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## FIRM GROWTH AND THE STRUCTURE OF AGRICULTURAL INDUSTRIES

Richard S. Johnston
Oregon State University

### Firm Growth and Market Structure

In recent years, several studies have revealed that beyond some critical size costs of production vary only slightly with the size of the firm in a number of the food industries [18, pp. 5-14]. It has been argued that under such circumstances there is no reason why size should influence the firm's growth rate. Thus, Gibrat's law of proportionate effect will operate, according to which the expected growth rate of the firm is independent of the size of the firm [11].[1/] That is, under conditions of constant returns to size, firm size distributions are determined by a stochastic process, and "the resulting steady-state distribution of the process will be a highly skewed distribution" [32, p. 609]. Indeed, studies of the size distributions of firms in particular industries have almost invariably shown such distributions to be highly skewed [14, 17, 18]. The share of the industry's output sold by the firms in the upper tail of such distributions is a measure of the extent of concentration in the industry. Thus, it has been contended that aspects of market structure -- particularly the question of changes in concentration -- can be approached fruitfully by directing attention away from the neoclassical theory of the firm and towards the stochastic processes which generate skewed distributions of variates [32, 33].

Such stochastic processes need not embody the law of proportionate effect, however. Thus, depending upon the nature of the process employed, a variety of steady-state distributions may be generated. In fact, several studies have estimated transition matrices which fail to support the universality of the law [16, 18, 21, 28, 30]. Thus, it appears to me that, if one chooses to examine the structure of an industry by dealing with stochastic processes, he should begin by examining the growth process of the individual firm. Treating the growth of the firm as a deterministic process does not preclude treating the generation of size distributions of firms as a stochastic process, where size is measured in terms of output. In fact, it will enable the analyst to select that stochastic process appropriate for analysis of industry structure.

### The Growth of the Individual Firm

There has been a considerable amount of conceptualizing about the growth process itself. The firm is viewed as an output-producing organism -- usually without regard to whether its output is an intermediate or a final product. The firm maximizes the present value of its expected future earnings and accumulates capital (i.e., those inputs treated as "fixed" for short-run decisions) at a rate which permits it to be at the optimum size at all future dates, as viewed from the present. Growth, then, is treated as a process of capital accumulation; it is the time rate of change in the firm's capacity to produce units of output.[2/] Thus, Baumol, Fraser, Halter, Williamson, and others are able to find "optimal" growth rates for individual firms [3, 10, 13, 37]. These models, while simple, are nonetheless able to yield hypotheses concerning how growth rates will change in response to exogenous changes -- such as a change in tax rates [3, pp. 1082-1085]. There has been little empirical testing of such hypotheses, however.

There is a striking similarity between this kind of growth model and various macroeconomic investment models. One such model was developed by Eisner and Strotz [9]. In their model, the firm is motivated to grow in response to "an instantaneous and permanent change in a parameter so that the new long-run equilibrium position for (the) firm entails a larger plant" [9, p. 68], for example, an unambiguous increase in the demand for the firm's output. Their firm discounts to the present (i.e., to the date at which the parameter shift is perceived), the net returns of all future dates. Its optimizing behavior leads to a function relating firm size and time. In their model, net returns equal total revenues minus total costs. Total costs, which are postulated to depend on both size and the rate of growth, include both output costs and expansion costs. According to Baumol, ". . . any costs which would be associated with a given level of output if the output rate were not changing may be classed under output costs; any additional outlays beyond the output

costs (and which therefore arise only as a result of the expansion process) are called expansion costs" [3, p. 1079]. Expansion, or growth, costs were postulated to increase at an increasing rate with respect to the rate of growth.

Eisner and Strotz show that the optimal growth pattern is one in which the growth rate of the firm decreases as the size of the firm increases; apparently, a different growth pattern than that envisaged by the law of proportionate effect. In their model, the ratio of the growth rates in any two successive periods is shown to be a constant whose value must lie between 0 and 1.

An important feature of this type of growth model is that the optimal growth rate for the firm at any date is reduced as either growth or production costs are increased. This is an important result with implications to be discussed later.

While output costs and growth costs may be impossible to distinguish empirically, there is a certain conceptual usefulness to the distinction. It was suggested that, after some critical size, the long-run average cost curve may be flat for firms in some agricultural industries. Thus, while there may appear to be no limit to the size of the firm, expansion costs place limits on its rate of growth. These costs include the costs of obtaining financing for growth [6, 18], the costs of coordination [22, 27], the costs of labor (e.g., training of new workers, overtime, etc.) [18, 35], the costs of adding physical facilities [18, pp. 25-27].[3/]

## An Empirical Investigation of the Relationship Between the Growth of the Firm and the Structures of Some Food Marketing and Processing Industries

In a recent study, I estimated transition matrices for several industries and used the resulting matrices to examine the appropriateness of a specific firm growth model: the Eisner-Strotz model discussed in the previous section. A secondary purpose of the investigation was to examine the appropriateness of the law of proportionate effect in describing the growth process of firms in these industries.

