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ORGANIZATION, SCALE, AND PERFORMANCE OF THE GRAIN TRADE

The United States grain-trading industry and its giant leading firms have been much in the news for their role in the rapid development of grain exports during the past decade. However, scholarly analyses of the marketing function they fill and the industry's competitive performance have been remarkably scarce.¹ The scantiness of statistical data or even organized anecdotal evidence partly explains this situation. In addition, the economics profession is still at the first step of translating the analytical concepts generally used in industrial organization into a form applicable to a trading industry. This essay attempts such a beginning in the following two steps. First, the major elements of market structure and conduct are defined as they apply to the grain trade. Second, upon finding the weight of evidence to suggest competitive behavior and performance of this sector, an explanation is proposed for the distinctive type of scale economy that begets a few large grain merchants with substantial shares in the export market.

MARKET STRUCTURE AND CONDUCT IN A TRADING ACTIVITY

The paradigm of market structure, conduct, and performance which has guided most statistical work in industrial organization and shaped many industry studies evolved from the contemplation of manufacturing industries: sellers and buyers are treated as distinct groups, scale economies are associated with physical facilities, and a pricing decision once made is assumed to stick for an appreciable period of time. The grain-merchandising industry exhibits none of these features.

The Problem of Market Definition

The industry does not transform commodities physically (except by such ancillary services as cleaning, blending, and drying), but grain is changed in value by transforming it in space and time. The industry sells three principal

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¹ An important exception is the proceedings of the grain marketing symposium held by the North Central Grain Marketing Research Committee in 1968; see (30).

services: it matches producers with processors, it holds inventories (incidental to this matching-up process), and it provides physical storage. (The large grain merchants provide some transportation services directly, but as an in-house function that is not central to their activities.) These services are often separated. Grain in storage is often owned and physically possessed by different parties, and brokers match up ultimate sellers and buyers without either owning or storing grain. The market in which these arbitrage services are provided is spatially dispersed and can be thought of as a collection of transportation corridors (actually or only potentially in use) stretching from production areas to processing locations. Alternative channels reaching out from a production area or converging on a processing location put into competition respectively the buyers or sellers located along those channels. Similarly, intersections of transportation channels limit monopoly or monopsony power that might be possessed by traders astride a channel on either side of the intersection.

These propositions, familiar from transportation economics,² explain why neither producing nor processing regions nor individual transportation corridors can be regarded as separate markets. To the extent that the arbitrage of grain and its ownership in transit do not depend on the merchant's ownership of physical facilities, he is not confined to dealing at individual locations, or along individual marketing channels, except by the modest fixed costs of market information and intermarket communication. Effective market control would have to include the ability to limit or exclude entrants and rest on the control of physical facilities. At first glance such control might seem feasible for terminal elevators at major inland centers or ports. As a storage facility, however, a terminal elevator competes not only with others at the same location but with storage capacity at all points on the distribution channels that pass through the terminal, including on-farm and processors' storage capacity. A terminal elevator enjoys a monopoly along a transportation channel only if it offers a unique facility for transshipment between efficient modes of transportation.

By the logic of this analysis, the most appropriate data for determining the potential for departure from competition take two forms. One is the elasticity with which grain distribution shifts between channels in response to changes in the distributive margin taken along a channel. The other is a measure of the concentration of activities or facilities of grain traders operating along well-defined transportation corridors.

The information available sheds only incidental light on the substitutability of distributive channels, because the variation observed in the channels in use is associated with variations in sources and destinations as well. The Interstate Commerce Commission *Carload Waybill Statistics* can be used to measure variations in freight car movements, and short-run changes in the identity of the terminal making the high bid to a given producer location should indicate the variability of actual transactions. Similarly, a programming model that allocates regional production to competing terminals can be used to explore the sensitivity of shipment patterns to shifts in prices bid by the terminals.³ Over the long run there is evidence of considerable shifts of grain traffic among export ports and

² For example, see Locklin (26, ch. 9).

³ For evidence, see Baumel et al. (4, pp. 23, 69, 85).

inland terminals (30, pp. 30, 39). All of these studies suggest a good deal of variability in the grain-marketing channels in use, in both the short and long runs—necessary though not sufficient evidence to show that localized groups of traders face elastic excess-demand functions at most points in the system.

