

Comments on "A Simulation Analysis of Alternative Pricing Strategies for Dynamic Environments"

If a person untrained either in economics or in business asked for a thumbnail sketch of the fields of marketing and industrial organization, he would probably conclude that they are the same, because they are both concerned with the interactions and optimal behavior of firms in a market. Of course the two fields have tended to focus on different techniques, different variables, and different priorities for their research agendas. It has been brought forcefully home to me during this conference that the two fields now have a very substantial overlap. Each has moved toward the other. Economists now show concern with intertemporal demand and cost effects, innovation, advertising, and so forth. Meanwhile, marketing researchers are more actively interested in price behavior and in the use of analytical models. These are all pleasing developments.

From my perspective, the interesting and suggestive paper by Clarke and Dolan looks like a duopoly model, and it is from this standpoint that I hope to say something useful about it. As they have explained already, it is a duopoly model specially formulated to deal with the relationship between a firm's optimal price policy, on the one hand, and certain intertemporal demand and cost effects, on the other. In commenting, I want to address three issues: (a) the usefulness of simulation, (b) some specific aspects of their model, and (c) approaches from the game theory literature that might fruitfully be adapted to their needs and that might yield rich analytical results.

a) They are aware that analytical results are more satisfactory than simulation results, and they have chosen the simulation route, no doubt, because they perceived a much better chance to obtain something interesting that way. The weakness of simulation is that no general propositions can emerge from it. Strictly speaking, all you learn about are the specific cases you run on the computer. But, in their defense, simulation results may provide valuable hints about how to

formulate analytical models and what to look for in them. I hope that some of the suggestions these simulations prompt from me will be useful in allowing the authors to achieve good analytical results.

b) Concerning the specifics of the paper, Clarke and Dolan have built in special demand and cost dynamics. First, as they deal with a durable good, more sales today mean fewer consumers in the market tomorrow. Second, those consumers who are in the market tomorrow have reservation prices that are positively related to the number of units previously sold. The firm's marginal cost, constant within any time period, falls as total sales in past periods rise. These specific demand and cost dynamics are interesting, novel as far as I know, and at the heart of the model. They can be summarized by noting that the single-period profit function of a firm does not depend only on the current price choices of the firms in the market. It depends also on the past choices, and it is quite natural that a firm is not maximizing discounted profits if it chooses its price so that current-period marginal revenue equals current-period marginal cost. Later I will return again to the element of structural time dependence outlined above.

In the simulations, after the second firm has entered the market, the relationship between the two firms is treated in two ways. Both of them strike me as inappropriate. One is that "the leader [the original firm] declares his price first, then the entrant selects his price to maximize his [current period] profits given the leader's price" (Sec. III). This Stackelberg-type decision structure seems contrived and unnatural to me. There is nothing inherent in the model to give this asymmetric situation—as contrasted with the two firms choosing prices simultaneously. There is no reason why Alcoa should announce prices prior to Reynolds merely because Alcoa was founded at an earlier date. The second way of modeling behavior is that of "the passive follower." The follower does not solve a maximization problem; rather he just charges the same price as the leader provided that price is above his unit cost. If the leader's price is below the follower's cost, the follower charges his unit cost. The prescribed behavior of the follower is unappealing because the follower is assumed to be much more thoughtful and intelligent than the leader. Why not have each firm use a decision rule, or strategy, to govern its price choices, which maximizes its discounted profits, given the decision rule of the other? This is a long-winded way of suggesting that the model be approached as a non-cooperative game.

Before I suggest what I hope is relevant literature, one other aspect of the model puzzles me. Why have one firm alone in the market, followed by the certain entry of the second firm at a specific time? As market entry is not endogenous, the model is one of duopoly grafted onto monopoly. It might be better to deal with three separate, but

related, models: monopoly, duopoly, and monopoly with a potential entrant.

The market in the simulation has the structure of a time-dependent supergame. That is a game which is played for more than one period, sometimes for an infinite number of periods, which has profit functions for each firm in each period, and in which the payoff function of a firm in a specific period depends on past, as well as present, price choices. This interperiod link, making the payoff of today depend on past as well as present choices, means that a rational firm would not choose today's price merely to maximize today's profit. It will also take account of the effect of today's price choice on future periods' profits.

A paper of mine (Friedman 1974) deals with discrete time-infinite horizon games of precisely this sort. The actions taken in one time period affect the profit functions of the next period. A second approach, found in Sobel (1971), is through stochastic games in which the profit functions of a period depend on the realization of a random variable whose distribution depends on the profit function and actions of the immediately previous period. The structural time dependence of Sobel's formulation remains even if randomness is removed from the model. Third, the fine paper by Kreps and Wilson (1982) is well suited to a finite horizon setting of more than one period.

These three papers are too abstract to yield the kind of equilibrium price policy results one would want, but appropriate specialized versions along the lines of the authors' model could be developed and might be very fruitful.

I will close by pointing out that the past 15 years have seen the development of a number of infinite time horizon oligopoly models by Prescott (1973), Kirman and Sobel (1974), Friedman (1979, 1980), Flaherty (1980a, 1980b), and Miller (1982). Perhaps adaptations of some of these models would be helpful in furthering marketing research. All of these papers involve "strategic pricing" and/or "strategic output choice."

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