasts of fertilizer and petroleum prices, more information on expected demand conditions; (3) price-location differentials for converting terminal market forecasts into local market equivalent prices; (4) price forecasts that can be used directly in computerized micro-decision models; (5) information on expected prices under formula pricing systems and contractual arrangements; and (6) price forecasts with associated probability distributions, i.e., procedures similar to those used by the weather bureau for making forecasts should be adopted. The most frequently mentioned need was for more long-term outlook information which could be

used by farmers and marketing firms for long-term capital investment decisions.

### Studies of the Overall Adequacy of Market Statistics for Agriculture

The AAEA Committee on Economic Statistics [1972], U.S. National Commission on Food Marketing [1966a], Carter [1970], Cochrane [1966], Sundquist [1971], and Simpson [1966] examined the overall adequacy of economic statistics for agriculture. Emphasis here focuses on their observations that relate directly to the adequacy of agricultural market statistics.

The AAEA Committee on Economic Statistics [1972] argued that the theoretical concepts around which our data systems were constructed are becoming obsolete. The committee contended that the farm can no longer be used as the basic observational unit for collection of some agricultural price data. As a partial remedy for this problem, the NCFM suggested that USDA should explore means of reporting forward prices, contract terms, and other potential successors to ordinary spot market prices (U.S. NCFM [1966a, p. 112]).

Cochrane [1966] suggested that factory-type agriculture may spread to hogs and perhaps dairying within the next few decades. He argued that our statistical data on the changing structure of livestock production and business organization in the processing and distribution of animal products, which could be used for monitoring this type of change, are incomplete, out-of-date, and often irrelevant. As a result, he said, we simply do not know what is happening in the organization of livestock production until long after it happens.

Simpson [1966, p. 1680] reported that on large farms where questionnaire traffic is increasing sharply, the operators are showing resistance to completing questionnaires. Sundquist [1970, p. 319] reported that difficulties have been encountered in getting voluntary response from large firms in the food and fiber industry on organizational and structural questions. Raup [1959] offered an explanation for the phenomenon reported by Simpson and Sundquist. He contended that "as firms become fewer, larger and more integrated, data on intentions to produce or market assume the status of trade secrets. At some point in the process of integration there emerges a powerful incentive to withhold data, or to distort it in reporting" [p. 1490]. The U.S. NCFM [1966a] concluded that new approaches, especially mandatory reporting, should be tried for collecting needed market information from larger firms.

Carter [1970], Cochrane [1966], and the AAEA Statistics Committee [1972] reported that Census of Agriculture data that are potentially useful for appraising change in market structure and organization are of limited value because they are obsolete by the time they are released. There is a

three- to four-year lag between collection and release of some Agricultural Census data. The AAEA Committee correctly pointed out that this is simply the result of the low priority being given to the Census of Agriculture data since the U.S. Bureau of the Census "is a perfectly competent organization with the greatest computer and data processing capacity in government" [p. 873].

The remedies suggested or implied for dealing with some weaknesses of agricultural market statistics (e.g., increased reporting of the price series that have replaced ordinary spot market prices, mandatory reporting, seeking a higher priority for early release of Agricultural Census figures) may be feasible. However, the problems identified by Cochrane and the AAEA Committee on Economic Statistics relating to the obsolescence of data systems may be difficult and expensive to remedy. If the system is obsolete, minor tinkering with the marketing and other statistical series may no longer suffice. What will be needed is a new conceptual framework for industry statistics and a means of getting data systems built around these concepts (Lee [1972, p. 1877]). Moreover, this work might be unproductive until additional empirical research on industry structure and economic and social interrelationships is completed. It may be difficult to complete such a major overhaul of the system since statistics developed to date have been developed incrementally and since there appears to be neither the inclination nor the commitment of resources required to carry out this type of effort.

#### Appraisal of Market Information Studies

The market information studies identified strengths and weaknesses in market news, longer-term supply forecasting, and economic outlook programs. USDA has adopted a number of changes suggested in the studies. Unfortunately, it is impossible to determine how much the studies contributed to bringing about these changes. Perhaps one area warrants more attention than it has received; it appears to us that more work is needed on systematically evaluating the accuracy and value of economic outlook information issued by land-grant university and USDA personnel.<sup>18</sup> Perhaps periodic audits of the type conducted by Fox [1973] on government forecasting might be useful for carrying out this evaluation.

#### *Grades and Standards*

Grading is the classification of products into categories established by standards of quality (Kohls and Downey [1972, p. 264]). Government agencies typically establish grading programs to make markets function more efficiently, to remove uncertainties inherent in exchange, and generally to make markets operate in a manner similar to the classical competitive model

(Breimyer [1963]). However, as will be evident, grades also have been used as a basis for product differentiation, as a merchandising symbol for product promotion, and for elevating incomes of one producer group at the expense of others (Rhodes [1960a], Williams, Bowen, and Genovese [1959]).

### Overview of Grades and Standards Literature

The post-World War II marketing literature on grades and standards contains few theoretical works. Most of the work is applied research relating to improving pricing and operational efficiency. The pricing efficiency research focuses heavily on studies relating to the effectiveness of grades for increasing price competition and those measuring the efficiency with which grading schemes help transmit price signals from consumer to producer. The operational efficiency work, appearing mainly in several marketing texts, includes material on use of grades to: (1) increase selling by description; (2) eliminate time and expense associated with arguments regarding quality; (3) increase specialization; and (4) reduce the expense associated with competitive brand advertising. In this review, the following topics are considered in turn: theoretical and conceptual articles on grading, livestock pricing efficiency studies relating to grading, studies of the effect of grading on industry structure and market power in the livestock-meat industry, consumer preference studies relating to grading, and miscellaneous grading studies.

### Theoretical and Conceptual Studies Relating to Grading

Clifton and Shepherd [1953] and Williams and Stout [1964] described the theoretical gains obtainable from grading through use of indifference or substitution models. Their analyses showed how introduction of grading helps consumers to make known their preferences for different qualities of a product in the form of price differentials, helps the marketing system to reflect the appropriate price ratios for different qualities of products, permits producers to allocate resources in a fashion that is consistent with consumer preferences, and increases social gains.

Freebairn [1967] and Williams and Stout [1964] suggested that introduction of grading often increases the value of the product to potential buyers and the demand for the product. Moreover, if, as a result of introduction of grading, the aggregate demand function shifts to the right throughout its entire length, consumer surplus normally will increase. Such a gain in consumer surplus can be regarded as a gain in consumer welfare.

Rhodes and Kiehl [1956] used indifference and transformation maps to show conditions that justify consumer grading, to define consumer grade boundaries, and to specify when quality ordering (designation of grade names such as Best, Better, and Good) of consumer grades is warranted. They concluded,

first, that a requirement for grading is that the consumer be unwilling to exchange some units of a product for other units at an equal substitution rate. Second, as a first approximation, there should be as many grades as organoleptically discernible types of product. However, grade boundaries can be wide enough to include some organoleptic heterogeneity if the included units remain homogeneous in value to consumers. Quality ordering names like Best, Better, Good may be justified when all consumers have identical preferences. However, the superiority or inferiority of a grade is related to its use by the consumer. Therefore, the assumption that all consumers' preferences are identical is a necessary but not a sufficient condition for justification of rank-ordered names.

Zusman [1967] developed a mathematical procedure for determining the optimal number of grades and optimal grade boundaries. In his analysis, products with different quality characteristics were regarded as different products. The theory involved specifying individual quality valuation functions (IQVF) and a market quality valuation function (MQVF). Profit maximizing grade boundaries for an individual seller in a competitive market were defined as the points of intersection of IQVF's on the MQVF. Zusman suggested that market experiments might be conducted to obtain the information needed to estimate the MQVF's needed for determining optimal grading and sorting schemes. To date, no empirical work of this type has apparently been carried out.

#### OPERATIONAL NORMS

Marketing economists have developed "optimal" specifications for grading systems which reflect a few of the considerations discussed in the theoretical and conceptual works. However, for the most part, they appear to reflect what is needed for a workable grading system. The set of norms described below is a composite of the norms specified by Kohls and Downey [1972], Williams and Stout [1964], and Wills [1972].

1. Overall, optimal grade standards should enable consumers to tell producers what they (consumers) consider desirable in a product for the use that they intend to make of it.

2. The grading system should help maximize the economic gains from grading. Among other things, this means that a basis and need for grading must exist. These conditions will be met if: (a) distinct or potentially separable demand functions, based on real rather than illusory differences in the product, exist; and (b) in the absence of grades, consumers, marketing firms, or both cannot readily and accurately distinguish among significantly large differences in basic quality attributes or differences in combinations of these attributes.

3. The standards separate units of the commodity into groups such that

for each grade the within-grade variation in quality attributes relative to the variation between that grade and each of the two possible adjacent grades has been minimized. The standards also should maximize differences among grades in the range of quality attributes, which means that overlapping has been reduced to a minimum.

4. Standards should be built on factors and terminology that will make the grades meaningful to as many users of the product as possible. Ideally, the same grade terminology would be used at all levels of the marketing channel from the consumer to the producer.

5. Standards should be built on factors that can be accurately and uniformly measured and interpreted.

6. The grading system must be: (a) simple, easily, widely, and uniformly understood; (b) fixed and unchanging in a short-term sense and, at the same time, subject to change as warranted by longer-term considerations; and (c) acceptable to various marketing agencies.

7. The cost of operating the grading system must be reasonable. Absolute uniformity at any price is not a feasible goal.

Tomek and Robinson [1972, p. 134] suggested that grades might be defined on the basis of relative income elasticities since income elasticities are thought to be highest for the best or preferred product categories and smaller for lower quality product categories. This idea apparently assumes that grades can be associated with strata of consumer demand. However, as Tomek and Robinson pointed out, little knowledge exists about quality differences and income elasticities. Moreover, a complication arises because, for many agricultural products, use of grades is confined to the wholesale level and grade identification is not visible at retail. When grade identification is absent at retail, it would be difficult to develop the income elasticities associated with the different grades and consumer demand strata. Therefore, it appears that there are practical difficulties associated with employing income elasticities to define product grades, but they could be taken into account in some grade definition work.

#### APPRAISAL OF THEORETICAL AND CONCEPTUAL STUDIES<sup>19</sup>

There are few theoretical works on grading. Moreover, relatively little use appears to have been made of the existing studies for defining operational grading norms. There is perhaps reason for pessimism about prospects for improved theoretical work on grading because of problems created by the multiple goals of users of grades (Williams [1961]) and complications related to the dynamics of actual markets (Mehren [1961]). However, in view of the apparent dearth of useful theoretical guides for defining optimal grade specifications, additional theoretical work might carry a high payoff.

## Empirical Research on Grades and Standards

Much of the post-World War II empirical research on grades and standards is related to three areas: increasing pricing efficiency in the livestock-meat industry, evaluating the effects of grades on industry structure and market power in the livestock-meat industry, and consumer preference research on meat.

### PRICING EFFICIENCY STUDIES OF THE LIVESTOCK-MEAT INDUSTRY

The pricing efficiency research focused principally on measuring how much pricing efficiency might be improved by adopting a carcass grade and weight marketing system for livestock. Much early research in this area was carried out as a North Central Regional Livestock Marketing Research effort (Clifton [1954]) involving personnel from thirteen state experiment stations, USDA, and the packing industry. Specific pricing efficiency questions considered in this research were: (1) How accurately does the present (live) method of livestock marketing in the United States transmit to the producer the different values obtained by the packer or wholesaler for different animals? (2) What objective physical measures of livestock carcass values might be used for developing livestock grade standards? (3) To what extent would the carcass or other basis of sale more accurately reflect value differences to producers? Research in these three areas began in about 1947 and continued into the 1970s. The early studies apparently were partly motivated by a desire to see how well a carcass grade and weight marketing system similar to that adopted for hogs by the Canadian government in 1940 would work in the United States.

*Accuracy of Transmission of Price Information to Producers.* When buyers price livestock on a live basis they estimate carcass yield and evaluate live grade as an indicator of carcass grade. Several studies evaluated the ability of buyers to estimate the value of livestock purchased on a live basis. Typically, this involved comparing buyer estimates of carcass grade and yield to actual carcass grade and yield obtained after slaughter of the animals.

A North Central Regional Research Committee study (Clifton [1954]) indicated that substantial livestock pricing errors occur as a result of errors made by buyers in estimating grade and yield from the live animals. In an NCR experiment conducted in Minnesota and Kansas, two cattle buyers erred by an average of 0.38 grade and 1.9 yield percentage points when estimating from the animals the carcass grade and yield of steers and heifers. Veal calf buyers in the Wisconsin NCR experiment erred by 0.48 grade and 2.8 yield percentage points when estimating the carcass grade and yield of calves purchased on a live basis. (See Williams and Stout [1964, pp. 683-699] for a summary of additional findings of the North Central Regional Research Group on pricing error.)

error  
high  
low?



Jebe and Clifton [1956] also measured how accurately buyers estimated carcass grade and yield of cattle purchased on a live basis. The buyers in this study generally overestimated the grade and yield of cattle grading above average and underestimated the grade and yield of those grading below average. McPherson and Dixon [1966] in 1966 examined the ability of seven individuals to grade cattle in an experiment involving grading of live beef cattle. Individuals in the study made absolute grading errors ranging from 0.3 grade to 0.6 grade. It was found that for lots of 100 head or more, errors made by graders tended to offset one another. But for small lots, it was found that the grading error could be sufficient to cause producers to be substantially over or underpaid for their cattle.

Naive, Cox, and Wiley [1957] examined the abilities of twenty-three hog buyers to estimate hog grade and yield from the appearance of live hogs in a 1957 study. They found a wide range of abilities in the buyer group. Also, among the buyers, ability to judge yield accurately was not closely correlated with ability to predict grade accurately.

The studies provide potentially useful information about the accuracy with which price information is transmitted to producers under the present live system of marketing. However, a few analysts may be criticized for attempting to generalize too much from their experiments. For example, some analysts found that in large lots of cattle over and underestimation of grade and yield occurred with about equal frequency when livestock were purchased on a live basis. This finding led them to conclude that for all slaughterers combined, or even for a given large slaughterer, about the same amount of money probably is paid for livestock purchased under the liveweight method as under the carcass grade and weight method (Dowell and Engelman [1949], McPherson and Dixon [1966]). It seems slightly heroic to draw such conclusions from studies that measured the grading ability of one or a few graders under experimental conditions that may not have closely approximated those under which livestock were normally graded.

*Objective Measures of Livestock Carcass Values.* Researchers who sought objective measures of carcass values typically looked for physical measures with a functional relationship to the quality of meat cuts or to the carcass grade. As an initial step, Engleman, Dowell, Ferrin, and Anderson [1950] developed an "index of lean" (pounds of high-valued lean cuts and trimmings expressed as a percentage of carcass weight) for measuring value of the cuts in a hog carcass. They found that backfat thickness and carcass length were the physical measures that best explained variation in the index of lean. They then developed several proposed objective hog carcass grade standards that took into account backfat thickness and carcass weight.

Brough and Shepherd [1955] developed objective grade specifications for hog carcasses that considered carcass weight, body length, and backfat thickness. The authors arranged to have 600 hog carcasses graded according to the specifications developed. The value of cuts in these carcasses subsequently was determined. It was found that the variances of the meat values within each grade were only about one-third as great as the variance between grades.