In the study, transition matrices were estimated for five food and beverage industries, as defined by the Standard Industrial Classification scheme [5].[4/] Since the only data available were those on size distributions of firms in these industries (as opposed to data on the actual changes in the sizes of the component firms), the estimation procedure was a version of one first suggested by Lee, Judge, and Takayama [19]. The procedure relied on the assumption that the size distributions had been generated by a homogeneous, first-order, Markov process. Once the matrices had been estimated, artificial data on changes in the sizes of the member firms were generated. I used the Pearson $X^2$ statistic to test the appropriateness of Gibrat's law in these industries [21]. While no critical test emerged for selecting from between the two models of the growth process, the results indicated that for none of the five industries studied did Gibrat's law seem to be an appropriate description of the growth process. This would appear to cast doubt on Herbert Simon's statement that as a matter of "fact, . . . there is little or no relation between size of firm and expected percentage rate of growth" [31, p. 81].

A weighted least squares procedure was used to estimate the ratio of firm growth rates (a constant in the Eisner-Strotz model). In only two of the five industries[5/] were the estimates between 0 and 1 -- hardly overwhelming support of the model but, given the artificial nature of the data employed, perhaps suggestive that the model is worthy of further study. Whether or not one feels comfortable with the particular growth model examined as an alternative to Gibrat's law, the study does suggest that there are dangers to ignoring purposeful behavior of firms if one wishes to understand changes in market structure.

A certain uneasiness with this approach remains, however. This is discussed in the next section.

## Some Limitations of the Approach and Some Suggestions for Improvement

The study just described has some obvious limitations: those surrounding the data used, the assumption that the observed size distributions were generated by a first-order Markov process, the highly restrictive growth model examined, to name a few. In this section, the nature of the growth model itself is subjected to some scrutiny from the point

of view of its usefulness in understanding certain aspects of market structure. While comment is directed toward the use to which I put a specific growth model, the comments are directed to the uses of many of the growth models developed to date.

First, a point not always made explicit in growth studies should be made: which growth model is appropriate will depend on the problem the analyst is seeking to examine. If one is interested in how a particular firm should grow, he will be concerned with the characteristics of, and environment surrounding that firm. If one is interested in the impact of exogenous changes on market prices, he may simply wish to extend the neoclassical theory of the firm to include dynamic considerations. However, attempting to understand changes in market structure by investigation of the growth process of firms may involve more than a simple aggregation of optimal growth patterns over many firms, as implied by research such as that just discussed.[6] Furthermore, one must also identify those aspects of market structure in which he is interested. As already indicated, there is some concern about the extent of concentration of output in the food industries. Yet much of the current concern with market structure in agriculture centers around monopolistic and monopsonistic pricing practices [12, 36]. Such processes may be the result more of entry barriers than of output levels (size) of existing firms.[7] Others have been concerned with the extent of such phenomena as vertical integration in the agricultural industries [15, 26]. Examining rates of change of output will reveal little about the extent to which these structural changes are taking place.

Thus, in studying the growth of the firm, the analyst must identify specific characteristics of the firm for analysis, and this depends upon the aspect of market structure with which the analyst is concerned.[8] There are many measures of the size of the firm, any one of which may grow. However, for some aspects of market structure, it may be useful to describe the firm in terms of both its rate of output and the number of functions it performs. Both are measures of the size of the firm, and both may grow (positively or negatively). But the impact of a specific exogenous change on the output of the firm may be very different than its impact on the number of functions the firm performs. And, from the point of view of understanding certain structural changes taking place in agricultural markets, it may be important to distinguish between these two characteristics.

Models dealing with the growth of the firm's output have been discussed. But the firm may also be viewed as an entity which engages "in a series of distinct operations: purchasing and storing materials; transforming materials into semi-finished products and finished products; storing and selling the outputs; extending credit to buyers; etc." [34, p. 131]. Thus, Stigler partitions the firm "not among the markets in which it buys inputs, but among the functions or processes which constitute the scope of its activity" [34, p. 131]. As noted by Stigler (and by Adam Smith before him) there is a tendency for functions to be split off from firms as the firms grow, particularly for those functions subject to economies of size.[9]

Other forces are at work also, however. Stigler believes "the most important of these other forces (to be) the failure of the price system (because of monopoly or public regulation) to clear prices within the limits of the marginal cost of the product (to the buyer if he makes it) and its marginal-value product (to the seller if he further fabricates it)" [34, p. 136]. Under this view, vertical integration is designed to "circumvent public and private price control and allocation" (i.e., output rationing) [34, p. 136].

