COLLUSION, ENTRY, AND MARKET SHARES

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Working Paper No. 15

Working Paper Series
Department of Economics, Finance
and Legal Studies
College of Commerce and Business
Administration
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Collusion, Entry, and Market Shares

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This paper analyzes market entry and collusion in a model of duopoly with product-specific-set-up costs. The analysis demonstrates that collusion can alter the incentives for entry deterrence. We find conditions under which an established firm will permit entry and collude with a potential entrant even though entry deterrence is a viable option under noncooperative oligopoly rules. Conditions are also specified in which entry will be effectively impeded and collusion will not be undertaken.

1. Introduction

In the extensive literature on entry into oligopolistic markets, it has long been recognized that it may not pay established firms to incur the cost of forgone profit that is necessary to deter entry.[1] The question of entry has, for the most part, been addressed under conditions of noncooperative behavior. An exception is the work of Wenders (1971) which introduces the possibility of collusion between established firms and a prospective entrant. More recent contributions by Dixit (1980), Eaton and Lipsey (1980), Schmalensee (1981), and Spulber (1981) investigate credible threats and commitments of capacity to deter entry. These contributions focus exclusively on noncooperative oligopoly behavior and have not analyzed the conditions under which established firms find it advantageous to permit entry and incorporate the entrant into a cartel. Entry followed by collusion may make both the established firm and the new entrant better off and, more importantly, may alter the incentives and conditions under which entry occurs.

In this paper we employ the Cournot-von Stackelberg methodology developed by Osborne (1973) and Dixit (1979) to investigate collusion and entry. In our model established firms may deter entry, allow entry responding in a Cournot-Nash or von Stackelberg fashion, or allow entry and collude. Even when entry deterrence is a viable option, we identify conditions under which an established firm will permit entry and collude. Conditions are also specified in which entry will be effectively impeded and collusion will not be undertaken. The analysis yields some clear results on the relationship of collusive market shares and barriers to entry in the form of product-specific-set-up costs.

An important issue to be addressed at the outset is the question of pre-and post entry behavior of the established firm. A variety of assumptions have been adopted in the literature. The most controversial is the Bain-Sylos postulate which assumes that the established firm maintains the same output in face of entry. The Sylos postulate has been subject to strong criticism, and its relaxation has been the focus of a considerable and growing literature. The impetus for much of the later work is Schelling's (1960) seminal treatment of the adversary problem which advances the proposition that a threat can become credible by a costly commitment in advance of an opponent's action. Spence (1977) applies Schelling's suggestion to the question of entry and concludes that the established firm may set a greater capacity in the pre-entry phase than that utilized post-entry. The advantage of this commitment is entry deterrence. Dixit (1979) extends the Bain-Sylos and Spence analyses while retaining the post-entry behavior. More recently, Dixit (1980) and Schmalensee (1981) introduce an alternative by assuming that the duopolists possess a common understanding of the rules of post-entry duopoly. Spulber (1981) goes beyond Dixit and Schmalensee to consider strategic capacity choices in a two-period-dynamic model, concluding that the conditions under which the established firm will hold excess capacity to deter entry are highly special.

The regimes considered in recent work are based on acceptance of Cournot-Nash or Stackelberg quantity rules. In contrast, in this paper, we adopt a collusion regime founded on mutual benefit but conditioned by the asymmetrical advantage of the established firm. Our approach is founded on the reasonable proposition that an action will be consummated if such action is to the benefit of one or the other of the firms and to the detriment of neither. The point of departure for our collusion regime and the determination of the division of gains is the initial acceptance of the Dixit (1979) rules in which the entrant is agreeable to non-warfare and, in the absence of cooperation, reacts along its Cournot reaction function.

We assume a single established firm and one prospective entrant. Both have access to the same cost function. Following Dixit (1980) and Schmalensee (1981) both firms confront costs of entering the market in the form of product specific set-up costs. In Baumol and

