Models in a Behavioral Theory of the Firm

by

R. M. Cyert, E. A. Feigenbaum, and J. G. March

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How do business organizations make decisions? What process do they follow in deciding how much to produce? And at what price? A behavioral theory of the firm is here explored. Using a specific type of duopoly, a model is written explicitly as a computer program to deal with the complex theory implicit in the process by which businesses make decisions. This model highlights our need for more empirical observations of organizational decision-making.

**MODELS IN A BEHAVIORAL THEORY OF THE FIRM**

by R. M. Cyert, E. A. Freeman, and J. G. March

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RECENT attempts to develop a behavioral theory of the firm have focused particularly on the internal characteristics of a business firm as a decision-making organization. They have used the rough framework of both the theory of competitive pricing and the modern efforts to extend that theory to situations of imperfect competition such as the case of oligopoly and duopoly where only a few, or possibly only two, firms supply a given market. They have, however, gone further in introducing as an important part of the theory the process by which business organizations make decisions. Since business firms are organizations, it has seemed reasonable a priori to assume that a theory of business behavior ought not to treat them as individual decision-makers.

(Ah, 1949; Bushaw & Clover, 1957; Chamberlin, 1948; Cooper, 1951; Cyert & March, 1955; Cyert & March, 1956; Gordon, 1948; Papandreou, 1952; Weintrob, 1942).

Two major obstacles to the acceptance of such a theory of pricing are obvious. First, it must be shown that the theory is at least as good as other existing theories in its ability to predict firm behavior (Friedman, 1952). Convincing demonstrations on either side of this point are not available. In our judgment, a major portion of the effort in the next decade of research on pricing should be directed to answering this question (or to making it irrelevant). But we do not propose to discuss the point in detail here. Second, a way must be found to deal with the complex theory implicit in the decision-making process approach. A major problem perceived by those sympathetic to a behavioral theory has been the lack of a methodology suitable for handling the kinds of complexities that seemed to be needed (Koopmans, 1957). It is to this problem and to the development of a specific model to which we address ourselves in this paper.

We show that a relatively complex model of the firm as a decision-making organization can be developed and used to yield economically relevant and testable predictions of business behavior. The methodology involved is computer simulation. The model is one of a specific type of duopoly. As a rough test of reasonableness, we compare the predictions of the model with actual data. Our hope is that the model will illustrate the promise of simulation as a technique of model building in economic theory and the behavioral sciences in general and at the same time demonstrate a general method for examining many of the concepts previously discussed in more abstract terms.

**THE DECISION-MAKING PROCESS**

Recent theories of organizational behavior have emphasized several important characteristics of the decision-making process that
are dealt with awkwardly in the theory of the firm. First, organizational decisions depend on information, estimates, and expectations, not necessarily accurate ones (Cyert & March, 1955). Second, organizations consider only a limited number of decision alternatives. The set of alternatives considered depends on some features of organizational structure and on the locus of search responsibility in the organization. This dependence seems to be particularly conspicuous in such planning processes as budgeting and price-output determination (Alt, 1949). Finally, organizations vary with respect to the amount of resources they devote to organizational goals on the one hand and suborganizational and individual goals on the other. In particular, conflict and partial conflict of interests is a feature of most organizations and under some conditions organizations develop substantial internal slack susceptible to reductio under external pressure (Cyert & March, 1956).

The concept of organizational slack is used to describe a situation within an organization in which individual energies potentially utilisable for the achievement of organizational goals are not devoted. The form of the slack may vary from a labor force not working at its full capacity to overly large departmental budgets. The extent and regularity with which the organization meets its goals, especially the profit goal, will affect the amount of internal slack.