This is similar to the view taken by Coase who has argued that, "the main reason why it is profitable to establish a firm would seem to be that there is a cost of using the price mechanism" [7, p. 336].[10] Coase had in mind what are now called the "transaction costs" of negotiating and concluding a separate contract for each transaction which takes place in a market. These include, in addition to those costs identified by Stigler,[11] costs associated with uncertainty about the future (shifts in demand, new productive techniques, etc.) which prevent the buyer from knowing how much he will want to buy in the future and the seller from knowing how much he will want to sell. If both feel that the cost of contracting every minute exceeds the expected loss from being committed to future exchanges, it will pay both of them to enter into a "more flexible, less-specific performance contract" [1, p. 320].

Agricultural economists have used this view of the firm to help explain why certain kinds of contractual arrangements come into existence, particularly where the parties to the contract are buyers and sellers of an input into the buyer's production process (i.e., an intermediate good) [see 8, 15]. These range from incomplete integration, under which the parties to the contract remain essentially autonomous entities for decisions outside

of the contract, to complete vertical integration, under which a single firm emerges where two or more existed before.[12]

What impact does viewing the firm as a collection of functions performed under various forms of contractual arrangements have on the firm growth models discussed earlier? What are the implications with respect to exogenous changes? It may be appropriate to summarize some of these implications of the discussion so far:

1. An unambiguous increase (decrease) in the demand facing the firm will lead to an increase (decrease) in the firm's rate of output.

2. A reduction (increase) in production costs will, in general, although not always, lead to an increase (decrease) in the optimum rate of output of the firm.

3. The speed with which the firm adjusts to the new optimum output will depend importantly upon the functional relationship between growth costs and speed of adjustment. An increase (decrease) in growth costs will reduce (increase) the rate of growth of output.

4. An unambiguous increase (decrease) in the market demand for a good, X, will decrease (increase) the number of functions performed by firms producing X and increase (decrease) the number of firms performing functions which produce inputs used in the production of X.

5. An increase (decrease) in transaction costs will (a) decrease (increase) the rate of growth of a firm's output and (b) increase (decrease) the number of functions performed by the firm (i.e., encourage vertical integration).

These results are very limited. No predictions are given concerning changes in the rates of output of firms in response to an increase in market demand. Considerably more work at the theoretical level -- particularly with respect to entry and exit -- is needed before predictions can be made here. No explicit attention is paid to the question of product differentiation. No prediction is made concerning the number of firms which will exist after, say, a technological innovation is introduced. (However, implications No. 2 and No. 3 suggest that survival will depend importantly upon the rate of adoption [see 6, 36]). Despite these limitations, the results do lead to some interesting testable hypotheses. Particular attention in the next section will be devoted to implication No. 5, although one must be careful not to ignore the interdependencies among these implications.[13]

## Hypotheses About the Effects of Exogenous Changes in the Agricultural Sector

Perhaps it would be appropriate to examine implication No. 5 in a little more detail. Suppose the market demand for good X increases. One would expect this to result in vertical disintegration, as already discussed. That is, one would expect to see new firms emerge which would specialize in some functions (especially those subject to "increasing returns") previously performed by X-producing firms. This is, essentially, what implication No. 4 states. To the extent that an increase in market demand leads to an increase in the demand facing any given X-producing firm, implication No. 1 states that this would lead to an increase in that firm's output. (How rapidly the firm would increase to a larger output rate would, as stated by the third implication, depend upon, among other things, the costs of growth). The move towards vertical disintegration could be mitigated by the discovery that such disintegration leads to high transaction costs: those associated with market exchanges, as discussed earlier. Thus, contractual arrangements between a number of X-producing firms and the newly-created "specialists" could arise.[14]

However, the implication deals with another important situation: the effect of changes in transaction costs (as a result, say, of public policy) on the firm's output and the number of functions it performs. It examines the impacts of changes in transaction costs in the absence of demand shifts, technological changes, etc.

A number of developments have occurred and are occurring in agriculture which may be having profound effects on transaction costs. These, in turn, may have had and be having significant impacts on the growth rates of agricultural firms and, ultimately, on the structure of agricultural markets. The discussion offers several hypotheses but leaves testing for future research.

