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ORGANIZATION, SCALE, AND PERFORMANCE IN
THE GRAIN TRADING INDUSTRY

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ORGANIZATION, SCALE, AND PERFORMANCE IN THE GRAIN TRADING INDUSTRY*

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The U.S. 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. But we are 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:

1. We define the major elements of market structure and conduct as they apply to this activity and summarize scattered evidence bearing on them.

2. Upon finding the weight of evidence to suggest competitive behavior and performance of this sector, we propose an explanation for the distinctive type of scale economy that begets a few large grain merchants with substantial shares in the export market.

I. 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 can be assumed to stick for an appreciable period of time. The grain merchandising industry exhibits none of these features.

A. The problem of market definition

In handling commodities the industry does not transform them physically

(except by application of ancillary services such as cleaning, blending, drying, etc.), but grain is transformed in value through being moved through space and over time from producers to processors (defined as those who perform the first physical transformation). The industry thus sells a collection of services that can be reduced principally to three: the matching up of producers and processors; the holding of inventories (incidental to this matching-up process); and the provision of physical storage. (The large grain merchants provide some transportation services directly, but as an in-house function this is not central to their activities.) The services are separable and often separated; grain in storage is often owned and physically possessed by different parties, and brokers can 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 production area or converging on a processing location put into competition not only the sellers and buyers (respectively) at the other ends of those channels, but also any traders that operate along them. Similarly, nodal points of intersection of transportation channels limit any monopoly/monopsony power that might be possessed by traders astride a channel on either side of the node.

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. Any effective market control, which would have to include the ability to limit or exclude entrants, must rest on the control of physical facilities. At first glance such control might seem feasible in the case of 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 upstream and downstream on the distribution channels that pass through the terminal point--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 departures from competition takes two forms. One is measures of the concentration of activities or facilities of grain traders operating along well-defined transportation corridors. The other is the elasticity with which grain distribution shifts between channels in response to changes in the distributive margin taken along a channel. Let us first consider the latter issue of substitutability among channels.

The information available sheds only incidental light on the substitutability of distributive channels, because the variation we observe in the channels in use is associated with variations in sources and destinations as well. Rough evidence can be found in the variability of freight-car movements tabulated in the Interstate Commerce Commission's Carload Waybill Statistics, data on short-run changes in the ranking of bids from a given producing area delivered to various terminals, and simulations of the effect of varying terminal prices on distribution patterns from a programming model that allocates regional production to maximize producer revenue net of transportation costs.^{3/}

Over the long run there is evidence of considerable shifts of grain traffic among export ports and inland terminals.^{4/} These data suggest a good deal 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.

B. Concentration of transactors

Because the functions of matching buyers and seller, holding inventories, storage, and transportation are all separable, the appropriate data on concentration would take them one by one. This same course is indicated by the fact that the appropriate scope of the market differs for each function. Pure brokerage is a function subject to the lightest geographical constraints, and so should be considered in a national market context. The most relevant data on the concentration of storage facilities, however, 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 21.0 percent of sales were accounted for by the largest four firms, 28.6 percent by the largest eight, 40.0 percent by the largest twenty, and 51.2 percent by the largest fifty. Back in 1960 a private study found only slightly higher concentration for shippers in the North Central region alone; 33 percent for the largest four and 50 percent for the largest eight.^{5/} 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. The significance of concentration in export shipments 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, as we shall see), but the meaning of these figures is very limited because of the competition of facilities upstream and downstream from any particular terminal. Nonetheless, there is some value to examining concentration of elevators at a major terminal like Chicago--where it has been thought in times past high enough to create a problem of market power. Concentration of control over federally licensed terminal space in Chicago by the largest four companies was 81 percent in 1969.^{6/} However, its significance 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 shipments from producer locations to a variety of export and processing locations by-passing Chicago and other inland terminals.^{7/}

2. Terminal elevators are public utilities that make storage space available to the public at state-regulated charges, so that agents without elevator space can compete with elevator owners as buyers of arriving grain.^{8/}

3. Terminal operators face competition from other agents. 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 per cent of terminal space is controlled by large processors who are in a position to buy grain arriving by truck, rail, or both, thereby avoiding intermediaries if necessary.

Another possible locus of high concentration is the country elevator--the initial purchaser of grain sold off-farm. Although numerous in producing areas at large, 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.^{9/} Because elevators receive grain shipped by high-cost media (small trucks and wagons) and ship it outbound by lower-cost media, an efficient organization of the grain distribution system involves an optimal compromise between the lower cost of elevator facilities and the higher total cost of transportation that results from enlarging elevators and spacing them more widely.^{10/} The optimum size of elevator 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, although great numbers of small elevators remain in operation because their variable costs compare favorably to the fully allocated costs of new capacity.^{11/}

For a dense producing area such as Iowa, it seems reasonable to take the county as a rough approximation to the market in which farm grain is sold to country elevators. The number of elevators per county was secured from Cargill records and a frequency distribution tabulated. The median county contains ten elevators, and only

17 percent of counties have five or fewer. Concentration in the county-wide market thus is only moderate, and studies of farm-to-elevator transportation costs suggest that they are low enough that a county is a very narrowly defined market.^{12/} These figures measure the concentration of establishments and do not reflect any common ownership or control of elevators within a county, but multi-elevator 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 section I.C). Their competition is pervasive among Iowa counties; their median share of elevator capacity is 45 percent, and it is over ten percent in 73 percent of Iowa's counties. Data for the North Central states shows that the co-operatives' 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 percent by line organizations. The six largest grain exporters accounted for only 3.0 percent of country elevator capacity, and thus were a small minority even of the line organizations.^{13/}

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 of these members of course stand ready to execute transactions for the general public. It seems clear that the futures markets can be assumed to exhibit purely competitive behavior.