One objective is to show how the general attributes of decision-making, some of which have been described above, can be introduced into a behavioral theory of the firm. Although our elaboration is an obvious abstraction of the details of procedures used in a complex organization, each of the processes specified can serve as headings for a further set of subprocesses. We have specified nine distinct steps:

1. Forecast competitors' behavior. The fact that firms assume something about the reactions of their rivals is, of course, incorporated in any theory of oligopoly. Our approach is to determine how the firm can form an estimate of the rival firm's reaction to its cost and output decision. The order of steps (1), (2), (3), and (4) is irrelevant in the present formulation. We assume that a firm performs such computations more or less simultaneously and that all are substantially completed before any further decisions are made. The subsequent steps are all contingent, the order in which they are performed may have considerable effect on the decisions reached. This is particularly true for the definition of the order of steps (6), (7), and (8). Thus, one of the structural characteristics of a specific model is the order of the steps.

2. Forecast demand. We have attempted to build a model that can encompass descriptions of the process by which the demand curve (the relationship between the price of the product and the quantity which can be sold at that price) is estimated in the firm. In this manner, we are able to introduce organizational biases in estimation and allow for differences among firms in the way in which they adjust their current estimates on the basis of experience.

3. Estimate costs. We do not assume, as in the theory of the firm of economics, that the firm has achieved the optimum combination of resources and the lowest cost per unit of output for any given size plant. We believe it is necessary to introduce the factors that affect the firm's costs, estimated as well as achieved.

4. Specify objectives. As has been noted above, organizational "objectives" may be permitted to be either two or three, with two quite distinct functions. First, in this step they consist in goals the organization wishes to achieve and which it uses to determine whether it is having at least one viable plan [see step (5)]. There is no requirement that the objectives be co-measurable since they enter as separate constraints all of which must be satisfied. Thus, we expect to be able to include profit goals, share of the market goals, production goals, etc. (Simon, 1955). Second, the objectives may be used as decision criteria in step (9). As will become clear below, the fact that objectives serve this twin function rather than the single (decision-rule) function commonly assigned to them is of major importance to the theory.

The order of steps (1), (2), (3), and (4) is irrelevant in the present formulation. We assume that a firm performs such computations more or less simultaneously and that all are substantially completed before any further decisions are made. The subsequent steps are all contingent, the order in which they are performed may have considerable effect on the decisions reached. This is particularly true for the definition of the order of steps (6), (7), and (8). Thus, one of the structural characteristics of a specific model is the order of the steps.

5. Evaluate plan. On the basis of the estimates of (1), (2), and (3) alternatives are examined to see whether there is at least one alternative that satisfies the objectives defined by (4). If there is, we transfer immediately to (9) and a decision. If there is not, however, we go on to step (6). This evaluation represents a key step in the planning process that is ignored in a model that uses objectives solely as the decision rule. Certain organizational phenomena (e.g., organizational slack) increase in importance because of the contingent consequences of this step relative to others.

6. Re-examine objectives. We specify that the failure to find a viable plan initially results in the re-examination of estimates. Although we list the re-examination of costs first here, the order is dependent on some features of the organization and will vary from firm to firm.1 An important feature of organizational slack is that it is not possible to "discover" under the pressure of unsatisfactory preliminary plans "cost savings" that could not be found otherwise. In fact, we have already seen the importance of permitting firms to begin approach an optimum combination of resources. With the revised estimate of costs, step (5) occurs again. If an acceptable plan is possible with the new estimates, the decision rule is applied. Otherwise, step (7).

7. Re-examine demand. As in the case of cost, demand is reviewed to see whether a somewhat more favorable demand picture cannot be obtained. This might reflect simple optimism or a consideration of new methods for influencing demand (e.g., an additional advertising effort). In either case, we expect organizations to revise demand estimates and use certain organizational feedbacks to exploit the downplaying pressure of the revised estimates. As shown in figure 8, re-examination of objectives begins again in most processes.