Concentration of Transactors

Because the functions of matching buyers and sellers, holding inventories, storage, and transportation are all separable, they should be examined for concentration one by one. This course is also indicated by the fact that the appropriate scope of the market differs for each function. Pure brokerage is subject to the lightest geographical constraints and should be considered in a national market context. The most relevant data on storage facilities, on the other hand, would bear on a particular distribution channel or perhaps a major terminal node. Some feeling for concentration in the pure trading function is supplied by data on nationwide concentration among grain merchants. In 1972, 21 percent of all sales were accounted for by the largest four firms, 28.6 percent of all sales were accounted for by the largest eight, 40 percent by the largest 20, and 51.2 percent by the largest 50. In 1960 a private study found only slightly higher concentrations of shippers in the North Central region alone: 33 percent for the largest four and 50 percent for the largest eight (37, ch. 2, pp. 1-112; 16). These figures are low in comparison with manufacturing industries, including those selling in highly regional markets. The concentration of export shipments is a good deal higher, with unofficial estimates generally crediting the largest four shippers with around 80 percent of the market. The significance of this concentration is considered below.

Few available data are relevant to the concentration of physical facilities along particular channels of grain distribution. The concentration of terminal elevators at major export and inland points is rather high (because of scale economies), but the meaning of these figures as measures of monopoly potential is very limited because of the competition of facilities upstream and downstream from the terminal. Nonetheless, there is some value in examining elevators at a major terminal like Chicago where concentration has in times past been thought to be high enough to create a problem of market power. In 1969 the four largest companies controlled 81 percent of all federally-licensed terminal space in Chicago.⁴ The significance of this high level of concentration is subject to important qualifications:

1. Storage facilities outside Chicago have become much more competitive with Chicago storage over the last two decades. First inland waterway shipments from country locations to Gulf ports, then unit-train and other multiple-car rail rates encouraged shipment from producer locations to a variety of export and processing locations bypassing Chicago and other inland terminals.⁵

⁴ See Chicago Board of Trade (8). Data on the control by six large grain exporters of terminal elevators in other ports are given by Juillerat and Farris (21, Table 4).

⁵ The major terminal markets handled 54 percent of commercial feed grain in 1939-48 but only 23 percent in 1963-64. See North Central Grain Marketing Research Committee (30, chs. 1, 2).

2. Terminal elevators are required to make storage space available to the public at state-regulated charges, with the result that agents without elevator space can compete with elevator owners as buyers of arriving grain.⁶

3. Terminal operators could monopolize public storage without obtaining a comparable monopoly of trade in grain moving through the terminal market. Brokers act as agents for country elevators and as sellers to processors or to other intermediaries in the market, and also trade on their own account. At Chicago, 16.4 percent of terminal space is controlled by large processors who can buy directly grain arriving by truck, rail, or both, if they desire.

Another possible locus of high concentration is the country elevator—the initial purchaser of grain sold off-farm. Although numerous in producing areas generally, only a few country elevators may be within economic reach of the individual farmer. High local concentration of country elevators, like terminal elevators, is clearly a result of substantial economies of scale in elevator construction and operation.⁷ Because elevators receive grain shipped by high-cost transport (small trucks and wagons) and ship it out by less costly means, efficient organization of the grain-distribution system involves an optimal compromise between the lower cost of large elevator facilities and the higher total cost of transportation that results from enlarging elevators and spacing them more widely (40; 9; 2; 30, p. 135). The optimum elevator size has greatly increased as a result of a long-run relative decline in farmers' local transportation costs and, more recently, realization of lower rail transport costs through multi-car shipments. Nevertheless, great numbers of small elevators remain in operation because their variable costs compare favorably to the fully allocated costs of new capacity (27; 24, esp. note 4; 4, chs. 4, 5).

For a dense producing area such as Iowa, the county is a rough approximation of the market in which farm grain is sold to country elevators. According to records supplied by Cargill, Inc., the median number of elevators per county is 10, and only 17 percent of the counties have fewer than six. Concentration in the county-wide market thus is only moderate, and studies of farm-to-elevator transportation costs suggest that they are low enough so that a county is a very narrowly defined market.⁸ These figures measure the concentration of establishments and do not reflect any common ownership of elevators within a county, but multielevator operation within a county is probably uncommon except for cooperatives. And the cooperatives themselves are an important presence because they can be expected to behave differently from commercial grain companies (see the following section). Their competition is pervasive among Iowa counties; their median share of elevator capacity is 45 percent, and it is over 10 percent in 73 percent of Iowa's counties. Data for the North Central states show that the cooperatives' share is substantial for the region at large—32.7 percent of capacity in 1968, with 43.7 percent accounted for by independent elevators, and 23.6

⁶ No evidence was uncovered to indicate whether or not state regulation of elevator charges is or can be an effective curb on market power.

⁷ Several studies have found diseconomies of small scale in elevator operation to be very substantial. See North Central Grain Marketing Research Committee (30, pp. 28-29) and Baumel et al. (4, Appendix C, pp. 184-88).