Clifton and Shepherd [1953] tested the hypothesis that certain physical measurements of slaughter steer carcasses are sufficiently correlated with grade that they can be used to determine grade. Thickness of fat over the eye muscle, carcass length, and carcass weight were found to rank first, second, and third, respectively, in closeness of relationship to carcass grade. These variables were used to develop tentative objective grade specifications for slaughter steer carcasses. About 90 percent of the carcasses graded according to the proposed grade standard were placed in the same U.S. official carcass beef grade chosen by government graders.

For objective pricing of hog carcasses, Ikerd and Cramer [1970] developed a simplified computer model that prices slaughter hogs on the basis of three prices: (1) a base price that is the estimated value per hundredweight of a carcass with mean backfat and carcass weight characteristics; (2) a price differential per tenth of an inch of backfat thickness; and (3) a differential per pound of carcass weight. This device bases payment on objective measurements rather than a mixture of objective measurement and subjective grade factors.

*Improved Pricing Accuracy from Sale on Basis of Carcass Grade and Weight.* Typically, researchers who examined livestock pricing accuracy tested hypotheses that pricing accuracy improves as pricing reflects meat values nearer the consumer level. According to these hypotheses, the most accurate pricing plan would pay producers according to the retail value of the meat from their livestock. The second most accurate method would pay producers on the basis of the value of wholesale or primal cuts of meat obtained from their livestock. Third in accuracy would be sale on the basis of carcass grade and yield. Most research focused on comparing pricing accuracy of live marketing with carcass grade and yield marketing since the latter method is typically regarded as the most accurate, practical pricing method for livestock. Other methods require that the identity and source of each meat cut be maintained through the wholesale or wholesale and retail market channels.

Engelman, Dowell, and Olson [1953] compared several methods of pricing hogs and found that a system based on backfat thickness and carcass weight eliminated 82 percent of the pricing errors that occurred under the usual method of live marketing. Brough and Shepherd [1955, p. 228] developed an objective carcass grading system which would improve the accuracy of pricing hogs by one-third over pricing hogs on a live basis alone. Hayenga [1971]

summarized the findings of additional studies that compared pricing error for live versus carcass-grade and weight marketing and reported the results of a study that examined different systems for determining the value of 1,000 hogs slaughtered in a Michigan experiment. Hayenga found that liveweight alone explained variation in live hog values poorly. The equation that gave the best pricing accuracy for a live or carcass pricing system used as explanatory variables a measurement of backfat thickness, carcass or liveweight and dressing percentage. Hayenga concluded that fairly simple procedures for improving pricing efficiency are available to packers at low cost.

*Summary of Pricing Efficiency Studies of the Livestock-Meat Industry.* The pricing efficiency research established that livestock buyers differ substantially in ability and that some make substantial errors when estimating carcass grade and yield on the basis of appearance of live animals. Unfortunately, the studies fail to reveal whether systematic biases exist which would cause producers to be systematically underpaid or overpaid when livestock are graded on a live basis. The search for objective standards for carcass grading contributed to knowledge about relationships between certain carcass properties (e.g., backfat thickness and carcass length) and value of the meat contained in carcasses. In general, the pricing efficiency research suggested that livestock values would be transmitted to producers more accurately under a carcass grade and weight marketing system.

#### IMPACT OF GRADING ON INDUSTRY STRUCTURE AND MARKET POWER

Williams, Bowen, and Genovese [1959] and Fienup, Motes, Hiemstra, and Laubis [1963] examined the economic effects of federal grading of beef and lamb on industry structure and market power of firms engaged in meat processing and selling. Food chains and independent retailers were found to have acquired additional market power because of federal meat grades which: (1) gave them access to the merchandising advantages of the word "Choice;"<sup>20</sup> (2) helped them increase specification buying of meat; (3) broadened their supply base in terms of the number, variety, and location of suppliers; and (4) helped them avoid becoming dependent upon a few packers. The factors that enhanced retailers' power caused reductions in sales of packer-branded meats. Consequently, the national packers lost market power relative to retailers, independent packers, and producers partly as a result of the widespread use of federal grades for beef and lamb. This caused national packers to question the legitimacy of having USDA develop as a byproduct of its grading service a merchandising symbol ("U.S. Choice") for meat that competed directly with packer brands (Welborn [1961]).

Independent packers generally gained from the existence of federal grades. These smaller packers found that U.S. graded beef and lamb met the specifica-

tions of the large retail chains. Accordingly, access to federal meat grading services enabled some of these packers to acquire large retail accounts and grow in volume to the point that their markets were regional or national. The independent packers also frequently became specialized processors of a particular species or class of meat desired by large retailers. According to Williams and Stout [1964, p. 513], overall concentration in the packing industry declined as a result of federal grading.

These studies suggest how grades based on uniform standards can make markets more competitive and increase price competition. The results also provide additional evidence that grades may be nonneutral in their effects on market participants. Perhaps the only deficiency in the studies is that the authors made too little effort to sort out effects of grades from other factors (e.g., transportation developments, changes in wage differentials, and other factors that favored locations of specialized meat packing plants in production areas) that were simultaneously bringing about changes in market structure and market power in the livestock-meat industry.

#### STUDIES OF CONSUMER PREFERENCES FOR MEAT

Rhodes and others at the University of Missouri did much of the economic research relating to consumer preferences for meat. The following review briefly summarizes consumer preference studies that relate directly to grades and standards. Readers may consult reviews by Kiehl and Rhodes [1956] and Williams and Stout [1964, pp. 517-532] for a more complete discussion of the grading and other implications (e.g., merchandising implications) of the research.

In studies providing historical perspective on the relationship of beef grading to consumer preferences Rhodes [1960b] and Kiehl and Rhodes [1960] reported that beef grade marking was undertaken without reference to tests of visual and sensory preferences of consumers. Rhodes [1960a] indicated that USDA instituted grade marking of beef carcasses in 1927 after certain midwestern and western cattlemen lobbied for the service. Apparently the cattlemen lobbied for the service thinking that USDA grade marks could be employed to differentiate carcasses of their cattle from leaner "common" beef and dairy carcasses. History suggests that this action was then an effective merchandising strategy.

The early consumer preference studies were visual studies that involved recording consumers' impressions to visual attributes of meat cuts (usually beef). In the studies consumers were shown pictures or actual samples of meat cuts of particular grades. Then the respondents were asked, assuming that the cuts could be purchased at equal prices, which they would prefer. Preferences revealed in these early studies varied, making interpretation of the results somewhat difficult. But, in general, visual preferences among grades

differed from those anticipated by experts. Often consumers indicated preferences for the lean Good and Commercial grades of beef over the Choice and Prime grades.

These results caused researchers to question whether the visual tests actually measured consumer preferences (Williams and Stout [1964, pp. 522-523]). Therefore, as an alternative, researchers began using eating or sensory tests to determine consumer preferences. This research revealed the not too surprising findings that eating quality of meat is made up of several attributes including tenderness, flavor, juiciness, and aroma. It was found that consumers sometimes rated beef from different grades much the same on the hedonic scales used in the experiments. Consumers tested in one Missouri study rated beef in the Choice, Good, and Standard grades much the same for tenderness, flavor, and juiciness (Rhodes, Kiehl, et al. [1956]). Taste testers in another Missouri experiment were not highly successful in distinguishing between beef from loins from the same grade and those from nonadjacent grades (Rhodes, Kiehl, et al. [1956]).

Considerable overlap in acceptability of different grades of beef was discovered. A 1958 Missouri study (Rhodes, Kiehl, Brady, and Naumann [1958]) found that the acceptability ratings of Prime and Choice grade beef overlapped each other so much that they might have been combined with little loss of eating homogeneity. Rhodes [1961] examined consumer preferences for Choice and Good grade beef in order to get information for appraising a proposal to lower the Choice-Good beef grade boundary by a fraction of a grade. The test results suggested that Choice and Good grades do not differ much in acceptability. However, in an earlier article, Rhodes [1960b] urged that results of consumer preference studies be interpreted cautiously. He stated: "Beef grades and brands have been so heterogeneous in eating quality as to hamper greatly any comparison of grades and preferences" [p. 147].

Results of some sensory tests contradict findings of earlier visual tests. One such test (Kiehl and Rhodes [1956]) involved a panel of 266 Missouri households which rated the acceptability of loin steaks supplied to them for three weeks free of charge. The study revealed that "the eating preference patterns contradict the visual preferences found by many researchers. . . . Many visual preferences have been for the leaner grades at equal prices or even with some price differential against the leaner grade. Eating preferences were very rarely for the leaner grades" (Kiehl and Rhodes [1956, p. 1340]). Consumers evidently preferred the higher grade beef, partly because of its greater uniformity. The findings of this experiment, of course, suggest that there is a rationale for beef grades based partly on degree of finish.

Rhodes's [1959] research on consistency of consumer preferences has implications for the feasibility of relating grade standards to consumer preferences. He found the null hypothesis that there is no trend on ratings over

time to be generally correct. Consumers exhibited no significant tendency to change their preference ratings for leaner Good grade beef as compared with Choice grade beef on subsequent replications. If consumers failed to exhibit consistency in preferences, this would further complicate any attempt to base grades on consumer preference patterns.

Consumer preference studies for pork with implications for grading often were concerned with measuring the strength of consumer preference for lean pork. Birmingham, Brady, Hunter, Grady, and Kiehl [1954] reported that pork leaner than that designated at the time as the No. 1 grade would be required to meet consumer acceptance. In a later study, Nauman, Jaenke, Rhodes, Kiehl, and Brady [1959] found that variability of pork cuts within the USDA grades was so great as to obviate any potential of a merchandising program based solely on USDA grades.

The research on consumer preferences contributed to knowledge of the relationships between eating quality and attributes like meat tenderness and aroma. It also revealed consistent consumer preferences over time and the need for changes in federal grade boundaries and for other changes in federal grades for meat. However, researchers apparently found consumer preference patterns to be extremely complex. Accordingly, some of the findings are untidy and contradictory. Rhodes [1960b, p. 149] characterized the research on relationship of grades and palatability as "inadequate and somewhat inconclusive." This still appears to be an accurate characterization.

#### OTHER CONSUMER AND COMMODITY STUDIES ON GRADES AND STANDARDS

The other post-World War II studies on grades and standards cover many grading questions and relate to several different commodities. These studies are grouped below into two broad categories: (1) Consumer studies on grading; and (2) commodity grading problems. Category (1) relates to consumer knowledge of and use of grades, consumer knowledge of factors that determine product quality and consumer preferences. Category (2) is broad, encompassing studies of the adequacy of grades for various commodities (eggs, tobacco, hay), price-quality relationships, and objective grade standards. Brief summaries of the material in the studies that relate to grading appear in Table 3.

*Consumer Studies on Grading.* Three of these studies (Campbell [1956], Hutchinsorr [1970], and Owens and Taylor [1955]) indicate that consumer knowledge of grades is low (Table 3). Owens and Taylor reported that consumers generally were not skilled in recognizing the quality differences in eggs and were not aware of factors that are considered in establishing egg grades. G. W. Campbell's study indicated that consumers had little knowledge of USDA beef grades and that only one-third of those questioned had used USDA

Table 3. Summary of Findings of Post World War II Consumer Studies  
Relating to Grading and Commodity Grading Problems

| Source  | Problem Area  | Principal Findings<br>and/or Recommendations   |
|---|---|--|
| <i>PART I. Consumer Studies on Grades and Standards</i> |   |  |
| Banks, Q. D. [1963]                                     | How grades affect demand for eggs.                      | Present standards do not include all attributes used by consumers to differentiate between eggs. Revision of grade boundaries for eggs would increase sales. Eggs can be produced to specification.                      |
| Bender, L. D., and L. A. Voss [1963]                    | Consumer visual preferences for interior egg quality.   | Describes how consumer preferences could be incorporated into egg grading standards.   |
| Campbell, G. W. [1956]                                  | Consumer acceptance of beef.                            | Consumers had limited knowledge of USDA beef grades. Less than one-third of consumers tested used USDA grades as guides for buying beef.   |
| Dalrymple, D. G. [1968]                                 | Economics of produce grading.                           | Applesauce grades were set up not for consumer use but to serve as convenient basis for sales, quality control, and determining loan values. Consumers preferred thin "substandard" applesauce to thicker grades 1 or 2. |
| Ford, K. E. [1956a, 1956b]                              | Quality of canned vegetables.                           | Retail prices were generally poor indicators of quality of canned vegetables. Factors causing grade variations in canned vegetables are described.   |
| Godwin, M. R., and W. T. Manley [1963]                  | Evaluation of grade and size standards for tomatoes.    | Standards delineate quality differences for tomatoes more finely than required by consumer.  |
| Goldman, A. S., and R. L. Baker [1953]                  | Consumer preferences for eggs.                          | Consumers generally preferred eggs with higher U.S. grades to those with lower U.S. grades. Two egg grades might be combined.  |
| Hutchinson, T. Q. [1970]                                | Consumers' knowledge and use of government grades.      | Consumer knowledge of U.S. food grades is low. Education of consumers on grades might be increased where they shop.  |
| Kohls, R. L., and N. Oppenheimer [1953]                 | Quality recognition and buying habits of egg consumers. | Two-thirds of consumers defined egg quality using criteria that agreed in part with quality criteria of federal grades; little relationship  |

Table 3—Continued

| Source  | Problem Area  | Principal Findings and/or Recommendations  |
|---|---|--|
| <i>PART I. Consumer Studies on Grades and Standards</i> |   |  |
| Nybrotten, N. [1953]                                    | Standards for consumer grades.                              | existed between prices paid for eggs and grade obtained.<br>Egg standards should be based on consumer preference factors. Large producers of eggs request grade tolerances that can be met only by big producers who can afford expensive measuring equipment.               |
| Owens, A. L., and F. R. Taylor [1955]                   | Consumer knowledge of factors that determine egg quality.   | Most consumers do not recognize quality differences in eggs or standards used to establish existing egg grades.  |
| U.S. Congress, Office of Technology Assessment [1977]   | Federal retail food grading                                 | Contains comprehensive description of issues relating to possible modifications of federal retail food grades. Suggests that to benefit consumers, simple, uniform terminology, increased nutritional information, and standardized system for grading might be established. |
| U.S. National Commission on Food Marketing [1966a]      | Various marketing problems, including consumer grades.      | Consumer grades should be developed and required to appear on all foods for which such grades are feasible. Grades should be of the A, B, C type [1966a, p. 109].  |
| Voss, L. A., and R. B. Smallwood [1966]                 | Consumer preference for exterior egg shell characteristics. | Shell cleanliness is important to consumers. Consumers preferred white or cream-colored eggs to brown ones.  |
| <i>PART II. Commodity Grading Problems</i>              |   |  |
| Abraham, H. C. [1977]                                   | Changes made in 1976 to USDA beef grades.                   | Under the revised standards adopted in 1976, 68 percent of a large sample of fed beef carcasses graded Choice compared with 54 percent that graded Choice under the old standards.   |
| Agnew, D. B. [1969]                                     | Changes in quality of hogs slaughtered in U.S.              | Quality of hogs slaughtered in U.S. improved substantially from 1960-61 to 1967-68.  |
| Angus, R. C. [1963]                                     | Price-quality relationships for hay in Arizona.             | No relationship was found between price and USDA grades for hay.   |