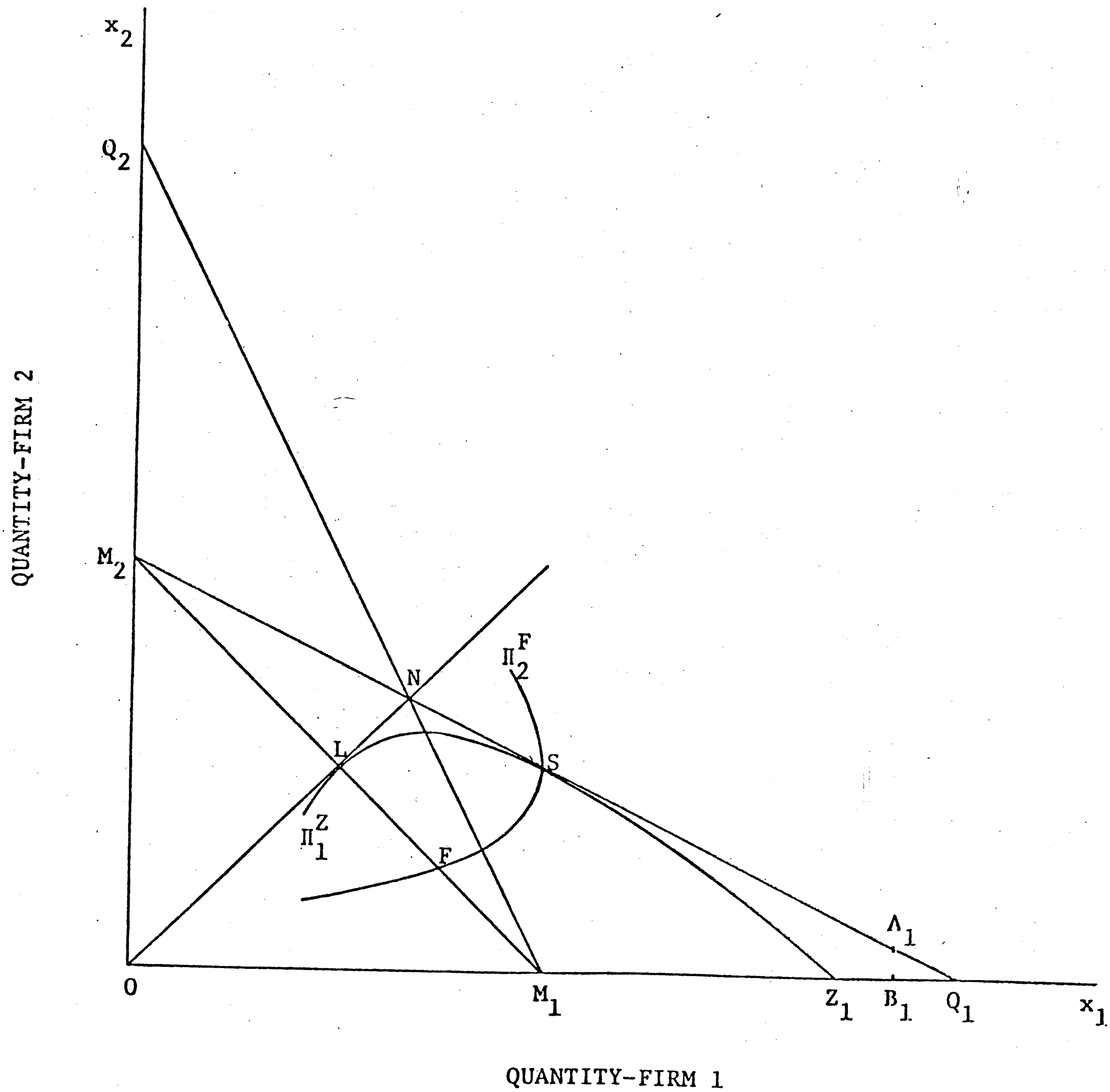
Willig's (1981) terminology these costs are sunk, not fixed, and therefore may create barriers to entry. The effect of the set-up costs is to create an L-shaped cost function of the sort first discussed by Modigliani (1958). Capacity costs are assumed to be zero. Although some interesting analytics and insights may be lost in adopting this latter assumption, the compensating gain is that the fundamental relation of collusion and entry is more readily grasped and carries over to more complex environments. Section II of the paper develops the collusion model. Concluding remarks are presented in Section III.

2. The Model

Following the relevant literature, we employ a model of homogeneous duopoly. Firm 1 is the established firm and Firm 2 the one prospective entrant. Quantities of products are denoted by x_1 and x_2 respectively. Fig. 1 shows the conventional isoprofit curves and reaction functions of two sellers. Throughout the paper, we adopt the common assumptions of linear demand and constant costs to highlight the effect of collusion and illustrate the basic point to be made, namely, collusion can alter the conditions under which entry occurs. The reaction function of the potential entrant is M_2Q_1 and that of the established firm is M_1Q_2. Point S is the von Stackelberg leader-follower solution in which Firm 1 is the leader. The Cournot-Nash solution is shown at point N. The joint monopoly solution locus is composed of points of tangency between the duopolists' isoprofit curves and is shown by M_2M_1. We use the joint

FIGURE 1

DIXIT's INEFFECTIVELY IMPEDED ENTRY CASE WITH COLLUSION



monopoly locus to aid in the identification of boundries to collusive solutions.