8. Select alternative. The organization requires a mechanism (a) for generating alternatives to consider and (b) for choosing among those generated. The method by which alternatives are generated is of considerable importance since it affects the order in which they are evaluated. Typically, the procedures involved play a high premium on alternatives that are "similar" to those generated in the recent past by the firm or by other firms of which it is aware. If alternatives are generated strictly sequentially, the choice phase is quite simple: choose the first alternative that falls in the estimate space, that is the set of positions determined by the estimated demand and estimated cost curves. If more than one alternative is generated at a time, a more complicated choice process is required. For example, at this point maximization rules may be applied to select from among the evaluated alternatives. In addition, this step defines a decision rule for the situation in which there are no acceptable alternatives (even after all re-examination of estimates).

There are two important observations to be made about a theory having these general characteristics. First, as we increase the emphasis on describing in some detail the actual process by which the firm makes price and output decisions, we decrease the relevance of one of the major debates in the theory of the firm. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory. Whether the firm maximizes, "satisfies," or just tries to survive is of major importance to the theory.
not the main issue (if indeed it is an issue at all). The emphasis on the process of making decisions in an organization obviates the need for the single decision rules and simple models implicit in much of that controversy.

The second point is a related one. Conventional mathematics is a somewhat awkward tool for developing the implications of a theory such as the one described here. It is no accident, therefore, that interest in detailed process models has grown with the development of the digital computer. Computer simulation is well suited to the complexities that are introduced when internal firm variables are utilized in the theory. The significance of simulation for business behavior has been explored vigorously in the so-called "business games" developed as business training devices; their potential for economic theory is at least as great.

A SPECIFIC DUOPOLY MODEL

The theoretical framework we have outlined in the preceding section can be viewed as an executive program for organizational decisions. That is, we conceive of any large scale oligopolistic business organization as pursuing the steps indicated. A change in decision must (within the theory) be explained in terms of some change in one of the processes specified. As we have noted above, such a change in the theory seems to suggest a computer-simulation model rather than treatment in mathematical form (Cyert, Simon & Trox, 1956). The rationale, of course, remains the same. We wish to explore the implications of the model.

The intention has been to construct a plausible set of estimation and decision rules for different types of organizations, and to simulate on a computer the behavior of these firms over time. When we attempt to develop models exhibiting the process characteristics we have discussed above, it becomes clear that our knowledge of how actual firms do, in fact, estimate demand, costs, etc., is disappointingly small. We know with reasonable confidence some of the things that many firms do but at a number of points in the model we can only educate guesses. Moreover, what knowledge we have (or think we have) tends to be qualitative in nature in situations where it would be desirable to be quantitative.

Because of these considerations, the models of forecast for which we will deal here should be viewed as tentative approximations. They contain substantial elements of arbitrariness and unrealistic characteristics, For example, we believe that each of the models as it stands almost certainly exaggerates the computational precision of organizational decision-making. In general, we have not attempted to introduce all of the revisions we consider likely at this time primarily because we wish to examine whether some major revisions produce results which are reasonably approximate observed phenomena.

The model is developed for a duopoly situation. The product is homogeneous and, therefore, only one price exists in the market. The major decision that each of the two firms makes is an output decision. In making this decision the firm must estimate the market price for varying outputs. When the demand is known, however, the optimal output price will be determined by the market. No discrepancy between output and sales is assumed, and thus no inventory problem exists in the model.

We assume a duopoly composed of an ex-monopolist and a firm developed by former members of the established firm. We shall call the latter, "the splinter," and the former, "the ex-monopolist" or, for brevity, "monopolist." Such a specific case is taken so that some rough assumptions can be made about appropriate functions for various processes in the model. The assumptions are gross; but it is only through such rough model that a start can be made.

To demonstrate that the model as a whole has some reasonable empirical base, we will compare certain outcomes of the model with data from the real industry, where approximately the same initial conditions hold.