Table 3—Continued

| Source  | Problem Area   | Principal Findings and/or Recommendations  |
|---|--|--|
| <i>PART II. Commodity Grading Problems</i>                        |  |  |
|   |  | Feeding value of hay needs to be better defined before meaningful hay quality standards can be developed.  |
| Ballantyne, D. J.,<br>E. W. Kalin, and A. H.<br>Harrington [1958] | Effect of introducing<br>grading on sales of<br>flowers.                       | Graded flowers generally com-<br>manded some premium over un-<br>graded flowers. Two of the carna-<br>tion grades could be combined.   |
| Beal, G. M., and<br>P. F. Summers, Jr.<br>[1954]                  | Extent of use of federal<br>tobacco grades by Mary-<br>land tobacco buyers.    | Maryland tobacco buyers made<br>little use of federal tobacco grades<br>in their purchasing decisions.   |
| Bender, L. D.<br>[1964]   | Evaluation of grade<br>standards for table eggs.                               | Egg grading was used to exclude<br>midwestern eggs from eastern mar-<br>kets. Consumer preferences were<br>not precisely transmitted to pro-<br>ducers under grading scheme in-<br>vestigated. |
| Broadbent, E. E.<br>[1957]  | Evaluation of graded<br>egg marketing in<br>Illinois.                          | Describes how marketing of eggs<br>on graded basis developed in<br>Illinois. Shows price premium re-<br>ceived by producers for graded<br>over ungraded eggs.                                  |
| Clifton, E. S., R. J.<br>Jessen, and E. M.<br>Jacobs [1954]       | Price differentials for<br>different grades of hogs<br>sold in Chicago market. | Buyers paid higher prices for<br>higher grades of hogs. Price gains<br>from sorting hogs into uniform<br>lots were reported.   |
| Feder, E., and F. C.<br>Andrews [1956]                            | Measurement of butter<br>quality by chemical tests.                            | A need exists for improved objec-<br>tive measures of butter quality.  |
| Gooch, E. D., Jr.<br>[1964]                                       | Effect of light intensity<br>on grade and price of<br>burley tobacco.          | Tobacco is graded higher on days<br>of high light intensity. Standard-<br>ized lighting would improve grad-<br>ing accuracy.   |
| Heid, W. G., Jr., and<br>D. N. Harrington [1960]                  | Relationship between<br>wheat quality and price<br>at county elevators.        | Low quality wheat was priced<br>too high and high quality wheat<br>too low.  |
| Hudek, H. J., and<br>R. E. Moreng [1962]                          | Egg quality in market<br>channels.   | Candle grading of eggs was inade-<br>quate for determining internal egg<br>quality.  |
| Hyslop, J. D.<br>[1970]   | Relationship between<br>price and quality for<br>spring wheat.                 | Suggests use of wheat grade that<br>incorporates measures of product<br>weight, kernel damage, and foreign<br>material.  |

Table 3—Continued

| Source                                     | Problem Area   | Principal Findings and/or Recommendations  |
|--|--|--|
| <i>PART II. Commodity Grading Problems</i> |  |  |
| Kendrick, J. G., and J. B. Hassler [1968]  | Standardization of hams.   | USDA ham standardization requirements relating to water/protein ratio should be changed.   |
| Kross, J. I. [1952]                        | Profitability of selling potatoes on graded basis.                     | Price differentials between grades, grade tolerances, and cost of grading determine at what grade it pays to sell potatoes.                                |
| McGlothlin, R. S. [1957]                   | Hay marketing practices including use of hay grades as basis for sale. | Little hay was sold in Arizona on basis of USDA grades. More meaningful hay grade standards need to be established.  |
| Purcell, W. D., and K. E. Nelson [1976]    | Changes made in 1976 to USDA beef grades.                              | Describes measures needed to make yield grading more effective for increasing pricing efficiency in the beef marketing system.                             |
| Slagsvold, P. L. [1951]                    | USDA efforts to develop objective grade standards for wool.            | Core testing techniques were developed to measure wool shrinkage. Objective measures were needed to measure wool fineness, variability, and staple length. |

grades as guides for buying beef. Hutchinson's study, which involved a survey of 3,000 consumers across the United States, reported similar conclusions. Many consumers surveyed by Hutchinson believed that all foods carried USDA grades. The consumers also confused grade and inspection marks. Only 22 percent of the consumers surveyed correctly identified the shield-shaped grade mark and 30 percent correctly identified the circular inspection mark. Hutchinson concluded that educational material on grading could be most effectively distributed at point of purchase in retail stores.

The consumer studies indicate that there is confusion over the meaning of federal grade names which, for example, designate the third best grade of apples as U.S. No. 1. The U.S. National Commission on Food Marketing (NCFM) argued for a less confusing A, B, C type of grading system for food [1966a, p. 109]. NCFM also recommended that increased use be made of consumer grades to heighten competition at the retail level. NCFM cited beef as a commodity for which there is widespread use of federal grades, little product differentiation, and satisfactory price competition at retail.

The Office of Technology Assessment (U.S. Congress, OTA [1977]), in a comprehensive study of federal retail grades, reported that confusing grade designation or nomenclature is a major problem for consumers of fresh fruits and vegetables and processed food (e.g., there are at least ten different terms denoting the top grade for various food products), and federal retail food grades impart little information to the consumers of most foods. OTA examined options that Congress might select to improve the federal retail food grading system, including mandatory retail food grades, uniform terminology, and information on nutritional content of food in restructuring the grading system.

The consumer studies (Table 3) also: described product attributes preferred by consumers (Dalrymple [1968], Voss and Smallwood [1966]); indicated whether consumers' preference rankings for different grades of products agreed with those assigned under grading schemes (Goldman and Baker [1953]); suggested that prices were poor indicators of quality for canned vegetables and eggs (Ford [1956a, 1956b], Kohls and Oppenheimer [1953]); and pointed out possible deficiencies in grades for certain products (Banks [1963], Godwin and Manley [1963]).

*Commodity Grading Problems.* Deficiencies in grades and standards for several commodities are described by one group of studies appearing in Part II of Table 3. Angus [1963] and McGlothlin [1957], for example, found that little hay was priced and sold on the basis of USDA grades. They contended that USDA needed to develop more meaningful hay grading standards if USDA grades were to become useful guides for hay pricing and marketing. Feder and Andrews [1956] and Slagsvold [1951], respectively, said that additional effort was needed to develop objective grade standards for butter and wool. A second group of studies (Ballantyne, Kalin, and Harrington [1958], Broadbent [1957], and Clifton et al. [1954]) compared the gains to growers and marketing firms from selling under alternative grading and sorting schemes, on a graded versus ungraded basis. A third group (Gooch [1964], Hyslop [1970]) recommended certain changes in grading procedures or standards. Gooch, for example, found that tobacco was graded too high on days when light intensity was high. Accordingly, he suggested that standardized lighting be adopted to improve the accuracy with which tobacco is graded. W. D. Purcell and Nelson [1976] found that beef grades adopted by USDA in 1976 may need to be modified to reflect the value of edible fat. Few other generalizations can be drawn from the miscellaneous studies dealing with commodity grading problems.

### Summary and Appraisal of Research on Grades and Standards

The research on grades and standards can be evaluated by asking: (1) How much did it contribute to the understanding of agricultural marketing

phenomena? and (2) To what extent did it serve as a basis for public policy aimed at enhancing public welfare?

There are few theoretical guidelines for defining optimal grade specifications. Therefore, additional theoretical work in this area might produce a high payoff.

In general, the research to determine the economic feasibility of carcass grade and weight marketing appears to have been well done. Effective use was made of the regional research committee to assemble the resources needed to do an effective job of the research. The research was additive. Overall, it produced a fuller understanding of the pricing efficiency gains to be achieved from carcass grade and weight marketing of livestock.

The studies that examined the economic effects of federal grades for beef and lamb documented how grades based on uniform standards: (1) increased the market power of the food chains, independent retailers, and independent meat packers relative to national packers; (2) reduced product differentiation in fresh meat sales; and (3) increased price competition at various points in the meat marketing channel. Unfortunately, few studies went on to deal with the broader economic implications of grading.

Several studies showed that: (1) consumer knowledge of grades was low; (2) consumers made relatively little use of grades when making decisions about buying food; (3) consumers found federal grade terminology confusing. These studies seem to point out the need for development by USDA of more uniform grading terminology and for increased efforts to inform consumers about grades.

The many miscellaneous studies (Table 3) conducted on grades and standards generally focused on some aspect of consumer preference or on a grading problem for a particular commodity. This research typically was not related to economic theory or to any other research in the problem area. Thus much of this research was nonadditive and probably made little contribution to systematic knowledge.

At least some grades and standards research findings were used as a basis for grade specifications and laws: The federal hog carcass grades issued by USDA in 1962 were based partly on studies dealing with objective grade specifications for hog carcasses (Brough and Shepherd [1955, p. 230]). Also, an Illinois law defining consumer grade standards for eggs was passed as a result of a study dealing with graded egg marketing (Broadbent [1957, p. 30]). Moreover, authors of grading studies were actively involved in public policy debates over proposed changes in grades. However, it appears to be impossible to determine how much the research contributed to improved public welfare.

### *Market Performance in the Spatial Dimension*

The costs of performing the necessary transfer functions for farm products are substantial. Transportation and trucking costs amounted to \$12.2 billion in 1979, or 7.6 percent of the total marketing bill for farm foods. Marketing researchers have been concerned with the transfer cost bill and with ways and means for keeping it as low as possible, given the functions that must be performed. Recognition of space as a relevant economic variable, however, has much broader implications for theory and research than is suggested by the goal of efficiency in transportation. At issue is the spatial dispersion of economic activity generally, and theories of interregional trade and of location are available for research on the spatial patterns of farm production and ancillary marketing activities.

In surveying the literature in this area, we first center on the question whether transport cost rates are minimized given the product movements that actually occur and the technological and input price data. Research on in-plant or in-firm efficiency, of which there has been a good deal, is outside the scope of this survey and will not be considered. Certain aspects of transportation policy will be of major concern. Thereafter we take up the literature on the efficiency of both product movements and spatial patterns of production, assuming that transport cost rates are exogenous.

#### Transportation Policy Issues

At present, motor carriers account for the bulk of farm product and input transportation, with railroads accounting for a decreasing but still important share. Waterways are mainly important in moving commodities of great bulk and weight and where speed of delivery is of secondary importance. Air freight of farm products is confined at present to breeding stock and specialty products like cut flowers but offers some potential for growth in the future.

The transportation sector has been characterized by substantial innovations that have reduced shipping costs significantly. In the post-World War II period, railroads have switched from steam to diesel engines and, in the face of increasing competition from other modes, introduced "Big John" freight cars and unit trains and sought to lower rates. The improved highway system along with "Double-Bottom" trucks and improved refrigeration techniques provided a considerable boost to the competitiveness of motor carriers. Old waterways have been improved, and new ones like the St. Lawrence Seaway have been introduced. Less dramatic innovations continue to occur in such areas as altering the product to allow lower costs (concentrated orange juice); reducing labor costs through palletized shipping; reducing spoilage, damage,

and breakage during shipment; and making greater use of loading space through better packing and lighter containers.

With some exceptions, rail, highway, and water transportation are subject to regulation by the Interstate Commerce Commission (ICC). Briefly, the ICC has ultimate control over the initiation and discontinuance of shipping services as well as changes in transport rates for most for-hire carriers. Regulation of the railroads dates back to 1887. When the regulatory philosophy was extended to trucking in the mid-1930s and still later to waterway transportation, farmers were successful in having unprocessed farm products exempted from controls. Because of the agricultural exemption, agricultural truckers are subject to standard business law rather than special transportation law. Entry and exit of shippers is unregulated except through profits and losses. Shippers are not bound to specified routes or areas. Shipping charges are determined by the forces of supply and demand. Redress for injured customers follows the usual legal procedures rather than the complaint system developed for regulated carriers.

Transportation policy raises important questions: Is regulation of the various modes of transportation required by or compatible with minimized shipping costs? Given the existing regulatory framework, how should rates be determined? Should dimensions of transportation performance other than rates be regulated and if so, how? These questions, though explored at considerable length by transportation economists, have not received much attention by agricultural economists. Still some instructive investigations have been made which merit attention.

Two such studies grew out of changing policy toward shipment of dressed poultry and frozen fruits and vegetables. Because of various court decisions, shipment of both fresh and frozen dressed poultry came under the agricultural exemption clause in the mid-1950s. Before that time, shipments were subject to regulation. Frozen fruits and vegetables were exempted from regulation by a 1956 Supreme Court decision but were again subjected to regulation in 1958 through an amendment to the Interstate Commerce Act. Here are two rare examples of "accidental" social experiments. The results of the experiments were analyzed in three USDA publications. The first to appear (Snitzler and Byrne [1958]) involved a nationwide study of 144 poultry processors and 67 motor carriers hauling fresh and frozen poultry. Truck rates charged by carriers during 1956-57, the period with no regulation, were approximately 33 percent below the 1952 rates on fresh poultry and 36 percent below the 1955 rates on frozen poultry, the latter years reflecting the results with regulations in effect. The second study, with a later supplement (Snitzler and Byrne [1959], Winter and Ulrey [1961]), showed on the basis of survey data that

motor carrier rates on frozen fruits and vegetables declined 19 percent following deregulation. It was further reported that rates increased and services decreased after regulation was again introduced in 1958. Taken together, these studies offer support for the conclusion that regulation leads to higher freight rates and restriction of services in the transportation of dressed poultry and frozen fruits and vegetables. In the absence of contradictory evidence one of course wonders whether the same conclusion applies to other commodities as well. Other studies seem to suggest an affirmative answer.

A paper by Farmer [1964] drew upon data collected by the USDA on 25 exempt carriers in the Washington, D. C. area. These data consisted of revenues, costs, and net revenues per intercity ton mile. When these data are compared with more-or-less corresponding data for regulated carriers, the conclusion that emerges is that the operating costs and revenues of exempt carriers are substantially below those of regulated carriers. A rationale for cost and rate differentials between regulated and exempt carriers was also provided.

Miklius and DeLoach [1965] soon took up the issues raised by Farmer and provided additional support for his major thesis. They argued that the structural characteristics of the exempt for-hire trucking industry were compatible with keen and effective competition. Evidence was adduced in support of the contention that economies of size exist mainly in terminal operations but not in line-haul operations. Also cited was the experience and developments in a period following deregulation of all modes of transportation in Australia in 1954. *A priori* arguments that asserted excessive competition would prevail in the absence of regulation were effectively demolished. Additional data were presented along with findings from other researchers which support the view that nonregulated trucking has not experienced excessive competition, that rates charged are quite in line with costs incurred.<sup>21</sup> A more recent study by Ulrey [1969] also supports the view that charges for highway and waterway transportation of exempt farm products reflect costs incurred.