Entrants into the market face product-specific-set-up costs that in a fashion analogous to Dixit (1979) result in a discontinuity in the reaction function of the potential entrant as shown by B_1 on the x_1 axis and A_1 on Firm 2's reaction function. Output B_1 is that output beyond which Firm 1 must produce to make entry for Firm 2 unprofitable. The greater the level of set-up costs, the less B_1 becomes and, the further to the left on M_2Q_1 the discontinuity occurs. Should the level of set-up costs be so high as to establish B_1 to the left of point M_1, the monopoly output, entry is blockaded and, it is infeasible under any circumstance for Firm 2 to enter.

The case Dixit identifies as ineffectively impeded entry is shown in Fig. 1.[2] The intersection of Π_1^Z with the x_1 axis identifies the point Z_1. Should set-up costs be sufficiently low to establish B_1 to the right of Z_1, it is unprofitable for Firm 1 to exclude Firm 2 because to do so implies lower profits than at the von Stackelberg leadership position. As Dixit states, ". . . the best point for Firm 1 remains at S, and it is optimal for the established firm to allow entry."[3]

A substantially different result can emerge if a collusive regime is adopted by the participants with S as the point of departure for market share negotiation. A market sharing agreement yielding a solution in the region bounded by Π_1^Z, Π_2^F and the monopoly solution locus (excluding S) will make at least one firm better off than at the von Stackelberg leadership point.

The collusion region is defined by the opportunities open to the firm before collusion. Firm 1 should be willing to accept no less than the profit associated with the option of von Stackelberg leadership. This level of profit prevails along the isoprofit curve Π_1^Z. Realizing that entry cannot be profitably precluded by Firm 1 and that Firm 1 can attain von Stackelberg leadership at point S, as the next best choice to collusion, Firm 2 will accept no less than the profits available to a von Stackelberg follower along Π_2^F.[4] The isoprofit curves Π_1^Z and Π_2^F thus form two boundaries of the collusion region and also enter into the determination of the third. The contract curve for the collusive market sharing agreement along which maximum gains from collusion are attained is the third boundary.

The contract curve is the segment of the joint monopoly locus between points L and F. The segment is defined by the points of tangency between Firm 1 and 2's isoprofit curves with associated profits greater than Π_1^Z and Π_2^F respectively. At point L, Firm 2 obtains one-half of the market and realizes all the gains from collusion.[5] At point F, all the gains accrue to Firm 1 with a market share of three-fourths. Between points L and F, the gains are shared with the actual collusion point determining the precise division. Because every point in the collusion region is Pareto superior to the Stackelberg point S, the established firm has a incentive to strike a collusive bargain rather than produce either at S or at an output slightly greater than B_1, the two basic options open to Firm 1 in Dixit's analysis.

The case of ineffectively impeded entry under collusion is shown in its most simple terms in Fig. 2. When the set-up costs are sufficiently high to establish B_1 to the left of Z_1, the established firm can earn profits greater than Π_1^Z by deterring entry.[6] The collusion region in this case is bounded by Π_1^B, Π_2^B and the monopoly solution locus. Every point in the region is Pareto superior to the entry deterring solution slightly beyond point B_1. The contract curve for the collusive agreement is the southwest boundary of the collusion region, KJ.