C. 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).^{14/} Scale economies in elevators create entry barriers into particular activities and locations, as we have seen. Also, we argue below that 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 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 it may be relevant that 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 been argued that "metaphytic competition" among basically different types of enterprises is likely to be more rivalrous than seller concentration alone would suggest, because different organizational 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 we expect of a cooperative maximizing surplus for its members and an identically situated commercial enterprise maximizing its profits. The major exception 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.¹⁵ 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. They thus enjoy a cost advantage over competing capitalist enterprises. Cooperatives are also exempt from ^{some} antitrust provisions, which could be an important fact 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.^{16/} 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 Commodity Credit Corporation storage rates during the period when U.S. agricultural policies involved the purchase of large excess supplies at support prices.^{17/} Another cause, important in the case of terminal elevators, is the shift in channels of shipment for export from East Coast to Gulf ports, the 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 historic average cost. This analysis would not apply to the grain industry if all its excess capacity were nonoptimally located, so that the operative marginal cost is generally that of an efficiently sited facility that is fully utilized.^{18/}

D. 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 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/in its pricing decisions.

with its rivals

An unusual number of unique influences affect the pricing decisions of each large grain-trading firm. Pricing decisions in large-scale transactions are first of all, generally "basis" 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 commodity at a given location. The structure of the futures market, we suggested, renders the futures price itself a flexible and competitive one. Basis pricing thus is 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.^{19/} 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.^{20/}

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). By contrast with many manufacturing activities there is no common cost level that can supply a basis for mutually dependent mark-up pricing.^{21/} 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.^{22/}

E. 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 appears to have been done. The casual evidence suggests that, since 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 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 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^{23/} and because they permitted the gathering of grain in producing areas for efficient bulk transport without transshipment through inland terminal elevators. The first unit-train tariffs published by the railroads stipulated very high minimum annual shipment volumes relative to the grain produced near the points 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 longer-run 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.^{24/}

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 competitive 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).^{25/} In 1973 the freight-car shortage for grain movement

reached its worst, 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.)^{26/} 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.^{27/} The same may not hold for their longer-run investment decisions (the construction of physical facilities, acquisition of transportation equipment, etc.). But it does hold for their central function of matching buyers and sellers--here there is no long run.

II. 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 we propose an explanation for large scale in the absence of market power and test it against evidence on the industry's structure and behavior.

A. 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 they undertake and the variety of origins, delivery channels, and destinations that are involved. We shall explore the hypothesis 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 large amounts of information about developments and conditions in various localities and also 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. There may be fixed costs of acquiring either a fixed stock or a continuing flow of information that 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 functions as fixed costs.

2. Trading activities involve arbitrage between low-price and high-price trading 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.^{28/}

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 multi-market information, it is necessary to incur costs of not just 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 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 time coordination within an administrative apparatus rather than at arm's length.^{29/} 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.

Our 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, we must consider 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 is in addition 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.

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. It thus joins scale economies in the coordination of information and the utilization of decentralized fixed facilities, as elements of our explanation of large-scale enterprises in a basically competitive grain-trading industry.

B. Evidence on coordination and integration

1. Vertical organization. In this section we employ empirical evidence to test various corollaries of the preceding model or assumptions that were employed for its construction. The first corollary deals with the organization of the large grain merchants. If they interface with 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 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 interfacing with market prices and not directly with the physical needs or opportunities of other divisions.^{30/} Also, the companies are apparently not averse to having different divisions (e.g., 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.^{31/}

Interestingly, the regional cooperatives, viewing their function as selling their members' grain rather than seizing profitable trading opportunities wherever they arise, have chosen a nonconventional 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.^{32/}

2. Concentration and trading scale. The assumptions in our 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 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 we proceed 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 reasonable estimates assign between 67 and 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, we have seen, is better suited for local than for interregional and international trade.