From examination of the literature, it appears that agricultural economists have tended for the most part to leave comprehensive assessments of transportation policy to other economic specialists.<sup>22</sup> A book edited by Davidson and Ottoson [1967] contains papers presented at a transportation workshop sponsored jointly by the Great Plains Resource Economics Committee and the Western Marketing Research Committee. The papers were written by people from various fields who held rather widely divergent views on the effectiveness of competition versus government regulation as the organizing mechanism in the field of transportation. J. C. Nelson [1967] provided convincing arguments in favor of promoting competition in the transport industries. Both in this

volume and elsewhere, Ulrey [1967, 1969] called attention to the dramatic effects of intermodal competition. He argued that carrier costs are now more important than ever in rate making but presented evidence suggesting that rail rate reductions reflect the costs of competing carriers more than the costs of rail shipments themselves. Felton [1967] strongly objected to the internal subsidization of the transportation of some products resulting from the value of service basis of rate determination. Under this policy, freight rates relative to marginal costs are much higher for high-value commodities than for low-value commodities. After considering arguments both pro and con, he maintained that long-run marginal costs offer the most appropriate guide for rate making. He also called attention to evidence of discrimination against products from the Northern Plains arising out of a lack of intermodal competition in that area. A number of institutional factors were discussed in the various papers including "gray area" trucking, mergers, freight car per diem, motor-carrier taxes, and agricultural exemption and transit privileges. Breimyer [1976, pp. 158-167] briefly reviewed some literature on transportation that takes issue with several of the views given above.

Before leaving the subject of transportation policy, it should be noted that state and local governments also have policies that affect transportation. Hillman and Rowell [1953] concluded that the major "barrier" to interstate movement of farm products by motor carriers in the Western states arose out of nonuniformity of requirements and procedures between states.

A substantial body of research on performance of the dairy industry relates to barriers (health regulations, federal milk orders, state milk control laws, and truck weight laws) to dairy product flows. A USDA study (USDA, AMS [1955b]) suggested that regulations of one type or another accounted for most, but not all, of the amount by which prices to milk producers were above a midwestern base price plus an allowance for transfer costs in 1953-54. The study reported that if these regulations were modified to permit the free movement of milk, prices to about one-fourth of the producers of milk in the United States would probably decline an average of about 48 cents per hundred pounds.

A study by Hillman, Rowell, and Israelsen [1954] concluded that the non-uniformity of requirements, standards, and procedures of state and municipal dairy codes and ordinances was a major barrier to milk movement. More recently, W. W. Jones [1970] found that plant fees to regulatory sanitation authorities served to restrict milk movement. He discovered that 1,249 plants were regulated by an average of 4.8 sanitation authorities. Beal and Bagnied [1976] documented the legal and economic developments that, by the early 1970s, had caused health regulations to diminish greatly in importance as a



barrier to intermarket flows. Gruebele and Sleight [1975] found that state milk control provisions inflated distributor margins and that unit milk delivery costs decreased rapidly as route volume increased in markets where union contracts permitted hourly pay contracts. These studies are merely illustrative of a specialized literature dealing with state and local laws that tend to thwart movement of farm products.

Finally, a rather large amount of agricultural marketing research provided descriptive information on the transport industry. Many drew attention to the changing modes of transportation for particular products and/or areas. Several studies provided information on shipping costs, especially rail rates for grain and certain livestock products. The USDA published many reports on for-hire trucking of exempt farm products. A few studies involved taking samples of shippers and tabulating information on such variables as number and age of trucks, insurance policies, use of supporting capital equipment, costs of operation, and the like. Occasional studies described innovations in the transport field and suggested possible economic implications for marketing locally produced farm products.

### Marketing Research on Spatial Problems

Recognition of space as a variable in economic analysis raises a wide range of issues regarding commodity flows and the location of economic activity. Agricultural marketing economists have devoted a substantial amount of resources to the study of these issues. Basic to much of this work is the concept of perfect competition in space. We begin a survey of the resulting literature by describing a few simple models of perfect competition in space.<sup>23</sup> We then take up illustrative applications and critical evaluation.

#### THEORETICAL MODELS

Let us first look at the transportation model. Consider a geographic area partitioned into several regions. The aggregate quantities of a standardized product demanded by buyers are given and fixed, regardless of price, for each region. Likewise, the aggregate quantities produced by sellers are given for each region. For any pair of regions, the per unit cost of transferring the product from one to the other is known and invariant with regard to the total amount shipped. Consumption, production, and shipments are assumed to occur at a single point in each region. Finally, the total quantity supplied equals the total quantity demanded. The problem is to find the pattern of shipments that minimizes the total transportation bill subject to the constraint that all demand quantities are satisfied. Simple computational procedures are available for finding solutions to such problems. Dorfman, Samuelson, and

Solow [1958] showed how the transportation problem can be converted into a general linear programming problem with corresponding increases in the capabilities of the model. The primal solution gives the least-cost flows.<sup>24</sup> The dual solution establishes regional differentials among prices paid by buyers and received by sellers. The resulting least-cost or optimal product flows and the implied price differentials can be shown to be equivalent to the performance of perfect competition in space (see, for example, Takayama and Judge [1971, p. 45-85]) under the restrictive assumptions set forth above.

Models that take regional demand and supply quantities as fixed obviously leave a great deal to the exogenous zone. Fortunately, a variety of spatial models are available for handling more general cases like the following: Consider again a geographic area partitioned into several regions, each of which is represented by a single point in space. Demand and supply functions are given for each region along with transportation cost per unit between any pair of regions. This unit cost is assumed to be independent of volume and direction of movement. Regional equilibrium prices and supply and demand quantities are desired along with the interregional product flows.

Where only two regions are involved, the problem can easily be solved graphically as in Figure 5. Supply (S) and demand (D) functions are given for two regions. Unit transfer cost is given by  $t$ . The excess supply (ES) function for each region is derived by subtracting the demand function laterally from the supply function. Spatial equilibrium prices,  $P_{11}$  and  $P_{21}$ , are given by the intersection of the two excess supply functions. Clearly,  $P_{11} + t = P_{21}$ . Given equilibrium prices, quantities demanded and supplied in each region are determined. The quantity  $(Q_{11} - Q_{10})$  is shipped from Region 1 to Region 2 so that  $(Q_{11} - Q_{10}) = (Q_{21} - Q_{20})$ . This case is both simple and instructive for it identifies either explicitly or implicitly all the major determinants of interregional trade. With a small number of regions trial and error methods would likely suffice in discovering the competitive solution, but as the number of regions increases and other complications are introduced, the need for more powerful techniques becomes increasingly evident.

In a famous paper, Samuelson [1952] showed how the spatial equilibrium problem posed above can be converted into a maximizing problem. By this means, the powerful tools of mathematical programming can be brought to bear on theoretical and applied cases involving considerable complexity. Consider the case involving a single product and many regions. Drawing upon the earlier work of Samuelson, Takayama and Judge [1964] showed that the spatial equilibrium problem may be defined as a quadratic programming problem. Kuhn-Tucker conditions are used to establish conditions for an optimal solution. The optimality conditions are rather what one would expect. If output flows from one region to another, the difference between the two regional

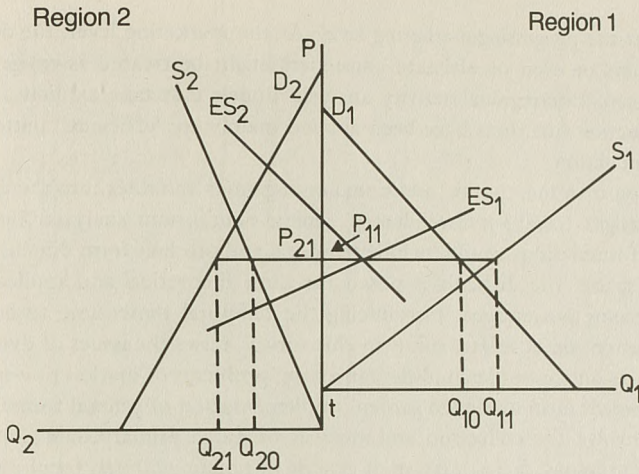


FIGURE 5. Graphical derivation of spatial equilibrium in a two-region, perfectly competitive market

prices will equal transport cost. If the price difference between any two regions is less than transfer cost, there will be no flow between them. At positive prices, supply equals demand. A number of different procedures are available for finding solutions to applied problems. Judge and Wallace [1959] developed iterative procedures which can be used with transportation models. Tramel and Seale [1959] proposed a reactive programming procedure. A number of efficient procedures are available for obtaining solutions to quadratic programming problems. Interestingly, several researchers found that a desk calculator, a bit of time, and simple trial and error were the only requirements for solutions to various applied problems.

Having incorporated prices and quantities of products into the spatial models as endogenous variables, the question naturally arises whether still more variables can be made endogenous. The answer is, of course, yes. To see this one need merely note that supply and demand functions do not fall like manna from the skies. With farm products, say, the supply function is a behavioral relation derived from a production model in which production functions and certain input prices, resource levels, and supply functions for inputs are viewed as exogenous but in which certain other resource prices and resource levels are endogenous. Such considerations have given rise to interregional activity analysis models that implicitly generate their own supply functions. The very same considerations apply to the demand side in that demands for farm products may, for the most part, also be derived from a production

model at the processing-marketing level. At the marketing level, the demand of retailers or even of ultimate consumers might be treated as exogenously determined. Interregional activity analysis models that take explicit account of production functions have been applied mainly to "efficient" patterns of farm production.

The push to incorporate additional endogenous variables into the analysis leads straight toward multi-industry, general equilibrium analysis. The more general formulations would include temporal and product form dimensions as well as space. The difficulties posed for both theoretical and applied work soon become horrendous. Introducing the temporal dimension, to be given greater attention at a later point in this survey, raises the issues of dynamics. As soon as one passes beyond the farm gate, problems of market power flourish like weeds in an untended garden. Implementation of general formulations would involve the collection and analysis of much primary data. For these and other reasons, the estimation of general optimizing models for the agricultural sector as a whole, including significant parts of the processing-marketing sector, appears unlikely in the near future.

#### EMPIRICAL RESEARCH

Transportation, spatial, and activity analysis models, each extended in a variety of ways, have served as the framework for a considerable amount of marketing research.<sup>25</sup> In this survey, well over 100 studies of interregional trade in agricultural products were unearthed in the libraries at the University of Wisconsin, but doubtless some remain buried in the archives of other universities. Most of these studies involved rather simple models, relative to what is theoretically possible. About one-third, in fact, used the simple transportation model or variants thereof. Nearly all major farm commodities have been studied, as have numerous minor commodities like frozen strawberries and slicing cucumbers. The initial applications involving mathematical programming occurred in the 1950s, with the number of new studies increasing rapidly during the 1960s but tapering off in more recent years. Detailed summaries of the results would entail hundreds of tables and maps, and it is not at all clear that such a compilation would be useful. Because of a lack of data, only a handful of cases involve models that as a practical matter could be used in making predictions which could then be subjected to empirical tests. Even such limited testing would require further empirical research, however, and is outside the scope of this survey.

In what follows, several alternative studies and approaches will be briefly described for illustrative purposes. Research that involves more or less formal applications of transportation and spatial models is considered first. The

remaining studies are then considered. Evaluation of past accomplishments and future prospects will then be taken up, drawing upon numerous critical evaluations already appearing in the literature (C. B. Baker [1961], Bawden [1964]).

*Transportation and Spatial Models.* Because solutions are readily obtainable, the transportation model is well suited to comparative static analyses. Consumption and production levels and transfer costs are exogenous variables. Any economic changes that alter these exogenous variables in specified ways will alter optimum interregional flows and the associated price differentials in ways that can be predicted by the model. Consider, for example, the flows of highly perishable fresh vegetables from production areas to consumption areas over the course of a marketing season. Several applications of the transportation model trace optimum flows of fresh vegetables at various time intervals (Cain and Toensmeyer [1969a, 1969b, 1969c], Farris and King [1960, 1961], Nichols, Mathia, and King [1964]). Optimum flows are then compared with actual flows and "competitive" price differentials are compared with actual differentials. In these studies it was found that the minimized transportation costs are in the neighborhood of 4 to 8 percent below actual costs. Optimal or competitive price differentials appeared, however, to differ rather substantially from actual differentials. To take another example, the effects of changes in transportation systems, of which there have been a great many in the post-World War II period, can also be analyzed. Thus Strawn and Parry [1966] found that the introduction of the interstate highway system had little effect on optimum routes for egg shipments. Padgett, Aaron, and Frazier [1964] used the transportation model to assess the effects of a proposed navigable waterways system on the optimum flows of feed grains in Georgia.

Information gleaned from transportation models may be augmented with information on regional farm production and processing costs to shed further light on the nature of interregional competition. In fact, regional processing costs may be added to transportation costs in the model. Optimum flows are not affected. Differentials in net returns to suppliers of farm based raw materials are affected, however, and might be used with farm production costs in assessing the competitive positions of alternative regions in the production of the output in question. Henry [1957] used such an approach to assess future broiler production regions. Dennis and Sammet [1961] employed this approach in a study of the frozen strawberry industry. Their study is especially notable for the care given to the estimation of regional processing costs.

Attention up to this point has focused on the applicability of the transportation model in the spatial dimension only. It is worth noting that multiple-dimension models are feasible in which time and product form are also included (see King and Henry [1959]). In a pioneering work, Snodgrass and

French [1958] used a space-form transportation model to determine optimum locations of milk processing facilities in a study of interregional competition in dairying. A milk production pattern that minimizes milk production, processing, and transportation costs was also estimated, but the results, as admitted by the authors, appeared to be unreasonable. More recently, Rizek, Judge, and Havlicek [1965] used a linear programming transportation model in determining regional levels of slaughter and interregional livestock and meat flows that satisfy regional production, consumption, and capacity constraints and that minimize total cost of transporting live slaughter animals and meat. Cattle, hog, beef, and pork flows were considered simultaneously.

Because data requirements and estimation problems are severe, the empirical applications of spatial models that have as major components demand and supply functions and transport cost matrices have focused on rather narrow problems with a decided "short-run" flavor. Several illustrative examples may be cited. Fox [1953] estimated interregional equilibrium prices and product flows for livestock feed. Supply functions for feed were assumed perfectly inelastic for each of ten regions. From an aggregate demand function for feed, with price the dependent variable and quantity and livestock price the predetermined variables, regional demands were based on the proportion of grain-consuming livestock produced by each region. In a 1956 study of eggs, Judge [1956] treated quantities of eggs supplied as predetermined for each of twelve regions. An aggregate demand function for eggs from a previous study, with price the dependent variable and per capita consumption of eggs and per capita disposable income the independent variables, was used with regional population and per capita income levels in determining demand functions for each region. Data on unit transport costs were also collected. These early studies by Fox and Judge, with regional demand functions and quantities supplied, paved the way for similar work on numerous other products including beef and slaughter beef (Futrell, Walker, and Stout [1965], McCoy, Goetzinger, Kelley, and Manuel [1963], Williams and Malone [1964], Williams and Dietrich [1966]); hogs and slaughter hogs (Amick and Purcell [1966], Kelley, McCoy, and Manuel [1961]); milk (Carley, Hurt, and Seale [1963]); peaches (J. D. Brown and Elrod [1967]); sweet potatoes (Law and Ponder [1964]); broilers (Seale [1965]); corn (Judge and Hieronymus [1962]); soybeans (Nakamura, Hieronymus, and Judge [1963]); and eggs (Seale [1964]). Chuang and Judge [1964] considered feed grains and high-protein feeds in a two-product model. Predetermined variables included: (1) number of animal units fed, and (2) prices of livestock and livestock products received by farmers, and feeds available for current feeding. Demand functions were estimated for both feed grain and high protein feeds. A paper by Fuchs, Farrish, and Bohall [1974] analyzed

the apple industry, simultaneously considering space, time, resources, commodities, production activities, and marketing levels.

