POTENTIAL ENTRANTS DISCOURAGE ENTRY

ROGER SHERMAN AND THOMAS D. WILLETT*
University of Virginia

Both J. S. Bain (1956) and Paolo Sylos Labini (1962) have revealed important effects of entry conditions on pricing behavior in oligopolies. In particular, whenever the minimal efficient plant size represents a significant portion of total market quantity, oligopoly firms can set a price low enough to forestall entry by another firm, yet high enough to yield profits beyond the competitive level. Modigliani (1958, 1959) provided an excellent synthesis and exposition of common elements in the work of Bain and Sylos. His formulation of a Bain-Sylos model showed that an entry-forestalling price could exceed the competitive price by a greater amount as economies of scale were greater, as the size of the market was smaller, and as market demand was less elastic. But only one potential entrant was considered in the model. In this note we examine the implications of increasing the number of potential entrants within the framework of the Bain-Sylos-Modigliani model.

The entry decision is greatly complicated when additional potential entrants are considered because the outcomes from entrants’ actions are no longer certain. Each potential entrant’s profit depends not only on the response of existing firms but also on whether other firms enter as well. Multiple entry could impose losses on all. While consideration of only one potential entrant escapes these complications, its general applicability seems open to question, for potential entrants might wonder whether others face a similar choice. We shall cast the potential entrant’s decision problem in a way that reflects the possibility that others may enter. For any of the main decision criteria that entrants might then adopt, we obtain a consistent result. Enlarging the number of potential entrants in this way will not lower the entry-forestalling limit price; instead, it will usually raise it.

To examine the effects of additional potential entrants, we shall assume that firms adhere to what Modigliani called the “Sylos postulate.” The postulate is Sylos’ assumption “that potential entrants behave as though they expected existing firms to adopt the policy most unfavorable to them, namely, the policy of maintaining output while reducing the price (or accepting reductions) to the extent required to enforce such an output policy” (Modigliani, 1958, p. 217). Such an assumption affords determinate solutions when there is only one potential entrant, and greatly simplifies strategic considerations when there are more than one.

Following Modigliani, consider a homogeneous oligopoly with effectively impeded entry. A “homogeneous oligopoly is defined as a situation in which all producers, actual and potential, are able to supply the identical commodity (more generally, commodities that are perfect substitutes
entry. Two potential entrants, A and B, that have access to the same cost function as existing firms, are affected by each other because one firm might profitably enter while two could not. If both enter, each will lose money. Let the profit rate on entry be \( f(p - p_1, n) \), where \( p \) is the market price before entry, \( p_1 \) is the price that would forestall entry by a single potential entrant, and \( n \) is the number of potential entrants (\( N \)) who actually enter. Then if \( p > p_1 \), we can expect \( f(p - p_1, 1) > 0 \). Define a higher price, \( P_2 \), so high that two firms could enter and both would break even. Then for \( P < P_2 \), we have \( f(p - p_1, 2) < 0 \). The four possible combinations of two firms' entry decisions are set forth in Figure 1. We shall regard these outcomes as utilities, on the assumption that utility is a linear function of profits. And we shall not allow side payments among firms, a stipulation that prevents collusion among potential entrants.5

The payoff matrix in Figure 1 possesses no dominance with respect to either firm's choice. If each potential entrant follows a maximax strategy, however, looking for maximum profits and ignoring possible losses, then its decision is clear. If \( f(p - p_1, 1) > 0 \), each one will enter in an effort to obtain the positive profit. This same result will obtain if the two potential entrants are unaware of each other or if there is only one potential entrant. Two (or more) potential entrants that follow the maximax decision rule can be discouraged from entering by the same limit price, \( p_1 \), that will discourage one entrant. Thus, if potential entrants adopt maximax strategies, the number of potential entrants will not affect the entry-forestalling price which could be charged by the existing firms.