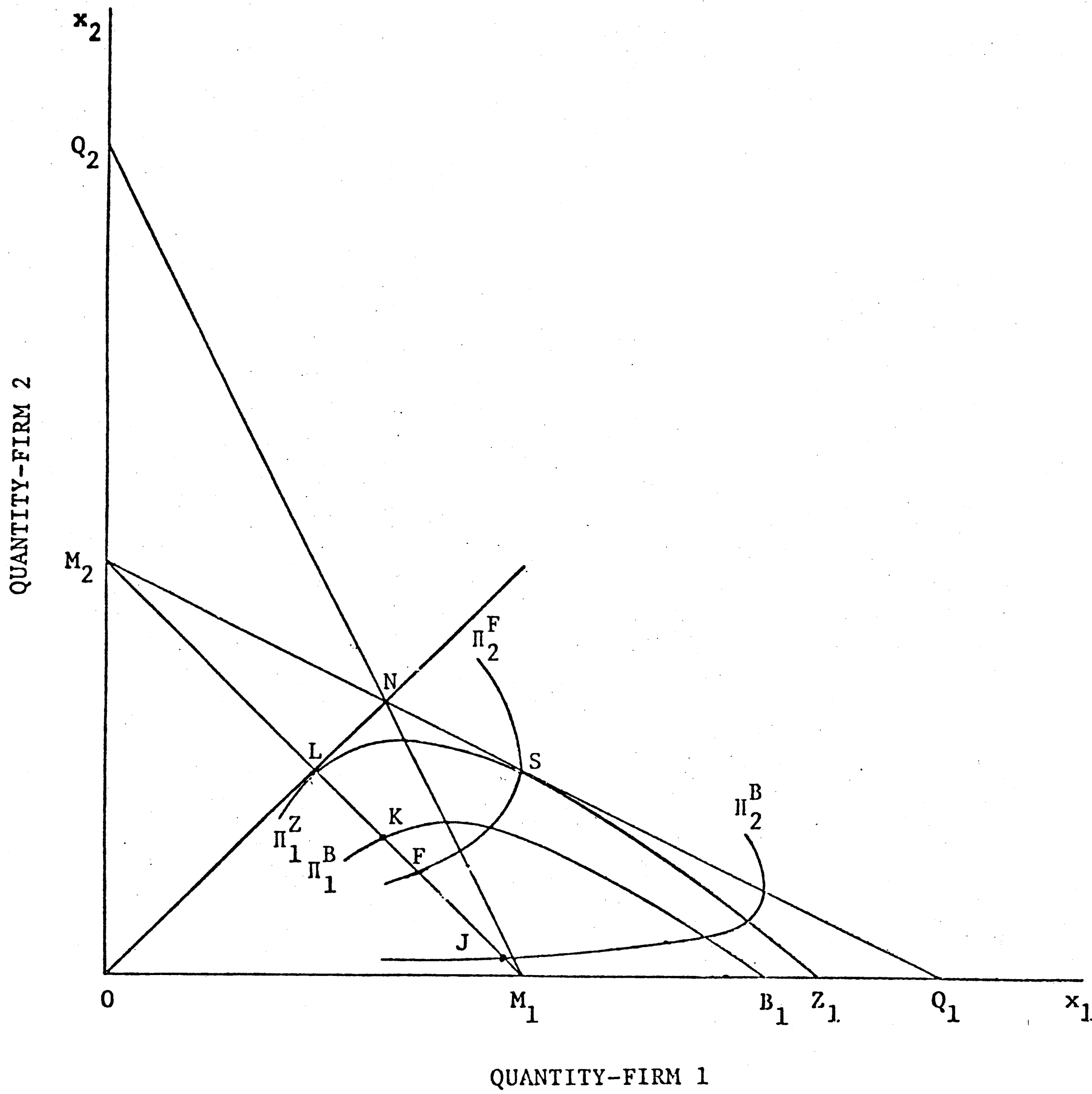
The important distinction which differentiates the effectively impeded case from the ineffectively impeded case is the fact that it is not profitable for Firm 1 to block Firm 2's entry as the next best option to collusion. This should be expected to change the bargaining strengths of the two firms as reflected in the changes in the collusion locus. Under these conditions, the relevant isoprofit curve for defining Firm 2's minimum acceptable output is no longer defined by Π_2^F with follower profits but by Π_2^B with zero profits.

As a result, the collusive market shares available to the firms has substantially changed in favor of Firm 1. On the collusion locus at point J, under assumptions linear demand and constant costs, the maximum possible share for Firm 1 now becomes .98 and the minimum acceptable share for Firm 2 is .02. Similarly, at point K, the minimum acceptable share for Firm 1 is now greater than one-half.

It is apparent from Fig. 2 that in the case of effectively impeded entry, as in the case of ineffectively impeded entry, the established firm has an incentive to adopt a collusive regime. This