⁸ Appropriate estimates of average, variable or marginal transportation cost data can be constructed from Baumel et al. (4, Appendix D) and Copeland and Kramer (9).

percent by line organizations. The six largest grain exporters accounted for only 3 percent of country elevator capacity, and thus were a small minority even of the line organizations.⁹

Another site that is potentially important for the competitive performance of the industry is the organized futures exchange. Members of the Chicago Board of Trade dealing in grain futures include the leading grain-export firms, but also processors and other "cash grain" firms, national securities dealers, local commission houses specializing in commodity futures, as well as individuals and partners trading for and clearing their own accounts. Many members will execute transactions for the general public. It seems clear that the futures markets can be assumed to exhibit purely competitive behavior.

Other Elements of Market Structure

The other elements of market structure usually covered in industry studies can be given brief treatment. Product differentiation is absent, except that farmers seem to develop some loyalty to particular country elevators, which usually are also sellers of supplies (30, ch. 12). Scale economies in elevators create barriers to entry into particular activities and locations, as indicated earlier. A distinctive form of scale economy gives advantages to very large organizations in the export trade and provides a more substantial (but socially unavoidable) barrier to entrants into that segment. The concentration of countervailing buyers is also a relevant element of market structure. The processing industries vary in seller concentration from low to moderately high and thus are not ideally organized to exert bargaining power. But grain is an important input cost for nearly all of them, irrespective of their concentration as buyers, so that it pays them to devote efforts to minimizing the cost of this input.

A distinctive structural element of grain merchandising is the presence of substantial numbers of cooperative organizations. It has sometimes been argued that competition among basically different types of enterprises is likely to be keener than seller concentration alone would suggest, because different organization values and perceptions make collusive behavior difficult. With cooperatives receiving about 41 percent of grain sold off-farm and carrying on substantial but smaller percentages of interregional and international grain trade, their behavioral differences are potentially very important. There is no general difference between the actions expected of a cooperative maximizing surplus for its members and an identically situated commercial enterprise maximizing its profits. They do, however, enjoy a cost advantage over competing capitalist enterprises that results from the exemption of cooperatives from the corporation profits tax and thereby from the double taxation of profits received by their members as implicit suppliers of equity capital.¹⁰ Cooperatives face a lower supply price of capital than otherwise identical commercial enterprises and should be willing to undertake investments at lower expected rates of return. Cooperatives are also

⁹ See Juillerat and Ferris (21, Table 13). The evidence on the degree of competitiveness of country elevators in setting buying prices is somewhat mixed, but generally suggests little impurity. See also Davis and Hill (12), Farris (13), and North Central Grain Marketing Research Committee (30, chs. 3, 5).

¹⁰ See Kaarlehto (22), Helmberger (19), and Helmberger and Hoos (20). The taxation of cooperatives is discussed by Schrader and Goldberg (33).

exempt from some antitrust provisions, which could be important if the grain market offered significant opportunities for noncompetitive behavior, but so far such opportunities do not appear significant. Important differences in cooperatives' behavior may also arise because their internal decision-making processes reduce their flexibility, and because they may define their organizational objectives as service to their members rather than maximizing profits with the resources under their command.¹¹ A tangible result of that difference in motivation is considered below.

A final element of structure to be noted is the presence of substantial excess capacity in grain elevators. The principal cause is the strong incentive to construct capacity that was provided by Commodity Credit Corporation storage rates during the period when United States agricultural policies involved the purchase of large excess supplies at support prices (30, ch. 15). Another cause, important for terminal elevators, is the shift of export shipments from East Coast to Gulf ports as a result of changing transportation technology and transport-pricing innovations. Because this storage capacity has a long physical lifespan and low variable costs, it tends to remain in operation though underutilized. As a structural feature of the market environment, excess capacity is generally thought to undermine collusive pricing by enlarging the gap between short-run marginal cost and a price that covers historical average cost. This analysis would not apply to the grain industry if all its excess capacity were nonoptimally located because the operative marginal cost is generally that of an efficiently sited facility that is fully utilized.¹²

Market Conduct

The structure of the grain-merchandising industry seems generally consistent with competitive performance. It provides little basis for the erection of market power either on a nationwide basis or at strategic points within the distributive system. However, concentration and entry barriers are not in all respects trivially low. It is useful to examine certain patterns of conduct among companies in the industry, partly as a test of the competitive behavior generally implied by the market's structure, partly to gain insight into the processes of short-run and long-run price formation in this type of service industry. Noncompetitive determination of price and other market variables in a market with multiple sellers depends on the coordination of decisions among them—generally a tacit and incomplete process within the framework of American laws. A trading industry faces an unusual set of hazards for realizing any interdependence with its rivals in its pricing decisions.