There are few applications of spatial models in which regional supply functions are estimated, along with regional demands. An extension of the Fox model [1953] by Fox and Taeuber [1955] established interregional equilibria for both feed and livestock and included a supply function for livestock in which quantity was related to prices of both livestock and feed. Quantities of feed were assumed predetermined. West and Brandow [1964] applied spatial analysis to a study of the impacts of all institutional barriers to production and movement of fluid milk on the dairy industry of the Northeastern and North Central regions. Competitive equilibrium levels were estimated for milk production, utilization, prices, and shipments. Supply and demand for various regions were estimated. They concluded that removing institutional barriers to competition would decrease the Class I price in the Northeast, increase the manufacturing milk price generally, and shift some production from the Northeast to the Lake States. A more detailed study of the dairy industry was later published by Ruane and Hallberg [1972]. On the whole, their results seemed quite consistent with those of West and Brandow. Ruane and Hallberg [p. 34] concluded that "the 1967 patterns of production and prices deviated substantially from the patterns that would have existed if the market had been organized as specified by the model. . . . Producer receipts would have been substantially lower in the northeast and south, but considerably higher in the lake states and corn belt." In a very promising approach, Kottke [1970] proposed a set of recursive relations that incorporate linear and quadratic programming formulations in order to handle the spatial, temporal, and product form dimensions of the dairy industry. Output of milk is written as a function of lagged milk price. An effort to build noncompetitive elements (price setting by milk order administrators) into the model is of considerable interest. Other applications of spatial models in which supply functions appear explicitly include a study of interregional competition of the turkey industry by Bawden, Carter, and Dean [1966], still another study of the dairy industry by Hsiao and Kottke [1968], and a spatial-temporal study of the North American pork sector by Martin and Zwart [1975].

*Other Approaches.* Although programming models might constitute the high road to research on interregional competition, many researchers have followed more pedestrian routes. Some researchers focused on factors affecting comparative advantage without showing much concern for comprehensiveness. The poultry industry has been a favorite subject. Rogers and Bluestone [1967] called attention to diseconomies of small flocks and the higher wage and chick prices in the Midwest in explaining that region's declining share of

egg production. Several writers considered the reasons for the changing competitive positions of the eastern states in the production of broilers in light of increased production in the South (Kriesel [1966], Rice [1951], Smith and Curtis [1961], and Via and Crothers [1970]). Hyslop and Dahl [1964] examined the implications of changing shipping charges for flour relative to wheat as regards the location of the flour milling industry. DeLoach and Miklius [1961] painted a gloomy picture of the prospects for California flower growers and shipping. (It seems that flower production is market-oriented.) Nichols [1969] emphasized how improved transportation gave rise to geographic specialization. A number of studies focused on various aspects of the livestock industries (Hassler [1956], A. D. Jones and Richards [1965], Rohdy [1964]).

Several writers have examined spatial price patterns for farm products, especially for milk. A pioneering study by Bredo and Rojko [1952] considered actual and "ideal" price relationships between milk markets and between fluid milk and cream. Their work involved mapping of net milk supplies available for market consumption, figuring transfer costs between farm and market levels, and determining regional surpluses and deficits. A series of successive determinations of market boundaries was used in estimating an efficient pattern. They concluded: "Comparison of actual and theoretically efficient milksheds indicate a considerable opportunity for adjustments by improving intermarket and interproduct price relationships, eliminating certain hindrances to the movement of milk between milksheds, and permitting freer movement of cream, particularly from the Midwest" [p. 78].

The Bredo-Rojko study was followed by others aimed at assessing spatial price efficiency in the dairy industry. Hassler [1953] used the concept of perfect competition in space, form, and time in evaluating pricing efficiency for butter, American cheese, and evaporated milk. Particular attention was centered on intermarket product prices in some major cities, relative net prices of products at processing plants, and the relationship between the latter values and producer prices for milk. Hassler concluded that "although some persistent inconsistencies in the price relationships of the manufactured dairy products industry were disclosed, much of the evidence suggested that the pricing mechanism was remarkably compatible with a competitive system" [p. 319]. The same general conclusion does not appear to apply, however, to Class I milk prices under federal order pricing in recent years. Recent studies of milk price alignment among markets suggest unnecessary shipments of Class I milk from some surplus areas to other surplus areas. Stitts and Hammond [1970] used a space-form model in estimating "efficient" milk prices and quantities for six milk marketing orders. They concluded that both Class I and blend prices were higher than normative values and that market supplies of milk and



milk utilization differed substantially from normative values. They noted, for example, that in 1965, milk moved to Chicago from as far away as 400 miles, whereas a supply area with a maximum radius of 160 miles would have met market needs. Blakley and Kloth noted that "the movement of Class I milk between markets, when it is not needed for fluid consumption, increases total costs with benefits accruing mainly to the transportation industry" [1972, p. 502]. These and other studies (Ladd [1969], Lasley [1965], USDA, Milk Pricing Advisory Committee [1972, 1973]) would seem to indicate substantial changes in milk pricing policy will be required if efficient marketing is to be achieved.

The interregional efficiency problems discussed above have elements in common with the problem of efficient assembly of farm products for processing at a limited number of locations because of economies of size. An example of a corresponding problem in distribution is the efficient door-to-door delivery of fluid milk and related products. French [1977] and Weinschenck, Henrichsmeyer, and Aldinger [1969] surveyed various approaches to the solution of local assembly and distribution problems. These approaches, therefore, need not be considered here. There is, however, one aspect of the distribution-assembly problem that merits mention. Although local assembly (distribution) industries may be rationalized in terms of optimum number, size, and location of processing plants, along with optimal routing of products, the resulting organization may be incompatible with competitive market structure. What then becomes of the quest for operational criteria for evaluating performance? One possibility is the introduction of cooperative enterprise. Another is government ownership or regulation.

In his classic study of fluid milk distribution, Bressler [1952] considered exclusive delivery territories and a municipally owned and operated system. It was estimated that exclusive delivery territories would have permitted cost reductions of 0.7 to 1.9 cents per quart and that a municipal system could have cut costs by 2.3 to 4.0 cents per quart. Under the latter system, total distribution costs would have amounted to about one-half the costs of daily delivery under the then existing system. This work is notable for its painstaking efforts to develop operational criteria for evaluating market performance. It was fully recognized, of course, that exclusive delivery territories would require public regulation in order to avoid monopoly abuses. The public ownership or utility approach has its share of potential problems as well, but as Bressler correctly noted, the ultimate validity of his results could probably be tested only through new public programs. The possibility that "efficient" organization of industry is incompatible with competitive structure is not limited to local distribution and assembly functions. It is a problem encountered time and time again in the literature on industrial organization.

## EVALUATION OF STUDIES OF PERFORMANCE IN THE SPATIAL DIMENSION

Does a market system lead to satisfactory performance in the spatial dimension? As noted, welfare economics has established the equivalence between perfectly competitive and Pareto optimal market performance under certain assumptions. This equivalence has been shown to apply when the spatial dimension is taken explicitly into account. Research on spatial problems must, for the most part, be interpreted as an effort to quantify the perfectly competitive or optimal market results. That numerical results can be obtained is surely beyond dispute. The crucial question is whether these results closely approximate those which would prevail in a system that tends toward the competitive ideal. The question is easier to pose than to answer. If the researcher is willing to assume that the model of perfect competition in space is a tolerably close approximation to the real world, estimated and actual market performance may be compared in order to assess empirical validity. If this assumption is not made, the only way of answering the above question is through a painstaking scrutiny of the assumptions, data, and parameter estimates that are required to obtain optimal solutions. In any event, a close correspondence between actual and estimated market results would suggest a lack of serious economic inefficiency in the spatial dimension. Under such circumstances, comparative static analysis might be employed in predicting future change or in explaining quantitatively why past results have occurred. Where a close correspondence does not exist, comparative static analysis would appear to be of dubious value. In this case one might hope for further analysis in order to ascertain the cause of inefficiency and whether programs exist that would generate benefits in excess of program costs. It is on the basis of such expectations and reflections that much of the results from spatial research appears disappointing.

The assumptions, data, and parameters used in obtaining optimal results are often open to question. Geographic regions and the basing points within them are often selected in arbitrary ways, and the reader is left to wonder whether an alternative specification would lead to different conclusions. Data permitting, sensitivity analysis might be employed to resolve this issue. The transport system is complex and heterogeneous, with opportunities for back hauls, discontinuities, and random elements. The choice of the best mode of transportation from the shipper's viewpoint depends on a package of services in addition to the rate charged. There is always the question whether the transport cost matrices that appear in the literature are accurate reflections of actual costs. Regarding spatial equilibrium models that require supply and demand parameters, Weinschenck, Henrichsmeyer, and Aldinger [1969] wrote, "We shall not discuss here the great difficulties of estimating these functions

statistically. But in summary it can be stated that, despite a large amount of work at different methodological levels, our knowledge of agricultural supply response is very limited. Therefore, empirical application has been limited to some narrow problems, especially short-run analysis and experimental comparative studies" [p. 25]. It should be recognized, however, that the estimation of regional *derived* demands also involves production models and poses problems that are no less severe, and possibly much more so, than those posed by estimating supply functions at the farm level. The presence of monopsony elements might even render the concept of derived demand irrelevant. Also, supply and demand functions may not always be independent of transport costs. For example, a change in the cost of shipping live broilers rather than processed broilers might have important impacts on the location of the broiler processing industry and therefore on the levels of regional derived demands for live broilers. Overall, we tend to agree with Hassler [1964] that many studies have employed crude formulations and input data, and are primarily illustrative of technique. This conclusion is rather consistent with numerous caveats found in the various researches, caveats which warn the reader that results are only as valid as are the various model inputs.

It is particularly disheartening that researchers, largely for want of relevant data, have been unable to offer detailed comparisons of estimated and actual market results. Such comparisons are a necessary first step toward evaluating marketing efficiency. Even when comparisons are available, they are not always satisfactory. Thus, after comparing actual and estimated regional price differentials for green peppers, D. E. Farris and King [1961] concluded that the results "reflect either substantial imperfections in the functioning of the market, erroneous price reporting, or a lack of correspondence between the theoretical model and that of the existing marketing system" [p. 37]. They then passed on to other matters, leaving it to the reader to decide which of the options should be chosen.

Although the results of spatial research appear on the whole to be somewhat disappointing, the fact remains that mathematical programming provides powerful new tools for handling problems of historic concern. Moreover, a few studies like that by Dennis and Sammet [1961] point the way toward greater refinements and more useful applications. One might well ask, however, for a moratorium on studies that are mainly illustrative of technique. Whereas transportation and spatial equilibrium models hold considerable promise for narrow problems, long-run problems involving major commodities will likely call for activity analysis models. Application of the latter models will require greater resources than access to a computer, a harried major professor, and one or two graduate students. We emphasize once again the need for confronting

estimated "optimal" results with real world results and the appropriate follow-up analysis when substantial differences are observed and judged attributable to something other than errors in model inputs.

Finally, we call attention to an alternative research procedure which involves the construction of models designed to explain actual performance. The resulting models could be validated by comparing actual and predicted data. From studies of actual situations, researchers might be able to form specific hypotheses about causes of any imperfect competition that might be thought to exist. Simulation experiments might then be employed to measure the impacts of removing hypothesized barriers to perfect competition. Once again follow-up analysis would be required in order to ascertain whether the benefits of programs designed to remove barriers would exceed program costs. Recent works by Kottke [1970] and T. C. Lee and Seaver [1972] point toward this latter research approach. At this early stage of development, it is by no means clear whether this suggested research procedure is superior to that which just seeks to determine first the perfectly competitive results.

#### *Market Performance in the Temporal Dimension*

A temporal dimension might really be given to market performance by the simple expedient of dating all the variables in profit and utility functions. Theories of dynamics, growth, and development are relevant along with the related empirical research. As far as market performance in the temporal dimension is concerned, the scope of this survey, however, is limited to storage, stabilization, and the role of futures markets for both storable and nonstorable commodities.

The marked seasonality of farm production in contrast to the temporal stability of demand for consumption for most products has been alluded to previously. The implications for storage of farm products in terms of magnitude and nature of operations, location, costs, and recent trends are summarized by Kohls and Downey [1972] who provide several valuable references to the literature.

The evolution of the theory of storage and price stabilization has taken a rather strange course. More than thirty years ago Waugh [1944] showed that the consumer is better off with fluctuating prices than with prices stabilized at or above their simple arithmetic means. Later Oi [1961] constructed a model in which a competitive firm earns greater total returns with unstable prices than with stable prices. These two pieces were provocative, challenging the traditional wisdom according to which stability is preferable to instability.

Other writers were soon to join in the further development of the theory. Massell [1969] created a linear model in which the Waugh and Oi results were shown to be special cases. Turnovsky [1974] made a major contribution

by noting that the previous work analyzed price variability rather than uncertainty. His models were designed to reflect recursive systems in which farm production decisions were made before prices were known. More recently Subotnik and Houck [1976, 1977] analyzed the implications of stabilizing nonprice endogenous variables. In the resulting literature, writers have been primarily interested in the distribution of benefits and costs of storage and in determining the pattern of storage that could maximize the gains to society as a whole.<sup>26</sup> Whether buyers (sellers) would be made better or worse off by complete price stabilization depends on the specific values of unknown population parameters. Certain results, particularly those of Massell, suggested that price stabilization gave rise to net gains to society relative to the zero storage case. In this work, storage costs were often neglected and the possible existence of a private storage industry growing out of the quest for expected profits in an uncertain world was abstracted away.

Another line of development followed the discovery by Samuelson [1952], as previously discussed, that problems of spatial equilibrium could be solved through maximizing what he called net social payoff. This discovery along with further developments in spatial analysis were soon shown to be applicable to temporal analysis as well. Simple models of optimal intraseasonal and interseasonal storage were developed by Bressler and King [1970]. Major emphasis was given to perfect markets and pricing over time. More sophisticated models, including some that deal with multiple commodities and with temporal and spatial allocation problems simultaneously, were given by Takayama and Judge [1971]. Much of their work made use of quadratic programming. The distribution of benefits and costs among market participants was given scant attention.

The work of Gustafson [1958a, 1958b] represents still another approach to optimal storage. Gustafson's method of analysis draws upon optimal inventory theory. The conditions under which competition leads to optimal storage are carefully developed. The distribution of benefits and costs associated with various storage rules are estimated using time series and under assumed conditions. Perhaps Gustafson's work has not received the attention it merits because agricultural economists were for the most part unaccustomed to inventory theory.