We can describe the specific model at several levels of detail. In Table 1 the skeleton of the model is indicated—the "flow diagram" of the decision-making process. This will permit a quick comparison of the two firms. In the remainder of this section

<table>
<thead>
<tr>
<th>TABLE I</th>
</tr>
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<tbody>
<tr>
<td><strong>PROCESS MODEL FOR OUTPUT DECISION OF FIRM</strong></td>
</tr>
<tr>
<td>1. Forecast:</td>
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<tr>
<td>2. Forecast:</td>
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<tr>
<td>3. Estimate:</td>
</tr>
<tr>
<td>4. Specify objectives:</td>
</tr>
<tr>
<td>5. Evaluate:</td>
</tr>
<tr>
<td>6. Revenue Alternatives:</td>
</tr>
<tr>
<td>7. Revenue:</td>
</tr>
<tr>
<td>8. Reduce:</td>
</tr>
<tr>
<td>9. Realize:</td>
</tr>
</tbody>
</table>

The process of decision-making is then described in terms of the model output. The decision-making process is postulated by the theory begins with a "forecast" phase (which competitor's reaction, demand, and costs are estimated) and a goal specification phase (in which a profit goal is established). An evaluation phase follows, in which an effort is made to find the "best" alternative given the forecasts. If this "best" alternative is inconsistent with the profit goal, a re-examination phase ensues, in which an effort is made to revise cost and demand estimates. If re-examination fails to yield a new best alternative consistent with the profit goal, the immediate profit goal is abandoned in favor of "doing the best possible under the circumstances." The specific details of the models follow this framework.

Forecasting a competitor's behavior

The model being analyzed in the paper assumes two firms in the market (a duopoly). As a result one of the significant variables in the decision on the quantity of output to produce for each firm becomes an estimate of the rival firm's output. For example, assume the monopolist in period 1 is considering a change in output from period 1 to period 2. At the same time the monopolist makes an estimate of the change the splinter will make. At the end of period 1 the monopolist can look back and determine the amount of change the splinter made in relation to his own change. The ratio of changes can be expressed as follows:

\[ V_{S,t} = Q_{S,t} - Q_{S,t+1} / Q_{S,t} \]

where \( V_{S,t} \) is the change in the splinter's output during period t as a percentage of the monopolist's output change during period t.

\[ Q_{S,t} - Q_{S,t+1} = \text{the actual change in the splinter's output during period t} \]

\[ Q_{S,t} - Q_{S,t+1} = \text{the actual change in the monopolist's output during period t} \]

In the same way we have for the splinter the following:

\[ V_{R,t} = Q_{R,t} - Q_{R,t+1} / Q_{R,t} \]

The ex-monopolist. When the monopolist in period 1 is planning his output, he must make an estimate of his rival's output, as noted above. In order to make this estimate we assume that the monopolist first makes an estimate of the percentage change in the splinter's output in relation to his own change, that is, an estimate of \( V_{S,t} \). We
have assumed that the monopolist will make this estimate on the basis of the splinter's behavior over the past three time periods. More specifically we have assumed that the monopolist's estimate is based on a weighted average, as follows:

\[ V'_{t,1} = V_{t,1-1} + \frac{1}{2} (V_{t,1-2} - V_{t,1-3}) + \frac{2}{3} (V_{t,1-3} - V_{t,1-4}) + (V_{t,1-4} - V_{t,1-5}) \]

where \( V'_{t,1} \) is the monopolist's estimate of the change in the splinter's output during period \( t \) as a percentage of the monopolist's output change during period \( t-1 \), that is, an estimate of \( V_{t,1} \).

Note that \( (V'_{t,1} - Q_{t,1} - Q_{t,1-1}) \) is the monopolist's estimate of the splinter's change in output, \( Q_{t,1} - Q_{t,1-1} \).

The splinter. We would expect the splinter firm to be more responsive to recent shifts in its competitor's behavior and less attentive to ancient history than the monopolist, both because it is more inclined to consider the monopolist a key part of its environment and because it will generally have less computational capacity as an organization to process and update the information necessary to deal with more complicated rules. Our assumption is that the splinter will simply use the information from the last two time periods. Thus

\[ V'_{t,1} = V_{t,1-1} + (V_{t,1-2} - V_{t,1-3}) \]

In the same manner as above, \( (V'_{t,1} - Q_{t,1} - Q_{t,1-1}) \) is the splinter's estimate of the monopolist's change in output, \( Q_{t,1} - Q_{t,1-1} \).