Numerous unique influences affect the pricing decisions of each large grain-trading firm. Price quotations in large-scale transactions, first of all, are generally the "basis" of the futures market, the basis being defined as the differential between the market price of a specified futures contract and the cash price of a

¹¹ Some evidence is contained in Dahl and Dobson (11). Compare with *Business Week* (6).

¹² That outcome is indeed suggested by the data of Ghetti, Scheinbein, and Kite (17), who found for 1967-68 that 58.2 percent of capacity was utilized in port terminal elevators, 42.1 percent in country elevators, but only 26.8 percent in inland terminal elevators. Efficiently located port elevators may thus be utilized at something approaching the maximum economic rate.

commodity at a given location.' The structure of the futures market renders the futures price flexible and competitive. Basis pricing is thus undertaken in light of the firm's conjecture about how the cash price will move relative to the futures; on this movement of the unhedged basis depends the trader's profit or loss.¹³ Optimal pricing for each trading company therefore depends on its own expectations about future developments—both short-run movements in buying and selling interests and the movement of all real economic forces that will affect future prices. It also depends on the details of the company's position at the moment—its current cash and futures position, constraints imposed by any open contracts, and the present and prospective utilization of the company's physical facilities. Expected developments in the market for one grain will affect the merchant's transaction preferences for other grains because they make common demands on the merchant's storage and shipping facilities (7, ch. 10).

These determinants of each company's transaction plan would gravely complicate the signaling process that is normally thought necessary for tacit recognition of mutual dependence in oligopoly. Companies do not know each other's cash and futures positions or the prospective utilization of each other's physical facilities, and thus do not know whether to expect a firm to be an active or passive buyer or seller on a given day. Companies certainly do not know each other's expectations about the future, or their plans for covering their open positions (a key determinant of their buying and selling interest at a particular time). In contrast to many manufacturing activities, there is no common cost level that can supply a basis for mutually dependent mark-up pricing.¹⁴ Any agreement would be further complicated because prices are in constant motion and because the merchant can be either a seller or a buyer and is often both at the same time, so that his interest in one capacity undercuts the value of any agreement reached in his other capacity.¹⁵

Innovations and Rents

A variety of types of statistical research could be undertaken to test the responsiveness to competitive forces of grain price differentials in space and time. Unfortunately, little work of this sort has been done. The casual evidence suggests that, after Commodity Credit Corporation sales policies and loan rates ceased to dominate grain prices, such competitive adjustments have been quite visible.

One instructive example of competitive pricing at work is the process of rent creation and destruction associated with innovations in the grain-merchandising industry. Most innovations in this industry take the form not of physical devices but of new types of transaction. These cannot be protected from imitation except

¹³ For evidence on the futures market's role in guiding competitive adjustment of crop inventories, see Kofi (23).

¹⁴ In a steady-state model of the industry, one might expect grain storage charges to govern the post-harvest movement of the cash price, and perhaps as well to supply a reference point for oligopolistic pricing. The typical pattern, however, is for post-harvest price movements to fail to cover normal storage charges, so this reference point can hardly be a workable one.

¹⁵ This analysis has concentrated, in the spirit of Fellner (15), on the conditions for effective tacit collusion in oligopoly. Other approaches could be developed. Following Stigler (35), an approach to the conditions for enforcing any collusive understanding would recognize that few if any stable buyer-seller relations persist in large-scale trading, so that competitors' actions cannot be detected from the defections of regular customers.

where scale economies in physical facilities are relevant. A recent example is the development of unit-train and multiple-car rates for rail shipment of export grain. These tariffs represented an innovation of real productivity, both because they greatly increased the effective utilization rate of railroad equipment and because they permitted the gathering of grain in producing areas for efficient bulk transport without transshipment through inland terminal elevators (5; 38, ch. 6). The first unit-train tariffs published by the railroads stipulated very high minimum annual shipment volumes relative to the grain that was available near the point of origination. To utilize these and subsequent unit-train and multiple-car tariffs, the shippers had to bid up the price paid for farmers' grain. A source of further rent erosion was the competitive imitation of these tariffs, with rival railroads as well as rival shippers taking part in this diffusion of low-cost volume tariffs.¹⁶

The competitive process that creates rents for the successful innovator in grain merchandising also holds some interest because it is consistent with the process of price-setting that appears to be at work in the industry. The major grain merchants have purchased fleets of large covered hopper cars, the most efficient equipment for grain transportation. Initially this acquisition was motivated by the capital position of the railroads, which has made it impossible for them to finance profitable forms of re-equipment because of unavoidable losses on other activities. But for the grain merchants, owning hopper cars is also consistent with making effective use of their logistical capabilities (discussed in the next section) (38, pp. 23-30). In 1973 the freight-car shortage for grain movement reached its most critical state due to a large volume of movement coupled with bad weather and many abnormalities in the pattern of shipments. In areas such as Iowa, where efficient unit-train shipment was not yet fully developed, the crisis was particularly acute. Shippers equipped with their own hopper cars were forced to lower their bids on grain to producers in order to avoid receiving more grain than they could ship. (Unregulated truck and barge rates were bid up by the same process.)¹⁷ The prices that constrained producers' sales to the shippers' capacities yielded substantial rents to the shipper-owned equipment.