If potential entrants adopt the maximin decision rule, on the other hand, the limit

<table>
<thead>
<tr>
<th>A's Strategy Choice</th>
<th>enter</th>
<th>do not enter</th>
</tr>
</thead>
<tbody>
<tr>
<td>enter</td>
<td>( f(p-p_1, 2), f(p-p_1, 2) )</td>
<td>( f(p-p_1, 1), 0 )</td>
</tr>
<tr>
<td>do not enter</td>
<td>( 0, f(p-p_1, 1) )</td>
<td>( 0, 0 )</td>
</tr>
</tbody>
</table>

Fig. 1.—The left-hand payoff in each cell goes to firm A, the right-hand payoff to firm B

4 We assume \( \frac{\partial f}{\partial n} < 0 \) and \( \frac{\partial f}{\partial p} > 0 \) in the price range of interest. Note that the profit (loss) function is affected by the mobility of resources; possible loss is greater as resources are less mobile and more specific to the industry. Even if resources were completely mobile, however, some strategic aspects might remain, since each potential entrant would still wish to influence the other. We assume that there is a positive cost to temporary entry into the industry, that is, \( f(p - p_1, 2) < 0 \) for \( p < p_2 \). This loss arises even though either entrant may attempt to exit immediately after entry. The ease and, in turn, the probability of exit can thus influence the level of \( p_2 \), but will not change the relation: \( p_2 > p_1 \).

5 Side payments are needed for collusive agreements under which one firm enters and pays another not to enter. But such agreements violate antitrust laws. Of course, potential entrants could form a single unit instead, just as Olin-Mathieson and Pennsalt companies formed Penn-Olin to enter the sodium chlorate industry. Because such ventures require explicit, covert agreements, however, they are not collusive. Another reason that collusion is more difficult among potential entrants than among existing firms is that potential entrants cannot always identify one another.
price will be affected. In adopting a maximin rule, a firm anticipates a malevolent opponent and seeks a best response to the opponent’s most harmful action. Following such a strategy here, neither firm will enter, for each will prefer a zero profit alternative to one that opens the possibility of a loss. Then the firms in being can forestall entry at a higher price than was possible with a single entrant. Indeed, the price must rise to \( p_2 \), where two firms could enter and both profit, before entry would be induced. The maximiner’s aversion to loss has the effect of making the minimal efficient scale for entry twice as large as it would be in the Mlodigliani model. The limit price will thus be above the level that would forestall entry by a single firm. Moreover, if maximin-type potential entrants were more numerous, they would all refuse to enter unless \( p \) were so high that all could enter with profit. Then the entry-forestalling price, \( p_n \), would be a monotonically increasing function of \( N \), the number of potential entrants.

A potential entrant might not presume that another potential entrant will be malevolent, yet it might not ignore the other firm’s actions either. A decision rule less extreme than either maximin or maximax is an expected utility-maximizing strategy based on subjective probabilities of the other firm’s entry. For firms \( A \) and \( B \), we can define \( P(E) \) as the subjective probability of the other firm’s entry, and \( 1 - P(E) \) as the probability of the other firm’s not entering.\(^6\) The expected utility from entry, \( E(U) \), for one firm will then be: \[ E(U) = P(E) \cdot f(p - p_i, 2) + [1 - P(E)] \cdot f(p - p_i, 1). \] The expected utility for not entering will, of course, remain at zero. Now observe that, since \( f(p - p_i, 1) > f(p - p_i, 2) \), expected utility will reach a maximum when \( P(E) = 0 \). But such an expectation yields the same limit price as the maximax strategy, which in turn is the same as when one entrant is ignorant of another entrant, or when there is only a single entrant. Any departure from this extreme case will lower each potential entrant’s expected utility, \( E(U) \). For such a departure, the firms already in being can successfully forestall entry at a higher price. An upper limit would exist where both potential entrants felt \( P(E) = 1 \), a probability estimate that would lead potential entrants to adopt maximin decision rules. Thus the limit price under expected utility-maximizing decision rules will be bounded by the high and low limit prices that result from maximin and maximax decision rules.