Forecasting demand

We assume that the actual market demand curve is linear. That is, we assume the market price to be a linear function of the total output offered by the two firms together. We also assume that the firms forecast a linear market demand curve (quite different, perhaps, from the actual demand curve). There has been considerable discussion in the economics literature of the frequent discrepancy between the "imagined" demand curve and the actual demand curve (Wright, 1942); and it is this concept which we are concerned with at this point. The values of the parameters of the "imagined" demand curve are based on rough inferences from the nature of the firms involved.

The ex-monopolist. We assume that, because of its past history of dominance and monopoly, the ex-monopolist will be overestimative with respect to the quantity which it can sell at lower prices, i.e., we assume the initial perception of the demand curve will have a somewhat greater slope than the actual market demand curve. On the assumption that information about actual demand is used to improve its estimate, we assume that the ex-monopolist changes its demand estimate on the basis of experience in the market. The firm assumes that its estimate of the slope of the demand curve is correct and it "recomputes" its previous estimate to pass through the observed demand point.

The splinter. We posit that the splinter firm will initially be optimistic with respect to the quantity which it can sell at lower prices. That is, its initial slope (average value) of its demand curve will be somewhat less than that of the actual market demand curve. Secondly, we assume that initially the splinter's demand curve is increasing over time. Thus, until demand shows a down turn, the splinter firm estimates its demand to be 5% greater than that found by forcing its perceived demand through the last point observed in the marketplace.

Estimating costs

In the process for forecasting and realizing costs, we do not make the assumption that the firm has achieved optimum costs. We assume, rather, that the firm has a simplified estimate of its average cost curve, that is, the curve expressing cost as a function of output. It is horizontal over most of the range of possible outputs; at high and low outputs (relative to capacity) costs are perceived to be somewhat higher.

Further, we make the assumption that these cost estimates are "self-confirming," i.e., the estimated costs will, in fact, become the actual per-unit cost (Cyert & March, 1956). The concept of organizational slack as a concept of organizational decision-making has been achieved for two consecutive time periods, then costs are estimated to be 5% higher than "last time."

The specific values for costs are arbitrary. The general shape of the cost curves has been discussed in detail in the literature and studied empirically (Dean, 1951). The concept of organizational slack has some important implications for the theory of the firm and has been defined earlier.

The ex-monopolist. The monopolist's initial average unit cost is assumed to be $800 per unit in the range of outputs from 10% to 90% of capacity. Below 10% and above 90% the initial average unit cost is assumed to be $100.

The splinter. It is assumed that the competitor will have somewhat lower initial costs. This is because its plant and equipment will tend to be newer and its production methods more modern. Specifically, initial average costs are $580 per unit. The range of outputs from 10% to 90% of capacity, below 10% and above 90% costs are assumed to average $870 per unit produced.

Specifying objectives

The multiplicity of organizational objectives is a fact with which we hope to deal in later revisions of our models. For the present, however, we have limited ourselves to a single objective defined in terms of profit. In this model the function of the profit objective is to restrict or encourage search as well as to determine the decision. Given the various estimates of competitors, demand, and cost, there exists a production level which will provide a profit which is satisfactory, we assume the firm will adopt such a course. If there is more than one satisfactory alternative, the firm will adopt that quantity level that maximizes profit. Whether even such a restricted maximization procedure is appropriate is a subject for further research.

The ex-monopolist. We assume that the monopolist, because of its size, its substantial computational ability, and its established procedures for doing things reliably, will respond over the past ten time periods. Initially, of course, the monopolist will seek to maintain the profit level achieved during its monopoly.

The splinter. The splinter firm will presumably be (for reasons indicated earlier) inclined to consider a somewhat shorter period of past experience. We assume that the profit objective of the splinter will be the average of experienced profit over the past five time periods and that the initial profit objective will be linked to the experience of the monopolist and the relative capacities of the two. Thus, we specify that the initial profit objectives of the two firms will be proportional to their initial capacities.