In summary, the conventional approach of industrial organization to market conduct requires modification when applied to the grain-trading industry because the time horizons for pricing decisions and the information required to determine each firm's preferred transactions price both differ greatly from those typical in commodity-producing industries. When these differences are considered, it seems clear that effective recognition of mutual dependence in pricing decisions is out of reach for the large grain-trading companies.¹⁸ The same may not hold for their longer-run investment decisions (the construction of physical facilities, acquisition of transportation equipment, and so forth). But it does hold for their central function of matching buyers and sellers—here there is no long run.

¹⁶ For documentation of conditions in Minnesota, see Dahl and Martin (10). In general the competition between railroads or between rail and barge transportation has complemented the rivalry among shippers in diffusing innovations in transportation and transport pricing. See Anderson and Mariska (1) and Sorensen (34).

¹⁷ Examples are provided by Fedeler, Heady, and Koo (14, p. 26). Also see Baumel, Thompson, and Hickman (3).

¹⁸ Previous research has accepted the conclusion that pricing is generally competitive throughout the industry. See Hieronymus "The Pricing System and Procedures," in (30, ch. 3).

SCALE ECONOMIES AND COORDINATION BY LARGE GRAIN MERCHANTS

With the grain-merchandising industry providing so little basis for establishing market power, why should it contain such large leading firms? In this section an explanation is proposed for large scale in the absence of market power, and it is tested against evidence on the industry's structure and behavior.

Scale Economies in Coordination and Risk-Bearing

The large grain merchants execute some transactions on very large scales. What needs explanation, though, is not so much the size of individual transactions as the number of transactions undertaken and the variety of origins, delivery channels, and destinations that are involved. The hypothesis will be explored here that scale economies arise in the coordination of information from multiple sources and the execution of transactions based on that information.

Coordination for grain-merchandising companies involves optimizing and executing a large number of "trades," each requiring for its success the sophisticated use of a great deal of information about developments and conditions in various localities as well as the efficient employment of physical facilities owned or otherwise accessed by the company. The employment of extensive information contributes to the advantages of large-scale operations because of several special features of information as a productive asset:

1. Fixed costs of acquiring either a fixed stock or a continuing flow of information can be spread over a varying volume of transactions (or volume per unit of time) undertaken on the basis of it. Information requirements thus may yield increasing returns in their classic function as fixed costs.

2. Trading activities involve arbitrage between low-price and high-price centers. If this arbitrage depends on incurring the cost of information about market conditions at each center, the number of possible trades between centers increases with the number of centers covered, the n th center revealing the potential profitability of another $n - 1$ trades. If there are no offsetting sources of increasing costs, this increase of information productivity with scale operates as a scale economy.¹⁹

3. In markets subject to continuous disturbance, information is highly perishable, and the trader must act upon it instantly to realize its value. Hence there are economies in continuity of a trader's activity. One not continuously in the market making and receiving bids is apt either to waste information or incur extra start-up costs. To realize the economies of multimarket information, it is necessary to incur costs of not only the information itself, but also of maintaining a trading presence in the market.

The cost function that pertains to trading information thus can be formulated in various ways, but any of them implies that the average net revenue productivity of trading information increases with the volume of information acquired, the volume of transactions executed on each bit of information, or both.

Economies of coordinating information are bound up with the coordination by

¹⁹ Possible offsets would include: (1) diminishing mean expected profitability of the feasible trades as more are investigated; and (2) rising information costs about trading *channels* between centers, which grow in number faster than the number of centers investigated.

the large grain merchants of numerous physical facilities for storing, transporting, and processing grain at diverse locations. Each facility has a fixed short-run capacity, and because of scale economies in these facilities each is likely to be large relative to the total volume of its activity at its location. Because the grain-trading industry produces a time-dependent service, the optimal utilization of these facilities depends on their capacities available at particular points in time. In principle, a competitive market could set a continuously changing shadow price on the capacity of each fixed facility. In practice, transactions costs and opportunism in bargaining processes may create a large advantage to undertaking such closely timed coordination within an administrative apparatus rather than at arm's length.²⁰ Therefore advantages accrue to the integrated company that can coordinate decentralized fixed physical facilities in the course of grain merchandising—advantages that turn on the costliness and scarcity of information but are independent of the scale economies in the acquisition and employment of information that were described above.