Direct evidence on the greater riskiness 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 known is a risk due to the structure of transportation channels reaching from U.S. 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.^{33/}

3. Changes in industry structure. Our 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 1957-1962,^{34/} a period when the export grain trade was shifting from the East Coast towards the Gulf. Grain receipts declined for the East Coast terminals during this period, but the decline for companies with grain interests outside the Northeast was substantially smaller than that 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 inland terminals, because the companies' Northeast terminals received grain from company-owned facilities outside the region in only a few instances.^{35/}

Other structural changes that support our interpretation can be mentioned briefly. 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 characterized by entry into processing activities and purchases of country elevators.^{36/} These are related activities that utilize the merchants' skills in multi-centered trading activities 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 origination 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 operator could achieve.^{37/}

4. Trading volume and profitability. Our 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 in the short run highly correlated/with the total volume of production and sales. Our 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 could be performed by calculating correlation coefficients 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 of these 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 1960's on (for 1969-75 the correlation for soybeans drops to +.141). The hypothesis that grain 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. From regressions of profit margins on volume that year's observation is a large positive deviation in the case of each grain.

III. 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 on the grain trading industry. Trading activities per se are not geographically constrained, and so are subject to relatively low concentration in the U.S. 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 point or accumulation to a consumption point; furthermore, storage facilities at different points along a distribution channel compete with one another. Thus, we can observe moderately high concentration of facilities at individual inland and export terminals but cannot attribute much significance 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 the recognition of oligopolistic interdependence. The futures market can be taken as purely competitive, and the pricing of cash grain "basis" 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 is 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 to 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 interface 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 advantage of large-scale traders lying in economies of information. And profit margins in large-scale 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.

Footnotes

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¹An important exception is North Central Grain Marketing Research Committee (30).

²For example, Locklin (26), chap. 9.

³For evidence of the latter two types, see Baumel *et al.* (4), pp. 23, 69, 85.

⁴North Central Grain Marketing Research Committee (30), pp. 30, 39.

⁵U.S. Bureau of the Census (37), chap. 2, p. 1-112; Fletcher (16),

⁶Chicago Board of Trade (8). Data on the control by six large grain exporters of terminal elevators in other parts are given by Juillerat and Farris (21), Table 4.

⁷The major terminal markets handled 54 percent of commercial feed grain in 1939-1948 but only 23 percent in 1963-64. See North Central Grain Marketing Research Committee (30), chaps. 1, 2.

⁸No evidence was uncovered to indicate whether or not state regulation of elevator charges is or can be an effective curb on market power.

⁹Several 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.

¹⁰Williamson (39); Copeland and Kramer (9); Araj and Walsh (2); North Central Grain Marketing Research Committee (30), p. 135.

¹¹Lytle and Hill (27), Ladd and Lifferth (24), esp. note 4; Baumel et al. (4), chaps. 4, 5.

¹²Appropriate estimates of average variable or marginal transportation cost data can be constructed from Baumel et al. (4), Appendix D; and Copeland and Kramer (9).

¹³Juillerat and Farris (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 Davis and Hill (12); Farris (13); North Central Grain Marketing Research Committee (30), chaps 3, 5.

¹⁴D. I. Padberg and D. C. Nelson, "Product Differentiation in the Grain Handling Industries," North Central Grain Marketing Research Committee (30), chap. 12.

¹⁵See Kaarlehto (22), Helmberger (19), and Helmberger and Hoos (20). The taxation of cooperatives is discussed by Schrader and Goldberg (33).

¹⁶Some evidence is contained in Dahl and Dobson (11). Compare Business Week (6).

¹⁷North Central Grain Marketing Research Committee (30), chap. 15.

¹⁸That 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.

¹⁹For evidence on the futures market's role in guiding competitive adjustment of crop inventories, see Kofi (23).

²⁰See Chicago Board of Trade (7), chap. 10.

²¹In 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.

²²This 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 grain trading, so that competitors' actions cannot be detected from the defections of regular customers.

²³See Boles (5), and U.S. House of Representatives (38), chap. 6.

²⁴For 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 Sorenson (34).

²⁵See U.S. House of Representatives (38), pp. 23-30.

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

²⁷Previous research has accepted the conclusion that pricing is generally competitive throughout the industry. See T.A. Hieronymus, "The Pricing System and Procedures," in North Central Grain Marketing Research Committee (30), chap. 3.

²⁸Possible 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.

²⁹Opportunism 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 (40).

³⁰An extensive study of foreign investment by large companies engaged in mineral and 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).

³¹Intracorporate 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).

³²See Phillips (31).

³³Another 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 the vessel at the export elevator, as well as undertake the other risks mentioned in the text.

³⁴Heid, Martin, and McDonald (18).

³⁵This study provides another insight into the industry's structure in its finding (p.16) that in this period of declining large-scale shipments small elevator operators in the Northeast had increased their share of the regional processing market.

³⁶D.W. Cobia, "Mergers, Acquisitions, and the Growth of Dominant Grain Processing Firms," North Central Grain Marketing Research Committee (30), chap. 9.

³⁷An interesting fact, in this context, is that country elevators operated by multi-unit organizations are on the average considerably smaller than those operated as single units (many of which are cooperatives). The last 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 U.S. Bureau of the Census (36), p. 2-129; also see Juillerat and Farris (21), Table 13. The advantage of the large organization must not lie in the achievement of technical economies of scale or the avoidance of capital rationing. Therefore it seems quite likely that they lie in the coordinated 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-scale transportation vehicles.

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