Whereas Gustafson was concerned with the derivation of optimal storage rules and with their application to estimation of optimum feed grain carryovers, the more recent tendency is to use simulation in estimating the extent to which price variation would be reduced by government buffer stock schemes of various kinds. The recent spate of studies (Reutlinger [1976], Cochrane and Danin [1976], Walker, Sharples, and Holland [1976], and USDA, ERS [1976]) reflects the pattern of farm price instability observed in the period

since 1972 and the pleas of several prominent agricultural economists for a government storage program. These studies ignore for the most part the performance of the marketing system and compare performance under government programs with performance in situations in which no storage occurs. Neither theoretical nor empirical analyses that make such comparisons are of much direct value in appraising performance of the storage industry under alternative policy options. The relevant principle is with and without government programs, not with and without storage.

Price expectations and the manner in which they are determined play a key role in the recent storage theory developments that have been considered thus far. This being the case, it is all the more surprising that futures markets have been widely ignored in this literature. It seems plausible that an integration of the theoretical work on futures markets, on the one hand, with the work on the efficiency and cost-benefit distribution of storage, on the other hand, would facilitate research that seeks to determine the adequacy of market performance under alternative government policies.

The literature on futures markets has been surveyed by Gray and Rutledge [1971]. Our coverage of this topic is very brief. Of prime interest are publications that address the question whether futures markets improve market performance in the temporal dimension. Are temporal patterns of consumption, production, and, where appropriate, inventories closer to the optimal patterns because of futures markets? This question is rarely addressed squarely by the literature. Much of the literature seems based on the view, possibly quite reasonable, that less price variation over time is to be preferred to more, at least over the range of price variation observed. Several of the conclusions reached by Gray and Rutledge appear relevant here. First, the average amount of seasonal variation in commodity prices tends to be less in the presence of a futures market than in its absence. Second, "there is also a rather compelling presumption, where inventories and cash-futures spreads are closely interrelated, that inventory management is more appropriate than it would be in the absence of futures" [pp. 95-96]. Third, the role of and motivation for hedging as developed by Working [1953] and Heifner [1966] can also be presumed to facilitate optimal storage decisions. Finally, the conclusion by Telser [1958] and others that the futures price can be considered an unbiased estimator of the subsequent spot price would seem to support the view that futures markets facilitate both optimal storage and production decisions in recursive systems with or without continuous storage. Supply analysts are increasingly looking at futures prices as better proxies for expected prices than are lagged prices.

A number of studies have appeared since the Gray-Rutledge survey; several are considered here. In the area of seasonal price variation, A. C. Johnson, Jr.

[1973], following the earlier studies of Gray and Working, examined the onion market. Johnson found support for a conclusion of no significant change in price performance with and without futures markets. Gray [1972] examined interseasonal price stability in the potato market, finding that the potato futures market had served well as a medium for routine producer hedging to ensure interseasonal price stability.

Powers [1970] and C. C. Cox [1976] examined the effect of futures markets on variability of cash price. Each of these studies compared price fluctuations before and after futures trading. Each of the studies concluded that futures trading served to improve information available to traders and thus improved the efficiency of price formation.

Kofi [1973] extended the earlier work of Tomek and Gray [1970]. Kofi applied the correlation coefficient ( $r$ ) as a measure of intermarket performance across several futures markets. He argued that the ability of current futures quotations to "forecast" subsequent price levels could be determined by measuring the correlation of current futures quotations and subsequent prices. He applied this measure to several commodities to show that the performance of futures markets depends on inherent difficulties in forecasting supply and demand conditions, institutions peculiar to the commodity, and other factors that contribute to or impair pricing efficiency.

Peck [1973] criticized the use of  $r^2$  as a measure of intermarket performance, arguing that this statistic does not adequately reflect the information available on forthcoming supply and demand conditions. Thus the  $r^2$  measure may reflect more on the institutions surrounding a particular futures market than on the market itself.

These more recent studies tend to support the conclusions of Rutledge and Gray on the importance of futures markets in increasing the temporal efficiency of markets. The work of both Kofi and Peck indicates that the role of futures markets must be considered in the context of other institutions that may increase or decrease the temporal efficiency of markets for storable and nonstorable agricultural commodities. It appears that the time is ripe for analyses examining situations that combine futures markets and other mechanisms to facilitate intertemporal price efficiency.

Although futures markets appear to have positive attributes with respect to temporal efficiency, they have come under widespread attack from farmers and Congress. Gray and Rutledge reviewed much of the history of the attack on futures trading. Since their survey, Congress has chosen to substantially re-vamp the regulation of futures trading through the creation of the Commodity Futures Trading Commission (CFTC). The hearings on legislation to establish the CFTC and to extend its life beyond the initial four years provide a wealth of information on the day-to-day problems of ensuring that futures markets

serve their legitimate economic function. These hearings also reveal a number of researchable questions concerning market rules for ensuring an efficient and equitable futures market.

### *Vertical Organization and Market Performance*

We turn now to the examination of research on vertical organization and economic performance. It is appropriate that this be one of the last portions of our review. The vertical dimension touches many of the previous sections but does not fit well within any of them. One of the major problems in research on the vertical organization of agricultural marketing systems has been the inability to develop a clear conceptual approach to the subject. Although there has been a substantial amount of research on vertical integration, contract farming, vertical coordination, and vertical cooperation, much of this work has suffered for the lack of a central theoretical focus. The industrial organization paradigm discussed earlier places the vertical scope of firms as an element of market structure. In this context firms with differing vertical relationships to buyers or suppliers may be expected to behave differently. The act of vertically integrating or forming more permanent ties to suppliers or buyers may also be considered an element of market conduct that flows from horizontal structure in input or output markets.

Mighell and Jones [1963] produced a landmark monograph on vertical coordination in agriculture in which they attempted to pull together the theoretical approaches advanced up to that time. They defined vertical coordination as "the general term that includes all the ways of harmonizing the vertical stages of production and marketing. The market-price system, vertical integration, contracting, and cooperation singly or in combination are some of the alternative means of coordination" [p. 17.] This has come to be a generally accepted definition. It went a long way in separating the "end" of harmonizing from the "means" or mechanism through which this might be accomplished. The research on vertical coordination might be logically divided into studies that examine the need for "harmonizing" and those that examine the functioning of the alternative "means" or mechanisms for harmonizing.

### *Incentives for Vertical Coordination*

When any economic activity is separated into specialized operations, a need arises to coordinate those operations. In the theoretical world of single-product firms, perfect information and costless transactions, prices are the main instrument of coordination. When we depart from this theoretical ideal, however, the coordinating task may be accomplished in a



variety of ways. In this context the question becomes how and why a firm chooses to coordinate its decision making with adjacent stages?

Several authors have discussed the incentives for changes in vertical organization (Allen [1972], Hirsch [1950], Padberg [1966], Roy [1972], and Trifon [1959]). Such lists can be reduced to four general incentives: technological changes or complementarity, imperfect markets in adjacent stages, the desire to reduce risk, and the desire to reduce transactions costs.

#### TECHNOLOGICAL COMPLEMENTARITY

The technical relationship between successive production stages concerns the degree of complementarity between the two production processes. The classic example is found in the making of steel from pig iron where substantial savings in energy may be attained by placing the processes in close proximity. Other examples include a variety of processes in which storage or holding costs could be reduced by coordinating the output/input rates between successive production processes.

The basic reasoning here is that certain production processes will be combined under a single management because of the joint nature of the production process and the need for joint decision making. The problem is thus one of finding the optimum vertical enterprise combination for the firm.<sup>27</sup>

Stigler [1951], and more recently Paul [1974], took a slightly different approach which rests on the interaction of technical factors that push toward specialization and the economic factors that determine the size of the market. In this approach the drive for economic specialization and minimum efficient scale in successive production stages is seen as the driving force determining the vertical scope of firm activities. In Stigler's view, this force is affected by the size of markets for the final consumer product. Thus he argued that when an industry is "new" and its sales volume is limited, it may be forced to be a self-supplier of most of its inputs. As its sales grow sufficiently so that certain inputs or functions can be provided at lower cost by specialized firms, these functions will then be "spunoff" to firms that become suppliers to the industry. Thus the drive for "division of labor" tends to result in disintegration in growing industries. This scenario has empirical relevance in the vegetable processing industry where history reveals that in its early development it was common for canning firms to produce their own crops. As output grew, however, this industry looked increasingly toward specialized farmers for inputs.

Paul's argument rested more strongly on technological change and the desire for risk-sharing arrangements as factors redefining the vertical scope of firm activity. The vertical disintegration of the traditional corn-hog, farrow-to-finish farm combination into separate farrowing and finishing farms may well be a good agricultural example where changing technology has resulted in a new vertical enterprise combination.<sup>28</sup>

## RISK REDUCTION THROUGH VERTICAL COORDINATION

Paul [1974] recognized, as had many earlier writers, that changing the vertical organization of the production marketing system may result in new patterns of risk distribution. He emphasized that as the degree of economic specialization changes, new risk-sharing arrangements evolve. Logan [1969] developed a model of firm utility incorporating the concept of lexicographic ordering of multiple objectives. He postulated that firms seek to maximize profits subject to a risk constraint. Using this model, he showed that a firm might choose to integrate vertically with an adjacent stage even if costs are not reduced, so long as the variability of costs and thus rate of return variability was reduced. Logan emphasized the complex nature of the vertical integration decision and the need for a multidimensional framework. Mueller and Collins [1957], in examining vertical integration in the vegetable industry, cited uncertainty as a substantial incentive for grower-canner contracts. In this case uncertainty for growers arises out of the inelasticity of demand at harvest. This inelasticity is the result both of product perishability and of the monopsony element associated with most grower-canner markets. Canners also face substantial uncertainty because of inelastic supply and the desire to run relatively fixed plants at efficient capacity. This situation produces incentives for both growers and canners to agree in advance on qualities, prices, and production timing.

Several authors have examined the question of risk reallocation under vertical integration. The basic concern here is the extent to which reduced variation in prices or costs may be offset by other factors. Daellenbach and Fletcher [1971] explored the savings to be gained from reduced variance of slaughter supplies to packing plants. They found that although costs of slaughter could be reduced, these cost savings could be offset by the inability to control variation in product market price. Similarly the price certainty gained by broiler contract growers during the period of the contract may be offset by the uncertainty associated with getting a new contract and being able to use specialized fixed investments. Reducing price risks through forward contracting reduces variability in only one element of the profit equation and may have the effect of increasing the monetary losses associated with variable production levels or variable input costs.

## MARKET IMPERFECTIONS IN ADJACENT STAGES

Vertical integration may be undertaken by a firm in order to avoid the payment of monopoly prices in an input market or to avoid monopsony prices in the sale of products. Several authors have argued that this is a major incentive for the formation of both marketing and supply cooperatives. Parker [1976] showed that integration into food manufacturing by food retailers is

related to levels of concentration and product differentiation in manufacturing industries.

Integration to avoid market imperfections has been explored by Helmberger and Mueller [1972] in a review of the "Chicago School" analysis of vertical integration. This analysis examines the price and quantity impacts of vertical integration by a monopolist buying from or selling to a competitive industry versus a monopolistic input supplier selling to a monopolistic final product manufacturer. In the first instance it is argued that the monopolist would have no incentive to enter competitive output or input industries. By having a monopolistic position, the monopolist could already extract all possible monopoly profits from the system. Thus vertical integration by a monopolist in such circumstances could only be done to improve efficiency. For successive monopolies, there would be an incentive for vertical integration of the two monopolies, but the effect would be to lower prices and increase output. This would result from the elimination of successive marginalization. The combined firm would no longer face an input supply price above marginal cost. These two models have been interpreted as meaning that there are no detrimental effects associated with vertical integration because either it will be undertaken to improve efficiency or it will have the impact of increasing welfare.

As Helmberger and Mueller [1972] and other authors (Hoffman [1940], Machlup and Taber [1960]) have pointed out, one should be extremely cautious about generalizing policy from the simple bilateral monopoly models. The usual case is not monopoly but oligopoly, and in this situation it is not at all clear that vertical combinations improve welfare.

Vertical coordination arrangements seldom confer any original market power. They can, however, serve to strengthen horizontal power (Walsh [1968]). This occurs when a firm with substantial power at one level extends that power by vertical integration to another level of the system. This can lead to foreclosure of markets or supplies for competitors, to price squeezing, and possibly to eventual restructuring of the industry.

As Breimyer [1976] pointed out, product differentiation may increase the need for vertical coordination. In many instances vertical integration or contract production is resorted to in order to secure supplies that allow the firm to differentiate its product. Hoffman [1976, p. 165] argued that advertising by major food manufacturers might be considered a form of vertical coordination since it has the effect of preselling the firm's products. This in effect moves the merchandising function from the retailer to the manufacturer.

#### TRANSACTIONS COSTS

The last factor posited as a major incentive for vertical integration is the cost of using the market mechanism. It is argued that operating and using

markets are costly and further that markets may not be able to transfer the kind of information needed to coordinate successive stages in numerous dimensions. One might argue that the centralized spot trading of commodities where the volume of trade is large, commodities are standardized, and product requirements are not unique is an unusual case. The transactions cost argument is traced to the writings of Coase [1937] who developed a rationale for the existence of firms. In recent years the idea of transactional barriers to market exchange has been advanced by Williamson [1971], Alchian and Demsetz [1972], and several other authors (Kessler and Stern [1959], Bucklin [1970], Goldberg [1968]; also see W. D. Purcell [1973] for an application to the beef industry).

### Vertical Coordination Mechanisms

It was suggested earlier that much of the research on vertical coordination centered on the mechanisms for coordinating the stages of production and marketing. In general, the research of agricultural economists has been focused on those areas where one coordination mechanism was being displaced by another. This has meant a focus on the movement away from spot transactions in organized markets and toward direct marketing and various types of contract exchange. Mighell and Jones [1963] classified contracts being used in agriculture at the time of their writing as market specification, production management, and resource providing. This classification scheme attempted to differentiate contracts by the extent of economic control. The most detailed study of contracts was conducted by Harris and Massey [1968] who collected over 400 contracts and attempted to classify them. Their study concentrated on developing a measure of the extent of integration achieved through different contracts. In developing their classification scheme they encountered a problem which they expressed as follows:

One view [of integration] holds that integration increases as elements of entrepreneurship are shifted from the Farmer to the Contractor chiefly through assumption of management control and decision-making. Implicit in this view is a corollary assumption that increased integration results in increased assumption of risk and uncertainty by the Contractor and increased certainty of price and market for the Farmer. Under another view, however, integration reaches its height when the Contractor has all the management control and decision-making and the Farmer bears all the risks and uncertainties. That is to say, integration reaches the maximum when the Farmer loses all rights but none of the burdens in the transfer of entrepreneurship. The "toughest" or "tightest" contract from this viewpoint represents the highest degree of integration [p. 95].

Much of the research on contracting in agriculture has been centered on the extent to which farmer-to-first-handler contracts are equitable in distributing obligations and rewards.<sup>29</sup> Many of these studies have taken a relatively standard partial budgeting approach to estimate costs and returns to farmers under specific contract arrangements. Although such studies have been helpful in evaluating contracts, they generally do not provide broad insights into the performance of contract exchange. Many of these studies fail to examine the exchange conditions surrounding the contract process in sufficient detail to determine the factors that influence a particular contract outcome.