This model of scale economies in coordination can be extended to recognize risk and advantages of scale in risk-pooling. The access of grain merchants to hedging opportunities in the futures market seems to be largely independent of their size. However, a basis cannot be hedged directly, nor can an investment in a physical facility. Risk-pooling provides the major protection against these uncertainties. If the individual risk-exposed transaction is large, the company must be large in order to obtain an appreciable reduction in the expected variance of its returns. In order to relate risk-pooling to scale economies in coordination, therefore, it must be considered whether the impressive size of the larger transactions undertaken by the major trading companies is itself a determinate of the basic technology of the grain market, and therefore a cause rather than an effect of the size of the larger grain merchants. Transportation is both an important component of the delivered cost of grain and an input typically subject to economies of scale. If these scale economies are proportionally greater in long-distance than short-distance transportation and producers and processors are randomly distributed in space, it follows that an efficient market solution will generally involve small-scale trade among adjacent producers and processors within a "region," while large-scale transactions pass from regions of local surplus to those with local deficits at the equilibrium price. Interregional trade therefore tends to be large-scale trade. But interregional trade in addition is likely to be relatively unstable over time. If interregional trade is a relatively small fraction of production (in exporting regions) and disturbances are proportional to regional consumption or production, the proportional variability of interregional trade flows over time will be greater than the variability of regional production, consumption, or intraregional trade. This characterization certainly applies to international trade in grain; although government policies add another source of disturbance to international commodity flows, their high variability can be deduced without reference to political whim.

²⁰ Opportunism arises because, for example, the grain elevator operator may strike a better bargain if the potential customer for storage is unaware that the facility is half empty, and thus carries a low shadow price. Such types of contractual and bargaining failure may explain a good deal of conventional vertical integration, according to Williamson (41).

If the large grain merchants are active mainly in interregional trade (an assumption to be tested below), and scale and risk are linked together for interregional transactions, it follows that risk-pooling supplies an additional explanation for large absolute scale. Risk-pooling thus joins scale economies in the coordination of information and the utilization of decentralized fixed facilities, as elements of this explanation of large-scale enterprises in a basically competitive grain-trading industry.

Evidence on Coordination and Integration

In this section empirical evidence is employed to test various corollaries of the preceding model or assumptions that were employed for its construction.

Vertical organization.—The first corollary deals with the organization of the large grain merchants. If they deal in competitive markets at the various locations where they trade, it follows that the coordination of their various storage and transshipment facilities would not center on the physical transfer of grain from one facility to the next. They would, that is, not be vertically integrated in the conventional sense. The process of undertaking profitable transactions while optimizing the company's risk position requires the coordinated use of its own facilities (such as export terminals at various ports for filling foreign orders), but not in general the coordinated transfer of grain between them. The divisions of the leading grain companies indeed appear to be organized so that each makes its decisions on the basis of market prices and not directly with the physical needs or opportunities of other divisions.²¹ Also, the companies are apparently not averse to having different divisions (for example, processing and marketing) buy and sell the same grain in competition with one another—a logical posture if the company's actions are not expected to affect the market price perceptibly.²²

Interestingly, the regional cooperatives, viewing their function as selling their members' grain rather than seizing profitable trading opportunities wherever they arise, have chosen a conventional vertically integrated form of organization, with export facilities designed to receive grain originated in cooperative country elevators and physically transship it to domestic processors or foreign destinations. The limited transaction possibilities open to this form of organization have been noted and the cooperatives urged to emulate the organization of the major grain traders, who simply fill each order that they capture from the cheapest possible source (31).

Concentration and trading scale.—The assumptions in the model about the economic traits of both information and transportation imply that the average size of transaction, absolute size of the trading organization, and therefore the

²¹ See U.S. Senate (39, pp. 102, 120-26). An extensive study of foreign investment by large companies engaged in mineral metal mining and refining reveals a similar pattern. They often invest in mining ventures abroad not to supply their own refining capacity but to make use of their knowledge of world markets for the primary ore or material that the mine produces. See McKern (28).

²² Intracorporate competition in a milieu of purely competitive markets is of course quite different from the competition among different brands of cigarettes, toothpaste, or automobiles produced by the same manufacturer. These branded articles are imperfect substitutes in the eyes of consumers, and additional brands permit the manufacturer to cater to diverse tastes while occupying niches in the marketplace where competitors could otherwise get a toehold. See Lanzillotti (25).

concentration of transactors should increase as the commerce becomes long-distance (interregional or international, rather than intraregional), and as information requirements become more onerous. These hypotheses enjoy a good deal of support.