When \( N \) potential entrants adopt an expected utility-maximizing decision rule, the limit price need not rise monotonically with \( N \) beyond \( N = 2 \). The effect of \( N \) on limit price depends upon the potential entrants and how they evaluate the likelihood of entry as \( N \) grows larger. The chance of encountering a maximaxer may increase as the number of potential entrants increases. But each potential entrant might tend to regard entry by another as more likely when there are many potential entrants, so each may be more reluctant to enter. Regardless of their individual evaluations, however, as long as the most optimistic firm regards entry by one or more other firms as a possibility, the limit price will be higher than \( p_i \). And it can never fall below \( p_1 \).\(^7\)

Even though concern on the part of each potential entrant about possible entry by others will raise the price that can forestall entry, there remains a question whether existing firms will take advantage of it. They cannot be certain of potential entrants’ decision rules, and errors in their

\(^6\) Each probability is assumed to be independent of the firm’s own entry decision. It is not necessary for the firms to have identical probability estimates, nor is it likely, for each estimate will be based on the psychology of the other firm’s managers as well as on their costs.

\(^7\) It should be noted that a higher market price will usually imply a different optimal scale for single entry than would \( p_i \). If a potential entrant considers possible entry by others, it may therefore be uncertain of the scale at which such entry will occur. Moreover, one entrant might choose a scale larger than optimal in the hope that it would discourage others from entering. But such additional strategic considerations will not affect conclusions regarding the limit price.
estimates may result in entry. Presumably, existing firms would raise the price until increased profits from $p - p_1$ just offset their evaluation of the added probability of entry due to an error in anticipating potential entrant behavior. As we just noted, an increase in $N$ might make the existence of a maximaxing potential entrant more likely, but it will also tend to make each potential entrant less apt to enter at any price level.\footnote{An increase in the number of potential entrants might also strengthen the relevance of the Sylos postulate (that the existing firm would not reduce output in the face of a successful entry). If one firm enters an industry and there is little probability of further entry, it might be profitable for the original firms to reduce their output and accept the new entrant. When potential entrants are numerous, on the other hand, punishment of an entrant is necessary to deter further entry. Knowing this, the existing firms would be more likely to act in accordance with the Sylos postulate when there is more than one potential entrant.}

There is no easy way to resolve these differences in expectations that arise from imperfect knowledge of potential entrants’ behavior. The behavior of potential entrants and existing firms alike depends not on what the others will do, but on what each thinks the others will do. Nevertheless, it is clear that when there are several potential entrants, rather than one, price can often rise above $p_1$ without inducing entry. In these cases, $p_1$ is no longer an upper limit on entry-preventing price.

That an increase in the number of potential entrants can raise rather than lower the entry-preventing price conflicts with the widespread view that entry should be kept open to as many firms as possible. The conflict rests in part on the strong behavior postulates and knowledge assumptions needed to obtain definite implications from the model.\footnote{The assumption of perfect information is essential for all implications of the Bain-Sylos-Modigliani model discussed in this note. If information were imperfect, price could exceed $p_1$ as calculated above without inducing entry whenever a potential entrant is unaware of the opportunity. Indeed, if an increase in $N$ would increase the probability of a potential entrant’s having information about the opportunity, it would increase the likelihood of entry. This would create, in the imperfect information case, an effect of $N$ directly counter to that developed here, leaving the net effect of $N$ unclear. Sergio Bruno (1966) has examined effects of some alternative behavior and knowledge assumptions in the Sylos model.}

Strategic interdependence will generally prohibit behavior predictions based on analytic techniques, but experimental studies of human behavior under interdependence have provided some descriptive results. D. R. Lutzker (1960) conducted an experimental investigation of behavior in a conflict situation similar to that in Fig. 1.

\footnote{Strategic interdependence will generally prohibit behavior predictions based on analytic techniques, but experimental studies of human behavior under interdependence have provided some descriptive results. D. R. Lutzker (1960) conducted an experimental investigation of behavior in a conflict situation similar to that in Fig. 1.}

REFERENCES