Re-examination of costs

We assume that when the original forecasts define a satisfactory plan there will be no further examination of them. If, however, such a plan is not obtained, we assume an effort to achieve a satisfactory plan in the first instance by reviewing estimates and finally by reviewing objectives. We assume that cost estimates are then reviewed by demand estimates and that the latter are only re-examined if a satisfactory plan cannot be developed by the revision of the former. The re-evaluation of re-examination of organizations at lower cost cannot be developed unless possible under pressure. We believe this ability to revise estimates when forced to do so is characteristic of organizational decision-making. It is, of course, closely related to the organizational slack concept previously introduced. In general, we have argued that an organizational decision can ordinarily find possible cost reductions if enforced to do so and that the amount of the reductions will be a function of the amount of slack in the organization. It is assumed that the re-examination of costs under the pressure of trying to meet objectives enables each of the organizations to move in the direction of the "real" mini-
The ex-monopolist. As a result of the re-examination of demand estimates, it is assumed that this firm revises its estimates of demand upward by 10%.

The splinter. The assumption here is that the upward revision of demand is 15%.

Re-examination of demand

The re-evaluation of demand serves the same function as the re-evaluation of costs above. In the present models it occurs only if the re-evaluation of costs is not adequate to define an acceptable plan. It consists in revising upward the expectations of market demand. The reasoning is that some new alternative is selected which the firm believes will increase its demand. The new approach may be changed advertising procedure, a scheme to work salesmen harder, or some other alternative which leads the firm to an increase in optimism. In any event, it is felt the more experienced firm will take a slightly less sanguine view of what is possible. As in the case of estimating demand, we assume that all firms persist in seeing a linear demand curve and that no changes are made in the perceived slope of that curve.

TABLE II

INITIAL AND STRUCTURAL CONDITIONS FOR MODELS EXHIBITED IN TABLE III

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
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<tbody>
<tr>
<td>Initial Market Demand (unknown to firms)</td>
<td>p = 2000 - q</td>
</tr>
<tr>
<td>Initial Perception of Demand Schedule by Ex Monopolist</td>
<td>p = 2200 - 3q</td>
</tr>
<tr>
<td>Initial Perception of Demand Schedule by Splinter</td>
<td>p = 1800 - q</td>
</tr>
<tr>
<td>Average Unit Cost</td>
<td>t \leq 8 = \frac{1}{2}</td>
</tr>
<tr>
<td>Minimum Average Unit Cost</td>
<td>q &gt; \frac{1}{2}</td>
</tr>
<tr>
<td>&quot;Real&quot; Minimum Average Unit Cost</td>
<td>q &gt; \frac{1}{2}</td>
</tr>
<tr>
<td>Ex Monopolist's Capacity</td>
<td>700</td>
</tr>
<tr>
<td>Splinter's Capacity</td>
<td>400</td>
</tr>
<tr>
<td>Market Quantity</td>
<td>50</td>
</tr>
<tr>
<td>Market Price</td>
<td>1300</td>
</tr>
<tr>
<td>Ex Monopolist's Profit Goal</td>
<td>1000</td>
</tr>
<tr>
<td>Splinter's Profit Goal</td>
<td>200</td>
</tr>
<tr>
<td>Conjectural Variations (W^\text{c} and W^\text{c}')</td>
<td>20,387</td>
</tr>
<tr>
<td>Splinter's over-optimism of demand in forecast phase</td>
<td>100%</td>
</tr>
<tr>
<td>Splinter’s raise demand forecast upon re-examination</td>
<td>100%</td>
</tr>
<tr>
<td>Ex Monopolist raises demand forecast upon re-examination</td>
<td>100%</td>
</tr>
<tr>
<td>Cost Reduction achieved in M's and S's search for lower costs</td>
<td>100% of costs above &quot;real&quot; min. av. unit cost</td>
</tr>
<tr>
<td>% Costs rise attributable to increase in &quot;internal slack&quot;</td>
<td>5%</td>
</tr>
<tr>
<td>Actual Demand Schedule shifts to right each time period</td>
<td>5%</td>
</tr>
<tr>
<td>Constraint on changing output from that of the last period</td>
<td>20%</td>
</tr>
<tr>
<td>% of capacity at which firm must be producing before it may expand (subject to other conditions)</td>
<td>60%</td>
</tr>
<tr>
<td>% change in capacity, when expansion occurs</td>
<td>20%</td>
</tr>
</tbody>
</table>