### The Extent of Nonmarket Vertical Coordination in Agriculture

Mighell and Hoofnagle [1972] developed the most widely used estimates of the extent of contracting and vertical integration in agriculture. These estimates were based on judgments by marketing specialists in the USDA. As Tables 4 and 5 show, production contracts are far more frequently used than vertical integration. Among crops, production contracts are most heavily used with vegetables, sugar beets, and specialty crops to provide coordination between farmers and first handlers. Among livestock products, production contracting is most important in fluid grade milk, broilers, and turkeys. Readers who wish more detailed information of the vertical coordination arrangements in specific commodities are referred to Roy [1972], Mighell and Hoofnagle [1972], and a recent NC-117 symposium (Marion [1976]). Here we choose to concentrate on poultry, fruits and vegetables, and hogs because substantial work is available.

#### VERTICAL COORDINATION IN THE POULTRY INDUSTRY

The poultry industry has been a frequent focus of concern as the most visible "laboratory" case of changing vertical organization of the food system. The rapid transition of this industry from a dispersed small flock, family farm enterprise to the concentrated, coordinated, large-scale industry it is today caused a general concern that the structural model followed by the poultry industry would become the pattern for all of agriculture. This concern led to a large number of studies and many pronouncements.

The U.S. National Commission on Food Marketing [1966c] traced the evolution of poultry integration from the time of the development of feed supply contracts, basically a financing device. As feed manufacturers became more involved in broiler production, they saw additional advantages in controlling hatcheries, hatching egg supply flocks, and broiler processing. As feed manufacturers increased their processing activities, fewer broilers were available to independent processors. Independent processors began contracting

Table 4. Crops: Estimated Percentage of Output Produced under Production Contracts and under Vertical Integration, United States, 1960 and 1970<sup>a</sup>

| Crop                        | Production Contracts |      | Vertical Integration |      |
|-----------------------------|----------------------|------|----------------------|------|
|                             | 1960                 | 1970 | 1960                 | 1970 |
| Feed Grains                 | 0.1%                 | 0.1% | 0.4%                 | 0.5% |
| Hay and Forage              | 0.3                  | 0.3  | --                   | --   |
| Food Grains                 | 1.0                  | 2.0  | 0.3                  | 0.5  |
| Vegetables for Fresh Market | 20.0                 | 21.0 | 25.0                 | 30.0 |
| Vegetables for Processing   | 67.0                 | 85.0 | 8.0                  | 10.0 |
| Dry Beans and Peas          | 35.0                 | 1.0  | 1.0                  | 1.0  |
| Potatoes                    | 40.0                 | 45.0 | 30.0                 | 25.0 |
| Citrus Fruits               | 60.0                 | 55.0 | 20.0                 | 30.0 |
| Other Fruits and Nuts       | 20.0                 | 20.0 | 15.0                 | 20.0 |
| Sugar Beets                 | 98.0                 | 98.0 | 2.0                  | 2.0  |
| Sugar Cane                  | 40.0                 | 40.0 | 60.0                 | 60.0 |
| Other Sugar Crops           | 5.0                  | 5.0  | 2.0                  | 2.0  |
| Cotton                      | 5.0                  | 11.0 | 3.0                  | 1.0  |
| Tobacco                     | 2.0                  | 2.0  | 2.0                  | 2.0  |
| Oil Bearing Crops           | 1.0                  | 1.0  | 0.4                  | 0.5  |
| Seed Crops                  | 80.0                 | 80.0 | 0.3                  | 0.5  |
| Miscellaneous Crops         | 5.0                  | 5.0  | 1.0                  | 1.0  |
| Total Crops <sup>b</sup>    | 8.6                  | 9.5  | 4.3                  | 4.8  |

<sup>a</sup>Estimates for individual items are based on the informed judgments of a number of production and marketing specialists in the U.S. Department of Agriculture.

<sup>b</sup>The totals were obtained by weighing the individual items by the relative weights used in computing the ERS index of total farm output.

Source: Mighell and Hoofnagle [1972].

with feed manufacturers and growers for live birds. As contracting spread, contracts with growers shifted more and more of the management decisions and risk to contracting firms. Growers furnished land, buildings, equipment, water, electricity, and labor. The NCFM argued that the reason broiler production was not integrated through ownership was the availability of underemployed farmers with facilities who were willing to sell their labor at very low rates because they had few or limited alternatives. Contracts also allowed integrators to avoid Social Security, Workmen's Compensation, and other nonwage labor costs associated with integrating and hiring employees. (Also see Aspin, Miller, and Walsh [1965] and Marion and Arthur [1973].)

Turkey production has followed a pattern similar to although more variable than broiler production. The seasonal nature of the turkey market, the longer

Table 5. Livestock and Livestock Products: Estimated Percentage of Output Produced under Production Contracts and under Vertical Integration, United States, 1960 and 1970<sup>a</sup>

| Crop                               | Production Contracts |       | Vertical Integration |      |
|------------------------------------|----------------------|-------|----------------------|------|
|                                    | 1960                 | 1970  | 1960                 | 1970 |
| Fed Cattle                         | 10.0%                | 18.0% | 3.0%                 | 4.0% |
| Sheep and Lambs                    | 2.0                  | 7.0   | 2.0                  | 3.0  |
| Hogs                               | 0.7                  | 1.0   | 0.7                  | 1.0  |
| Fluid Grade Milk                   | 95.0                 | 95.0  | 3.0                  | 3.0  |
| Manufacturing Grade Milk           | 25.0                 | 25.0  | 2.0                  | 1.0  |
| Eggs                               | 5.0                  | 20.0  | 10.0                 | 20.0 |
| Broilers                           | 93.0                 | 90.0  | 5.0                  | 7.0  |
| Turkeys                            | 30.0                 | 42.0  | 4.0                  | 12.0 |
| Miscellaneous                      | 3.0                  | 3.0   | 1.0                  | 1.0  |
| Total Livestock Items <sup>b</sup> | 27.2                 | 31.4  | 3.2                  | 4.8  |

<sup>a</sup>Estimates for individual items are based on the informed judgements of a number of production and marketing specialists in the U.S. Department of Agriculture.

<sup>b</sup>The totals were obtained by weighing the individual items by the relative weights used in computing the ERS index of total farm output.

Source: Mighell and Hoofnagle [1972].

growing time, the higher risk of disease, and the greater management and capital requirements have been suggested as factors retarding the change in organization of the turkey industry. (Also see E. G. Thompson and Rhodes [1969], Rhodes [1970].)

The egg industry has also experienced a shift toward contract arrangements for egg sales. This has paralleled the evolution of factorylike methods of egg production in very large units.

In evaluating the changing vertical coordination in the poultry industry, the U.S. NCFM [1966c, p. 10] concluded:

it is reasonably clear that the physical production efficiencies actually achieved would not have come as rapidly if it would have been required that traditional agriculture—independently organized into autonomous decision-making units—should have prevailed. New technologies in poultry production made it possible to separate out the routine, repetitive jobs so they could be centrally supervised and efficiently performed by relatively unskilled labor. Skilled management could be spread widely.

Rogers [1971] examined the relationship of integration in the egg industry and marketing margins. In a relatively rare attempt he developed a system to

quantify the extent of integration. Although his method was crude, he could graphically relate the changing vertical organization of the industry to steadily declining marketing margins (farm to retail spreads).

Marion and Arthur [1973] in a recent study of the broiler system applied a mixture of conceptual approaches to examine the industry as a dynamic commodity system. They concentrated on the structural and institutional characteristics and the distribution of decisions in the broiler system as a group of vertically linked firms. A major conclusion of their study was that even though individual integrators have developed tightly coordinated vertical networks, the system in the aggregate has continued to experience relatively unstable prices and profits. The key element of horizontal coordination was not present to a sufficient degree to prevent "mercurial prices and profits." In evaluating the performance of the system, Marion and Arthur concluded that the broiler system has substantially lowered broiler costs, that this cost reduction probably came sooner than it would have in a nonintegrated system, and that a number of transactional efficiencies have been achieved. However, Marion and Arthur [1973, p. 46] also concluded: "there is no solid evidence that integrated systems are inherently superior to market coordinated systems or vice versa." A major strong point of the Marion and Arthur study was its attempt to develop an approach to examining vertical systems from input supply through consumption. Although the study was generally not a hypothesis-testing effort, it did raise questions that could be tested through the use of more quantitative techniques. What it did was to examine in a holistic way the production-marketing process, taking account of the interrelated vertical elements in this process.

#### VERTICAL COORDINATION IN PROCESSED VEGETABLES

As was mentioned earlier, close coordination between vegetable production and processing has been the norm for most of the industry's history. The Mueller and Collins [1957] examination of coordination between tomato growers and processors remains the major contribution to understanding this phenomenon. The structural circumstances surrounding the marketing process as well as the technical factors encouraging varietal selection and production timing appear to be the major explanations for the vertical organization which has been quite stable over time. (Also see U.S. NCFM [1966e].)

There continues to be some concern about the impact of processor integration combined with contract procurement on returns to contract growers. Andrews [1959] in a study of the sweet corn industry showed that under conditions of inelastic supply processors could be better off growing some of their own supplies and that this could result in lower returns to growers.



Helmberger and Hoos [1965] argued, however, that where processors provide a large share of management and specialized capital, supply would likely be relatively elastic. In growing regions for crops like peas, sweet corn, and snap beans, other crop alternatives are usually readily available and limit the exploitation potential for processors.

In studying vegetable production contracts many attempts to evaluate contract terms have been made (Black and Froker [1947], U.S. NCFM [1966e]). Jesse [1970] and Jesse and Johnson [1970], in an analysis of Wisconsin pea and sweet corn contracts, used multiple classification analysis to develop an adjusted price that accounted for the provision of inputs and other nonprice contract terms. They concluded that whereas the per ton price indicated in contracts varied widely, the net economic benefits derived by the contractee were quite similar for all contracts. They also found some evidence of lower prices where the number of processor outlets was limited.

#### VERTICAL COORDINATION IN THE HOG-PORK SUBSECTOR

For a number of years concern has been expressed over the possibility that the hog production-marketing system would follow an evolution similar to that of broilers. Although there has been sporadic use of production contracts and sow-lease programs, an increasing number of large-scale hog enterprises, and increasing direct marketing, the hog-pork subsector has remained primarily market coordinated.

Blaich [1960], in a paper attempting to develop and apply a theory of vertical integration, forecast a separation of corn and hog production. Further, he believed that the role of feed manufacturers in vertical integration in the hog industry would be limited by the small scale required for efficient on-farm feed mixing. He hypothesized that the form of integration by feed manufacturers would be of a weaker contract type. His predictions have in the main been borne out.

In reviewing the contributions to a symposium on vertical coordination in the pork industry, Schneidau and Duewer [1972] predicted that there would be increased vertical coordination and integration in the pork industry but that it would exist side by side with an independently owned and controlled production and open-market system. Newcom, Grimes, Rhodes, and Cramer [1971], in examining the production and marketing of hogs under contract, concluded that disease problems remained a significant barrier to risk-shifting contracts similar to those used in the poultry industry. They concluded that until disease is controlled sufficiently contractors cannot afford the risk of contract production.

In terms of incentives for improved coordination, research has emphasized

the importance of savings resulting from regularity of volume and quality. Holtman, Sullivan, and Barreto [1974] estimated that slaughter plants could realize cost savings of over 10 percent if complete control of market hog supply could be obtained. The greatest share of cost savings (9.1 percent) would be achieved by reduction in seasonal supply variation. As the authors pointed out, this would be the most difficult type of variation to control. Snyder and Candler [1973] also found that substantial savings resulted from improving the regularity and volume of live hogs marketed. Neither of the studies cited above provided estimates of the costs of achieving the degree of supply regularity they assumed. These studies were not alone in this regard. It has been quite common to use a variety of firm efficiency models to estimate potential savings resulting from improved coordination. It has been much more difficult to estimate the costs of achieving particular levels of control through alternate market mechanisms. Although there have been studies examining the costs of alternative market channels (R. D. Johnson [1972]), none have tried to estimate the efficiency of particular market mechanisms in achieving coordination objectives.

Campbell and Hayenga [1973], in a study of procurement contracting and sow-leasing programs, discovered several barriers to changes in vertical coordination systems. Packers who had attempted production contracting sometimes found that contractees did not provide the degree of management found on owner-operated farms. Packers were also concerned about being "locked in" to fixed input costs if their competitors were not. This echoed the earlier findings of Daellenbach and Fletcher [1971] that fixed input prices could be detrimental to returns if output prices were not stabilized.

Feed manufacturers were found to provide mixed reactions to sow-leasing programs. Where these programs were viewed as part of a feed sales strategy, they were generally regarded as successful. Where they were treated as independent profit centers, the results were not generally viewed favorably.

### Subsector Systems Research

In the late 1960s Shaffer [1968a, 1968b, 1973] called for a new approach to marketing research. He emphasized the need to consider the vertical systems involved in producing and marketing agricultural products as well as horizontal and firm efficiency questions. As French [1974] indicated in a paper evaluating the subsector as a conceptual framework, this approach could be divided into: "(1) subsector research systems, a way of organizing research; and (2) subsector systems research, a methodological approach to which the subsector is the unit of observation" [p. 1014].

The work by Marion and Arthur [1973] and Marion [1976], reported earlier, and some of the work on the hog-pork subsector (Candler and Manchester

[1974]) were carried out in the system research mode. Earlier studies by Goldberg [1968] and Tobin and Arthur [1964] also fit within this macro approach to coordination (also see Henderson [1975]). Although few studies have been conducted to date using the subsector approach, it appears to be a promising way of analyzing vertical systems. It is clear from the previous work on vertical coordination in the poultry, fruit and vegetable, and hog industries that the type of vertical coordination arrangement at one level is not strictly independent of other levels in the production distribution system. Thus it seems essential that an improved understanding of vertical coordination will require its examination within the subsector context.

### Vertical Organization and Coordination in Perspective

The literature on vertical coordination in agriculture suggests a number of reasonable incentives for nonmarket exchange, documents the development of alternative coordination arrangements, and estimates the efficiencies to be gained from improved coordination. The literature does not generally compare the trade-offs involved in "administered coordination" versus "market coordination," nor does it provide a well-developed framework for doing so. In general, vertical coordination arrangements must be evaluated on a case-by-case basis. As Breimyer [1976] argued, a chief concern with vertical coordination through integration or contracts is that it removes much information from the economist's view, making it increasingly difficult to evaluate.

### Public Policy toward Vertical Integration

The U. S. National Commission on Food Marketing [1966a, pp. 106 and 111] suggested several changes in public policy toward vertically integrated firms including public availability of information on their integrated operations and close scrutiny of their business practices to ensure that competition was not restricted. In addition, they suggested that the U.S. Department of Agriculture should have the authority to require submission of price, quantity, grade, and similar information from firms transacting business in foods, including growers. The commission believed that such authority would allow price-reporting programs to function more effectively in an increasingly decentralized marketing system.

Recently the U.S. Federal Trade Commission initiated a limited program requiring diversified and integrated companies to report their operations by line of business. This program would accomplish some of the suggestions of the U.S. NCFM, although the program is not currently comprehensive enough to cover many cases of concern in the food system. The U.S. Department of Agriculture at the time of this writing has not been given authority to require mandatory price reporting. Even without this authority the Agricultural

Marketing Service has begun to experiment with programs for reporting contract prices.