The data indicate that seller concentration increases considerably as one proceeds from intraregional and domestic grain trade to the export market. In 1972 the largest four sellers in the domestic grain-merchandising industry accounted for only 21 percent of sales, and the large merchants' share of capacity in country grain elevators was lower still. No official figures exist on concentration in the export trade, but the usual estimate assigns 80 percent to the top four companies. A supporting statistic is the decline of the cooperatives' share from 41 percent of off-farm grain sales to 25 percent of grain moved to export ports to 7 percent of grain sold to foreign buyers; the cooperatives' organization, as demonstrated earlier, is better suited for local than for interregional and international trade.

Direct evidence of the greater risk of interregional and international grain transfers is difficult to secure. However, some of the sources of risk are structurally intrinsic, such as the foreign-exchange risks and risks of shifting government policies associated with international transactions. Equally intrinsic though less well known is a risk due to the structure of transportation channels reaching from United States grain-producing areas to export terminals. As grain moves toward an export port it diverges from the least-cost transportation channels leading to an increasing proportion of domestic users. Once at the export terminal it is, in the terminology of the trade, "out of position" to be sold profitably to the bulk of domestic processors. This inability of a would-be exporter to divert his shipment to domestic processors without a transportation-cost penalty evidently increases the merchant's exposure to risk.²³

Changes in industry structure.—The model of the large-scale grain merchant implies that an organization of this type would be relatively successful in coping with major structural changes in the industry, because of its central function of integrating information from diverse trading centers. One example is provided by a study of the northeast grain-marketing industry during 1957-62,²⁴ a period when the export grain trade was shifting from the East Coast toward the Gulf. Grain receipts of the East Coast terminals declined during this period, but the decline was substantially smaller for companies with grain interests outside the Northeast than it was for railroad-operated terminals and port-authority terminals without such connections. The greater success of the grain merchants was not associated with captive originations of grain in their upland terminals, because the companies' northeast terminals received grain from company-owned facilities outside the region in only a few instances (18).

²³ Another source of risk exposure is the size of ocean shipments. The exporter is subject to a substantial loss if an 80,000-ton vessel arrives at its destination after the contract delivery time has elapsed or with its grain cargo out of condition. By the same token, dealing in individual transactions of this scale demands larger scale and extensive coordination capacity elsewhere in the exporter's administrative apparatus—to accumulate 80,000 tons of grain, time deliveries from many origins to coincide with the arrival of a vessel at the export elevator, as well as to undertake the other risks mentioned in the text.

²⁴ Consistent with the model, the smaller firms engaged in the export trade tend to specialize by commodity or by destination. See U.S. Senate (39, p. 103).

Other structural changes support this interpretation. A study of the expansion process of large grain merchants and large grain-processing firms found that the merchants grew relatively more by internal expansion, and that their acquisitions were typically processing plants and country elevators.²⁵ These related activities utilize the merchants' skills in multi-centered trading and large-scale materials handling; diversifications were avoided. The merchants' acquisitions of country elevators have come under some suspicion from antitrust authorities as backward vertical integration contrived to control the origin of grain and to feed the merchants' terminal elevators. A more plausible interpretation, in light of the analysis set forth above, would recognize that transport innovations have made terminal elevators increasingly less central in the grain-marketing process and increased the trading gains available to a large merchant operating a country elevator over the revenue productivity than an independent producer could achieve.²⁶

Trading volume and profitability.—This interpretation can also be tested on the movement over time of the large grain merchants' profit margins. It is a commonplace that profit margins in manufacturing industries tend to be highly correlated in the short run with the total volume of production and sales. The model predicts this pattern for the grain merchants only in a highly qualified way. Their trading activities per se are not constrained by any fixed physical capacities, and if the business is competitive there is no reason to expect that margins should be strongly related to volume. There is a basis for a positive volume-margin relation, though, in the fixed costs of the merchants' elevators and transportation equipment, especially considering that short-run marginal costs may not increase much short of full utilization of capacity, so that *observed* variable costs do not increase. If the model predicts no strong relation between profit and volume, it does predict high margins in years of large disturbances to the grain economy and to interregional and international trading patterns because the merchants' skills are best adapted to profitable arbitrage under such conditions.

A rudimentary test of these hypotheses was performed by calculating correlations between annual trading margins (cents per bushel) reported by Cargill for the crop years 1965-66 to 1974-75 and the total volume of each grain traded. The correlation coefficients were: spring wheat, +.106; hard and soft winter wheat, +.265; durum wheat, +.224; corn, +.218; and soybeans, +.829. All fall short of statistical significance at 5 percent except for soybeans, and that positive correlation is due to the major increase in volume from the late 1960s on (for 1969-75 the correlation for soybeans drops to +.141). The hypothesis that grain

²⁵ This study also found that in this period of declining large-scale shipments small elevator operators in the Northeast had increased their share of the regional processing market.