TABLE III

VALUES OF SELECTED VARIABLES AT 2-PERIOD INTERVALS

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1,420</td>
<td>311</td>
<td>2,285</td>
<td>203,693</td>
<td>158,601</td>
<td>158,601</td>
<td>158,601</td>
<td>311</td>
<td>48</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td></td>
</tr>
</tbody>
</table>

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maximization with respect to its perception of costs, demand, and competitor's behavior. The specific alternatives selected, of course, depend on the point at which this step is invoked (i.e., how many re-evaluation steps are used before an acceptable plan is identified). The output decision is constrained in two ways: (1) A firm cannot produce, in any time period, beyond its present capacity. Both models allow for change in plant capacity over time. The process by which capacity changes is the same for both firms. If profit goals have been met for two successive periods and production is above 90% of capacity, then capacity increases 20%. (2) A firm cannot change its output from one time period to the next more than ±25%. The rationale behind the latter assumption is that neither large cutbacks nor large advances in production are possible in the very short run, there being large organization problems connected with either.

The various initial conditions specified above are summarized in Table II, along with the other initial conditions required to program the models.

**RESULTS OF THE DUOPOLY MODEL**

We have now described a decision-making model of a large ex-monopolist and a splinter competitor. In order to present some detail of the behavior that is generated by the intersecting models, we have reproduced in Table III the values of the critical variables on each of the major decision and output functions. By following this chart over time, one can determine the time path of such variables as cost, conjectural variation, and output for both of the firms. More than any one thing, a careful study of this table will give a feeling for the major characteristics of the behavioral theory we have described.

In addition, we have compared the share of market and profit ratio results with actual data generated from the competition between American Can Company and its splinter competitor, Continental Can Company, over the period from 1913 to 1956. These comparisons are indicated in Figures I and II. In general, we feel that the fit of the behavioral model to the data is rather surpris-
Models in a Behavioral Theory of the Firm

It should be noted that the results in period XLIV do not necessarily represent an equilibrium position. By allowing the firms to continue to make decisions, changes in output as well as changes in share of market would result. One of the reasons for the expected change is the demand curve is shifting upward. Another, and more interesting reason, is that no changes have been made within the organizations. In particular, the splinter firm by period XLIV is a mature firm, but the model has it behaving as a new, young firm. One of our future aims is to build in the effect on organization, and hence on decision-making, of growth and maturity of the organization.

An examination of Table III indicates that the re-examination phase of the decision-making process was not used frequently by either firm. This characteristic is the result of a demand function that is increasing over most of the periods.

Whether this stems also from an inadequacy in the model's description of organizational goal-setting or is a characteristic of the real world of business decision-making is a question that can be answered only by empirical research.

**DISCUSSION**

One of the primary points that has been stressed here is the importance of the decision-making process for the theory of the firm. The implication of this position is that the decisions studied by conventional theory can be better understood when variables relating to the internal operation of a business firm are added to the theory. Accordingly, we would hope that such a theory would not only lead to improved prediction on the usual questions but would also facilitate the investigation of other important problems, e.g., allocation of resources within the firm.