A recent Supreme Court ruling (Baarda [1978]) shed some light on public policy toward the role of vertically integrated firms as members of agricultural marketing cooperatives. This case, which involved the National Broiler Marketing Association (NBMA), concerned the eligibility of this group to claim exemption from the antitrust laws as a Capper-Volstead cooperative. The court found that some members of the association were not producers in the sense of the Capper-Volstead Act and the association was therefore not eligible for the Capper-Volstead exemption. The court did not go so far as to say that an association of totally vertically integrated firms involved in agricultural production would not be protected by the Capper-Volstead Act. The evolution of the National Broiler Marketing Association case illustrates the difficulty the courts have had in interpreting public policy toward vertical integration in agriculture. The district court had found the association qualified under Capper-Volstead because the members shared the risks of broiler production. The appeals court held that the members of NBMA were not farmers even though they shared production risks. In general the court was not able to determine clearly how to treat the vertically integrated firm.

At the congressional level, legislation has often been introduced to prohibit vertical integration into farming. The Family Farm Antitrust Act (HR941 [Jan. 1977]), sponsored by Representative Kastenmeier of Wisconsin and several farm state congressmen, would have prohibited vertical integration backward into farming by corporations above a fixed asset size. This legislation was designed to protect the "family farm" from outside investment, and although the legislation has been introduced in several sessions of Congress it has yet to become law.

Many states have passed "corporate farm" laws that attempt to collect data on and regulate nonfarm investments into farming. Many of these laws have placed limited controls on direct vertical integration by nonfarm firms. Further, some states have attempted to regulate specific practices associated with contract coordination and vertical integration. For example, a recent Wisconsin law (Wis. Stats. 100.235) requires vegetable processors who grow more than a fixed percentage of their own supplies to pay farmers prices at least equal to the companies' cost of production. This law attempts to prevent firms from monopsonistic exploitation of growers.

In the early 1970's the Packers and Stockyards Administration of the USDA issued rules that prevented the operation of custom feedlots by meat packers or the operation of packing plants by custom feedlots (39 Federal Register 17529 [May 17, 1974]). This regulation prevented the development of an

institutional tie between custom feeding and meat packing which had an inherent conflict of interest. The custom feedlot linked to a meat packer could not be expected to serve the interests of the cattle owner in seeking the best market outlet for the cattle.

At the time of this writing, the Packers and Stockyards Administration is seeking to stop an agreement between a major meat packer and an association of feed lots (*U.S. vs. Iowa Beef Processors, Inc. and Columbia Foods, Inc.* [1978]). The agreement involves a long-term contract for cattle supplies to be provided exclusively for the packer. The chief concern appears to be the expected foreclosure of cattle supplies to other packers and cattle markets for other feedlots.

There has been no general legislative outcry for legal barriers to vertical integration into farming. Although such proposals have received support from farmers, the lack of a clear link to noncompetitive behavior, absent high levels of horizontal control, has limited the general legislative concern over vertical integration. Further, the generally favorable impact that vertical integration appears to have had on production and marketing costs has limited the desire of many policy makers to prevent integration. One might also observe that most of the public policy concern has been with backward vertical integration into farming. Whereas forward integration into food marketing by farmers has generally been encouraged, only recently has forward integration by agricultural cooperatives received much attention and then only when horizontal control appeared to be sufficient to threaten competition.

Although the general public has had limited interest in vertical integration in the food system, it is a recurring topic in debates on farm policy. Further research could add significantly to these debates, especially in the area of the link between horizontal market power and vertical control. In addition, further research would be helpful in developing new institutional designs that contribute to improved vertical coordination and yet ensure equitable exchange among the participants in the food marketing system.

### *Concluding Remarks*

Probably the most important decisions in the public policy arena are based on highly subjective appraisals of cause and effect relationships. Economics has not progressed to the point where all consequences can be accurately quantified for relevant policy alternatives, leaving only the choice of ends to policy makers. It seems likely, however, that the quality of public decisions improves with a better understanding among the electors and the elected of how the real world functions and what some of the consequences of alternative policies are likely to be.

Viewed from this vantage point, the achievements in aggregative agricultural marketing research since World War II have been impressive and augur well for continuing progress. Public policy affects the marketing of farm outputs and inputs in many and varied ways. We have not the slightest doubt but that policy makers and the electorate are now in a much better position to identify problems and possible solutions than they would be in the absence of the countless bulletins, journal papers, and books, and the educational programs, including extension, the classroom, and mass media, through which agricultural economists have striven to explain how and why the marketing sector performs the way it does. Concrete examples are not hard to find. As antitrust authorities and the USDA become more involved in enforcing prohibitions against monopolization by farmer cooperatives, for example, they will find a growing literature to guide their investigations. It will be seen that market share is a much less meaningful indicator of market power of cooperatives than of profit-seeking corporations. To take another illustration, the Commodity Futures Trading Commission Act of 1974 charged a newly created commission with exploring several issues relevant to the efficiency of futures markets. Clarification of the meaning of hedging and dual trading as a means for increasing market liquidity are examples. Economists have played a leading role in the exploration of these issues, having, in turn, a substantial impact on the regulation and efficiency of futures markets.

The achievements in aggregative agricultural marketing seem impressive except when viewed against what it is we have yet to learn. This is another way of pointing out the obvious, that many problems remain unsolved, that the agricultural marketing system continues to change and to challenge those who propose to explain its contribution to the larger economic system of which it is a part. We believe, for example, that a substantially improved understanding of the dynamics of our food and fiber system would result from increasing attention to vertical coordination systems. Research in this area has been blocked by the absence of an acceptable theoretical framework for studying vertical coordination. As another example, the conglomerate firm does not fit neatly into the theory of price; the issue of the performance consequences of the growth of conglomeration is very much in dispute. As a final example, marketing research has made little use of benefit-cost analysis, in spite of the preoccupation with the need to increase marketing efficiency.

At various points in this survey we have identified areas meriting further work. We are not particularly eager, however, to press our views on others. A priority ranking of problems meriting further work depends not only on the importance of problems but on the progress that can be made toward their solution. Research interests and skills differ widely among individuals, and the choices of future research projects depend to an important extent on per-

sonal evaluations. We expect that future work in agricultural marketing will depend not so much on exhortations as to the importance of this or that phenomenon as on breakthroughs in theory, research methods, availability of data, and imaginative applications of existing theory which show the way for further productive research. The lifelong study of futures markets by H. Working [1949], a small note on stabilization by Waugh [1944 or 1971], an excellent industry case study by Nicholls [1951], a simple comparison of industry profits with concentration ratios by Bain [1968]—these are the stuff of which progress is made.

There are those, of course, who will point out rightly that much of the work on agricultural marketing has been descriptive and that studies and research programs have not been coordinated one with the other, so that bricks are bricks but never a house. Others will note the tendency of scholars in the field to go off on sprees of imitation as happened to some extent with spatial studies and descriptions of market structure. There are doubtless many explanations for this. Some of the descriptive work may have reflected professionals who were inadequately trained in mathematics, economic theory, and quantitative methods. Some reflects the desire of professionals to become better acquainted with the real world as a preliminary for further research and/or extension programs. The close association between graduate education and departmental research programs bias the latter toward small-scale projects compatible with dissertations. Like cats that sharpen their claws by scratching on trees, many scholars teach themselves the problems and promises of new-fangled research techniques through applications. They thus keep themselves current and ready for bigger game; publications are a mere by-product. Then, too, some problems are important enough to attract research resources even though available theory, techniques, and data are woefully inadequate. In the absence of an analytical framework, description and subjective judgments are the most one can expect.

The shortcomings of aggregative marketing research are often more apparent than real, although some failures have surely occurred. To understand why failures have occurred is to begin to see what might be done to avoid them in the future. The widespread emphasis on theory and quantitative methods in current graduate programs is certainly a start. Shaffer's [1968a] suggestion of establishing research desks in the USDA and forming interstate and interagency consortiums has received considerable attention. The experience now accruing under NC-117 may provide further evidence on ways to organize for more effective research. Although greater coordination and new organizational arrangements may be very productive in terms of applied research, we believe that the wellsprings of future progress are basic research and the associated flashes of genius that rarely strike individuals and never strike committees.

*Notes*

1. Although agricultural marketing may be defined to include both supplying farmers with production inputs as well as marketing farm outputs, the former has received far less attention than has the latter; the resulting balance or imbalance, as the case may be, is reflected here. Also, the above characterization of the farm sector is not as apt as it once was nor is the boundary between the farm and marketing sectors as clear-cut as it might first appear. We return to these considerations at various points in the survey.

2. The division of marketing literature between that focusing on intrafirm relationships and that focusing on interfirm relationships is based on differences in research methods and in criteria used to evaluate performance. The suggestion dates back to a paper by Nicholls [1948, p. 44] and has since become commonplace.

3. For want of time, we have chosen not to update the survey of marketing agreements and orders by Hoos [1958]. The works by Harris [1958], Kessel [1967], and Dobson and Buxton [1977] on milk orders and an excellent study by Jamison [1971] on fruit and vegetable orders provide references to the more current literature. The institutional and economic nature of marketing agreements and orders is well explained in a technical report by the National Commission on Food Marketing [1966e]. A study by Babb, Banker, Goldman, Martella, and Pratt [1977] contains many valuable references to the literature on dairy marketing including milk orders.

4. Kaysen and Turner [1959] proposed grouping firms into an industry even though they produce different products, providing the producers of any one product can readily produce any other. We believe that this suggestion confuses industry definition with barriers to entry.

5. Marion and Handy [1973] distinguished between descriptive and evaluative performance. Regarding the latter, they wrote (p. 23), "For an evaluative measure to have meaning, it requires a norm or ideal to which it can be compared." Absence of norms, as in the case of selling costs, and disagreement over what norms to apply, would render the concept of evaluative performance meaningless.

6. Our definition of market performance reflects the distinction between endogenous and exogenous variables in econometric models, with the interpretation of performance variables being very close to that of endogenous variables.

7. These definitions can be extended to cover national and international economic systems, but such extensions are mainly useful in the study of macroeconomics and international trade.

8. The need for performance norms received some attention in the national marketing workshops that followed passage of the Agricultural Marketing Act of 1946. Out of the 1955 workshop (USDA, AMS [1955a]) came the view that marketing efficiency could be defined as the ratio of ends to resources. This concept of efficiency was embraced by Kohls and Downey [p. 10] in 1972. The ratio of ends to resources appears to be nothing more than a benefit-cost ratio. Maximization of net benefits implies equating marginal benefits to marginal cost. Maximizing a benefit-cost ratio is inconsistent with equating marginal benefits and costs except under very restrictive assumptions.

Let  $B$  and  $C$  equal, respectively, the level of benefits and costs associated with the quantity of marketing services or resources given by  $Q$ . Assume  $B$  and  $C$  are both upward-sloping functions of  $Q$ . Then  $\max [B(Q)/C(Q)]$  implies that  $C \, dB/dQ = B \, dC/dQ$ . If marginal benefits are equal to marginal costs, as implied by the maximization of net benefits, defined as  $(B - C)$ , then  $C \, dB/dQ = B \, dC/dQ$  implies  $B = C$ . Maximization of the benefit-cost ratio is consistent with the maximization of net benefits if and only if the maximum of net benefits occurs at the level of  $Q$  where the benefit-cost ratio equals one.



9. The above discussion can be easily adapted to the case of a buying industry. The *degree of buyer competition* refers to the extent to which buyers coordinate their procurement (profit) policies in order to garner some, if not all, of the fruits of monopsony.

10. For a more complete discussion, see Stigler [1968].

11. The possible role played by market structure in persistent inflation is receiving increasing attention (Mueller [1974b]). Here is a potentially important area for future agricultural economics research.

12. See Scherer [1970] for a review of the literature on the determinants of market structure. An important point made is that the random growth hypotheses may be quite important in explaining market structure. If the reader prefers, B can be viewed as fixed at  $B_0$ . The surface then collapses to a line in three dimensions.

13. K. L. Robinson [1963] concluded: "There appears to be little correlation between market structure and performance as reflected in long-run price and output behavior, either among firms supplying agricultural inputs or those purchasing from farmers." Unfortunately, Robinson did not separate out the effects of changing demand and cost conditions, i.e., basic conditions, in measuring the net relationship of structure and performance. Decreasing prices over time are fully consistent, for example, with pure monopoly.

14. For an interesting set of papers on suggested changes in marketing channels, see U.S. Senate [1976].

15. More recent data indicate a continuing increase in concentration through 1975-76 (U.S. Congress, Joint Economic Committee [1977, p. 90]).

16. Bressler [1966] delivered a scathing attack on what he called the number games played by structuralists.

17. For a good analysis of the merger wave of the 1960s and a discussion of policy implications see Steiner [1975].

18. Relatively little published information is available concerning the accuracy and value of economic outlook information from these sources. The same is true with respect to privately issued forecasts. However, the latter situation is perhaps less of a problem since a dissatisfied user of a private outlook letter can cancel his subscription to make his dissatisfaction known. No completely analogous safeguard is available with respect to public forecasts.

19. This appraisal does not refer to the status of grade-based product differentiation. The theoretical work in this area is well developed as a result of studies of Waugh, Burtis, and Wolf [1936], Waugh [1944], and Price [1967].

20. A 1972 USDA report recommends that pork carcass grades be renamed to include a grade with a "U.S. Choice" designation. This recommendation, which was designed to increase consumer acceptance of pork, perhaps indicates the merchandising value of the term "U.S. Choice."

21. Although the conclusion that truck regulation leads to unworkable performance has not gone uncontested (R. A. Nelson [1967], Spychalski [1966]), the counterarguments and evidence seem weak indeed.

22. Scherer [1970] provided a brief summary of the more comprehensive researches along with valuable references. Regarding resources devoted to the various modes of transportation, Scherer concluded: "The utilization pattern encouraged by the intermodal freight rate structure developed under Interstate Commerce Commission regulation has been enormously deficient from the standpoint of efficient resource allocation" [p. 539].

23. In what follows, we shall not be occupied with theoretical advances per se. A recent book by Takayama and Judge [1971] provides an excellent summary of recent work, references to the literature, and a range of new optimality models which permit

handling a variety of spatial and temporal price and allocation problems. Also, see the survey paper by Weinschenck, Henrichsmeyer, and Aldinger [1969].

24. The simple transportation model may be extended to cover situations in which: (1) total regional supplies are not equal to total regional demands; (2) regional per unit costs of production are known; and (3) several commodities may be substitutes in consumption or production.

25. Studies that deal mainly with optimum location of farm production without getting very far into the marketing phase are not considered in this survey.

26. Several writers including Houthakker [1967] and McKinnon [1967] have considered the possibility of stabilization programs through government participation in the futures markets. A critique of the Houthakker proposal was given by Richardson and Farris [1973].

27. French [1977] addressed this question briefly in his earlier review. Blaich [1960] also examined the long-run planning decision to expand the firm vertically or horizontally.

28. Blaich [1960] applied a model emphasizing technical complementarity in the vertical and horizontal dimension to the corn-hog enterprise.

29. See, for example, Cravens and Marlowe [1957], Kohls and Wiley [1955], and Roy [1965, 1972].

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