²⁶ Country elevators operated by multi-unit organizations are on the average considerably smaller than those operated as single units, many of them cooperatives. The census figures available, for 1967, indicate the following relation between number of establishments operated by the company and average annual sales: 1 or 2 units, \$958,000; 3 to 5 units, \$812,400; 6 to 25 units, \$700,200; 26 or more units, \$613,700. The data are from the U.S. Bureau of the Census (36, pp. 2-129); also see Juillerat and Farris (21, Table 13). The advantages are unlikely to lie in the achievement of technical economies of scale or the avoidance of capital rationing; they probably lie in the coordinating marketing of grain from many sources. When the large grain merchants have constructed or greatly expanded country elevators, it has apparently been to load large transport vehicles.

merchants' profits rise in an abnormal year is usefully tested on data for 1973-74, when volumes were down from the preceding year but transportation bottlenecks, bad weather, and other adverse conditions upset the market. Regressions of profit margins on volume show that year's observation is a large positive deviation for each grain.

SUMMARY AND CONCLUSIONS

This paper seeks to adapt the concepts of market structure, conduct, and performance to an analysis of competition in the grain-trading industry. The adaptation is necessary because the standard concepts address themselves implicitly to a commodity-producing industry. In a commodity-trading industry, by contrast, the functions of arbitrage, ownership, and physical possession are independent of one another, scale economies can exist independently of physical facilities, and the time span over which pricing decisions are made is extremely short.

The concepts of market structure and conduct can be adapted to these altered circumstances so as to allow some interpretation from the limited data available about grain trade. Trading activities per se are not geographically constrained and so are subject to relatively low concentration in the American national market. The concentration of physical facilities (grain elevators and transshipment facilities) at particular locations is generally of limited economic relevance because of the substitutability between channels of distribution from a production or accumulation point to a consumption point; furthermore, storage facilities at different points along a distribution channel compete with one another. Thus, although a moderately high concentration of facilities at individual inland and export terminals can be observed, little significance can be attributed to it. The concentration of country elevators in the relevant local marketing areas is only moderate.

Other significant traits of market structure include the presence of cooperatives (with organizational characteristics and tax status different from commercial firms and thus with differing behavior), moderately concentrated buyers, limited barriers to entry (due to scale economies in facilities at particular locations), excess capacity in storage facilities (due to historic changes in the industry), and an absence of product differentiation.

In its market conduct, the industry is notable for the low potential it provides for oligopolistic interdependence. The futures market can be taken as purely competitive, and the pricing of cash grain "basis" of the futures market is a moment-to-moment decision resting on each dealer's current trading position and conjectures about the future, and thus apparently incapable of coordination with his rivals. Innovations take the form of new transaction arrangements, and these cannot be protected from competitive imitation and the erosion of rents.

With the evidence pointing to a largely competitive market structure and conduct, the presence of large traders and high concentration in export sales requires a theoretical explanation. There appear to be scale economies in coordination and risk-bearing that are due to the characteristics of information as an input. Information has a fixed cost that can be spread over varying amounts of

transactions, and information about trading locations is subject to increasing returns in the trading possibilities that it reveals. Also, the perishability of information creates scale economies in the maintenance of a continuous trading presence. The effect of these economies in coordinating information is multiplied by the existence of scale economies in physical facilities at particular locations, because the shadow prices required for efficient utilization of these facilities in an arm's length competitive market would have very short lives and be difficult to determine and transmit. Also, scale economies in transportation and storage facilities create large scales for efficient individual transactions and thereby impose large overall scales for substantial risk-pooling within the enterprise. The needs for risk-pooling in large-scale grain trading are further increased because the basic economics of transportation tend to make the intertemporal variance of grain transactions increase with their size and distance (even without reference to the governmentally imposed uncertainties that affect international trade). Thus, the large scales of the principal grain-trading firms seem to result from scale economies in coordinating information and risk.

A good deal of casual evidence supports this interpretation. The large grain traders are not vertically integrated in the conventional sense; rather, their individual facilities and divisions tend to interact with competitive market prices. The concentration of traders increases steadily as the transactions become more long-distance and large-scale. The behavior of the industry in periods of structural change is consistent with the hypothesis that the advantage of large traders lies in economies of information. And profit margins in large trading depend not so much on the volume traded as on the incidence of disturbances that create opportunities for a good deal of non-routine arbitrage.

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