The theory we have used differs from conventional theory in six important respects: (1) The models are built on a description of the decision-making process. That is, they specify organizations that evaluate competitors, costs, and demand in the light of their own objectives and (if necessary) re-examine each of these to arrive at a decision. (2) The models depend on a theory of search as well as a theory of choice. They specify under what conditions search will be intensified (e.g., when a satisfactory alternative is not available). They also specify the direction in which search is undertaken. In general, we predict that a firm will look first for new alternatives or new information in the area it views as most under its control. Thus, in the present models we have made the specific prediction that cost estimates will be re-examined first, demand estimates second, and organizational objectives third. (3) The models describe organizations in which objectives change over time as a result of experience. Goals are not taken as given initially and fixed thereafter. They change as the organization observes its success (or lack of it) in the market. In these models the profit objective at a given time is an average of achieved profit over a number of past periods. The number of past periods considered by the firm varies from firm to firm. (4) Similarly, the models describe organizations that adjust forecasts on the basis of experience. Organizational learning occurs as a result of observations of actual competitors' behavior, actual market demand, and actual costs. Each of the organizations we have used readjusts its perceptions on the basis of such learning. The learning rules used are quite simple. This is both because simple rules are easier to handle than complex rules and because we expect the true rules to be susceptible to close approximation by simple ones. (5) The models intro
duce organizational biases in making estimates. For a variety of reasons we expect some organizations to be more conservative with respect to cost estimates than other organizations, some organizations to be more optimistic with respect to demand than others, some organizations to be more attentive to signals of changes in competitors’ plans than others. As we develop more detailed submodels of the estimation process, these factors will be increasingly obvious. In the present models we have not attempted to develop such submodels but have simply predicted the outcome of the estimation process in different firms. (6) The models all introduce features of “organizational slack.” That is, we expect that over a period of time during which an organization is achieving its goals a certain amount of the resources of the organization are funneled into the satisfaction of individual and subgroup objectives. This slack then becomes a reservoir of potential economies when satisfactory plans are more difficult to develop.

In order to deal with these revisions, the models have been written explicitly as computer programs. Such treatment has two major values. First, simulation permits the introduction of process variables. The language of the computer is such that many of the phenomena of business behavior that do not fit into classical models can be considered without excessive artificiality. Entering naturally into the model are cost and demand perceptions within the firm in relation to such factors as age of firm, organizational structure, background of executives, and phase of the business cycle; information handling within the firm and its relation to the communication structure, training, and reward system in the organization; and the effects of organizational success and failure on organizational goals and organizational slack.

Secondly, simulation easily generates data on the time path of outputs, prices, etc. For that large class of economic problems in which equilibrium theory is either irrelevant or relatively uninteresting, computer methodology provides a major alternative to the mathematics of comparative statics.

At the same time the models highlight our need for more empirical observations of organizational decision-making. Each of the major steps outlined in the program defines an area for research on business behavior. How do organizations predict the behavior of competitors? How do they estimate demand and costs? What determines organizational planning objectives? In the models we have specified we have introduced empirical assumptions for such things as organizational learning and changes in organizational aspiration levels. We have ignored several factors we consider quite important (e.g., informational biases stemming from variations in the communication structure). In the final development of the model these relationships must be defined from observable characteristics of business organizations.

We see three major directions for further research. First, we would hope that further research will be made to compare the results of the models with observable data. In these studies it will be possible to change such variables as have been indicated above and others that appear to be important in the model. Second, we need a great deal of work in actual organizations identifying the decision procedures used in such things as output decisions. Field research on organizations has frequently been extremely time-consuming and costly relative to the results it has produced, but we believe that research focused on the questions raised by the model is both necessary and feasible. Third, there is room for substantial basic research in the laboratory on human decision-making under the conditions found in business organizations. Many of the major propositions in organization theory depend on evidence generated by studies in the laboratory and many of the mechanisms with which we have dealt can be profitably introduced into controlled experiments.

REFERENCES


(Manuscript received November 17, 1968).
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(Continued)


30. The Role of the Field Staff Representative, by Myron L. Joseph. Industrial and Labor Relations Review, April 1959.