Consider, for example, the role of the Market News Service. Here is a government-provided service designed to reduce the private costs of obtaining information on prices and, hence, on exchange opportunities. Thus, one would expect this to have a retarding effect on the rate at which the firm internalizes functions, but a stimulating effect on the rate at which the output of the firm increases.

A recommendation of the National Commission on Food Marketing was that disclosure of both prices and quantities in exchange between producers and first buyers should be mandatory [24, p. 111]. The net result of such a regulation is difficult to predict. It is argued that it would further increase information to market participants. If so, it may discourage complete vertical integration and encourage increases in output rates. On the other hand, in industries characterized by a high degree of interdependence among sellers (and/or buyers), resulting in intensive personal rivalry, such forced disclosure may be regarded as costly to those coming under the regulation. In this case, the regulation may provide an incentive to internalize completely; i.e., to merge (vertically) into one firm.

Government-sponsored programs designed to increase the income positions of farmers may also have profound effects on the growth of agricultural firms and the structure of agricultural industries. Would legislation requiring all producers to sell through a bargaining board provide the incentive for processors to integrate backwards in order to avoid the costs of bargaining and high purchase prices?[15]

If supply cooperatives result in monopsonistic pricing, would supply companies thereby be provided with the incentive to integrate forward?

There are undoubtedly other factors which affect the degree of internalization of functions performed by individual firms. To what extent, for example, is vertical integration a device by which sales taxes (on intermediate products) may be avoided? Have price controls and production quota schemes (again, on intermediate products) encouraged vertical integration? Have standardized grading procedures reduced the incentive to integrate? To what extent is internalization a means of accomplishing price discrimination by avoiding the costs of preventing resale?

With current concern about pollution, would government control programs (for example, taxation on the production of effluent by processing firms, feed lots, etc.) provide the incentive to "internalize externalities" and avoid the private costs of the control program through, say, merger of the affected parties? For example, suppose firm A's production process leads to pollution of water used by firm B. Further, suppose the government taxes firm A on the effluent it produces or somehow controls production of the effluent. If this sufficiently increases A's production costs, firm A may find acquisition of firm B a less costly alternative. On the other hand, in the absence of such a control program, firm B may have an incentive to merge with firm A in order to have direct influence over A's production decisions.[16]

## Conclusions

This paper suggests that it may be fruitful to construct a model of the firm which considers both growth costs and transaction costs and, hence, to provide an analytical framework out of which testable hypotheses -- so far advanced only as conjectures -- may emerge. The discussion, perhaps, helps to distinguish between growth in the rate of output of the firm and growth in the number of functions it performs internally.[17]

The paper fails to consider many aspects of firm growth: income tax considerations and satisfaction of the desire for "growth" by publicly-held, non-agricultural firms, for example. Hopefully, however, it has stimulated an interest in investigating the impact of what are generally referred to as exogenous changes -- including government programs which are justified on the grounds of helping the small producer -- on growth costs, contractual arrangements, market structure, and ultimately, market prices.

## FOOTNOTES

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1/ Or, more precisely, the distribution of percentage changes in size, over some finite time period, of the firms in a particular size class will be the same for all size classes. In other words, ". . . a firm randomly selected from those with a billion dollars in assets has the same probability of growing, say, 20%, as a firm randomly selected from those with a million dollars in assets" [32, p. 609].

2/ In the sense of minimum short-run average costs.

3/ A number of alternative models of the firm have been developed: behavioral, organizational, simulation, linear programming models, for example. Summaries of some of these theories are available elsewhere [20, 23]. For purposes of understanding some aspects of market structure, further work in these areas may have a high payoff. They are not explored further here because of my inability to see how they may be extended to generate hypotheses about market characteristics. Simulation and programming models of markets, on the other hand, may be highly useful and, in fact, may themselves usefully incorporate some of the ideas this paper reviews with respect to the firm [see 4].

4/ Data were obtained from the Internal Revenue Service. The industries studied were the Wines, Sugar, Alcoholic Beverages, Nonalcoholic Beverages, and Meat Products industries. These industries were selected largely because of data availability and data comparability over time. Of course, problems of the appropriate definition of an industry loom large in studies of this sort.

5/ The Alcoholic Beverages and Sugar industries.

6/ One may ask why market structure should be of interest to economists. In addition to helping understand the process of exchange, perhaps justification can be found in public policies resulting from and/or leading to structural changes in agricultural industries. Activities of the Federal Trade Commission, recent recommendations concerning farm bargaining boards [2], recommendations of the National Commission on Food Marketing [29] come to mind.

It should be pointed out that changes in market structure would, in general, be classified as concerning "comparative statics" while the growth of the firm is, by definition, concerned with "dynamics." Perhaps a defense of treating the two phenomena jointly is provided by Mueller and Garoian, who state, "A firm's growth methods and the underlying motives for growth are necessarily of interest in market structure analysis because they explain why a particular structure exists" [25, p. 5].

7/ In Stigler's sense of the expression, "barriers to entry," a phenomenon which he distinguishes from "economies of scale." "A barrier to entry may be defined as a cost of producing (at some, or every rate, of output) which must be borne by a firm which seeks to enter an industry, but is not borne by firms already in the industry" [34, p. 67].

8/ This may seem obvious. It should be pointed out that the arguments of some would suggest that it doesn't matter what characteristics one deals with in discussing firm growth. Marris contends, for example, that for growth to be sustainable, ". . . most of the alternative measures of size are required to expand in balance," and, hence, the rate of change of any one of them is an appropriate measure of growth [22, p. 118]. Simon and Bonini state that "whether sales, assets, numbers of employees, value added, or profits are used as a size measure, the observed distributions always belong to the class of highly skewed distributions that include the log-normal and the Yule" [32, p. 611].

9/ Notice that it is the functions which are subject to such economies (or, as Stigler calls them, "increasing returns"). This does not preclude the existence of a horizontal long-run average cost curve for the firm's output [34, pp. 131-134]. The distinction between output and function is crucial throughout this discussion.

10/ Hence, the firm is viewed as a contractual arrangement between buyers and sellers of intermediate goods (e.g., labor services) such that the nature of the services to be exchanged during the life of the contract is specified within some boundary defined at the inception of the contract.

11/ Which may be thought of as the difference between prices which prevail because of restrictions leading to closed markets [1, Ch. 3] (such as occupational licensure,

agricultural market orders, etc.) and prices which one or both parties to an exchange believe would prevail in the absence of the restrictions.

12/ The paper by Peter Helmberger provides an interesting discussion of these issues, with particular attention to the role of information in determining the nature of contractual arrangements [15]. The author is grateful to James Youde for referring him to this paper.

13/ For example, implication No. 4 is derived under the assumption of no change in production costs (No. 2) or transaction costs (No. 5).

14/ Most of these implications have focused on responses to demand (either market or firm) increases. Similar kinds of implications would emerge from other parametric changes; e.g., technological changes.

15/ There are, of course, many incentives for producers to collude. Food companies may prefer to deal with cooperatives if contractual arrangements contain specifications on the nature of the commodity to be purchased. This is really an extension of the Collins' argument [8]. Williamson refers to the phenomenon as an "information processing advantage" [38]. According to this argument, cooperatives are in a better position to follow through on their contracts than are independent producers since they can select from among their members to satisfy the "quality" demands of individual buyers. However, it should be pointed out here that this factor may result in either long-term contracts, or in complete vertical integration. Which prevails would depend on other factors, many of which hinge on the extent to which parties to a contract feel they can adequately anticipate future conditions which, in the absence of present contractual specification, would result in extensive haggling because of differences in interpretation of contractual terms. (McKean argues that haggling is reduced by internalization because all parties are more willing to "accept monitoring by overall management" since they are rewarded for increasing the integrated firm's profits [24].) This could be particularly true when volume changes are made in response to changing environmental conditions. To specify contract terms to take care of all possible contingencies (demand shifts, weather fluctuations, technological changes) would be very costly. Vertical integration may be preferred. This should be kept in mind when one is making predictions about the organization of farm labor on the structure of agricultural industries.

16/ These mergers may involve a very high growth cost, which would also be included in the decision-making calculus.

17/ A recent interesting study provides some evidence to support the ideas advanced here. This was a study of the relationship between the procurement policies of retail food chains and adjustments in the fluid milk processing industry [12]. In that study, the researchers found that "more and more retailer groups are contracting for packaged milk supplies through central or district office purchasing programs" [12, p. 395]. This may be an example of vertical disintegration wherein the purchasing function is split off from these firms to take advantage of economies of size associated with this function. Ownership of the resulting "firm" resides, in this case, in the retailers, who were previously performing the functions themselves. Contractual arrangements with suppliers may then emerge because of information processing advantages discussed earlier. Further, small milk processors, facing a reduction in demand because of these contractual arrangements with the large processors, have found it profitable to integrate forward into dairy stores. The authors also found that food chains "are taking on part or all of the services involved in delivering milk from the processing plant to the food stores" [12, p. 402]. As they point out, this phenomenon may well be an attempt to reduce the transaction costs incurred through dealing with unionized wholesale drivers.

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