FIGURE 2

DIXIT'S EFFECTIVELY IMPEDED ENTRY CASES WITH OVERLAPPING COLLUSION LOCI

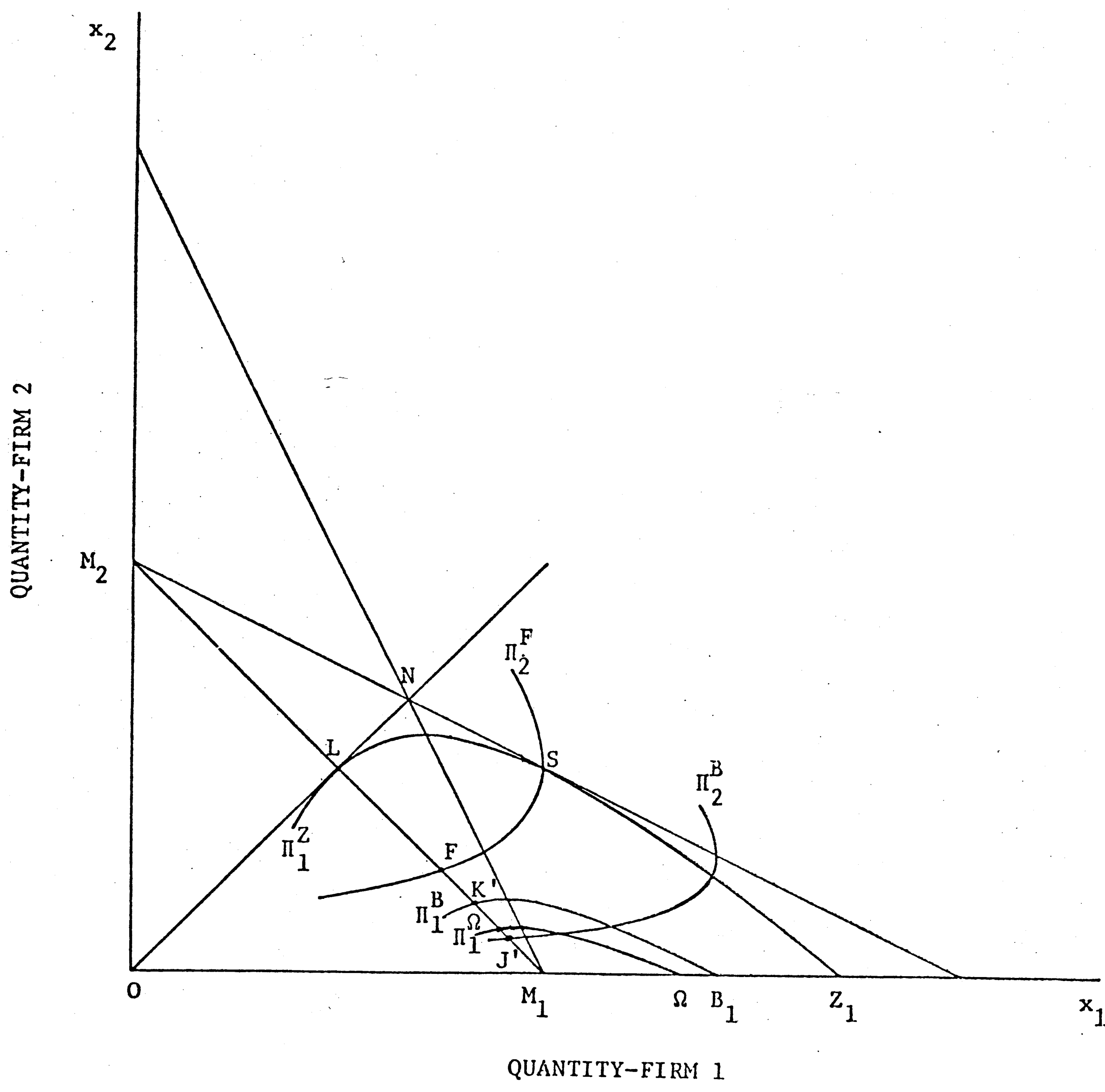


demonstrates that entry can occur and can be profitable for both firms in Dixit's effectively impeded entry case once collusion is considered. The collusive option can affect the entry decision and alter the conditions under which entry occurs.

The magnitude of set-up costs is an important determinant of the size of the collusion region. The higher the level of set-up costs, the smaller the viable collusion region and locus become. This is made clear by comparing Fig. 2 and Fig. 3. As set-up costs increase, the output beyond which Firm 1 must produce to exclude Firm 2, namely B_1, is reduced. As a result, the boundary on the collusion locus defined by the intersection of Π_1^B and M_2M_1 moves rightward and downward along the monopoly solution locus. Compare point K' in Figure 3 with point K in Figure 2. The maximum obtainable share for Firm 2 diminishes and the minimum acceptable share for firm 1 increases. Similarly as set-up costs increase and B_1 decreases, the zero isoprofit curve for Firm 2, denoted in general as Π_2^B, intersects Firm 2's reaction function at greater outputs for Firm 2. With higher set-up costs, Firm 2 must produce a greater output merely to break-even. As a consequence, the boundary on the collusion locus defined by the intersection of Π_2^B and M_1M_2 moves leftward and upward along the monopoly solution locus. Compare J' in Fig. 3 with J in Fig. 2. The minimum acceptable share for Figure 2 increases and the maximum obtainable share for Firm 1 decreases. Thus, the collusion locus as well as the collusion region diminishes in size as set-up costs increase.

FIGURE 3

DIXIT'S EFFECTIVELY IMPEDED ENTRY CASE WITH NON OVERLAPPING COLLUSION LOCI



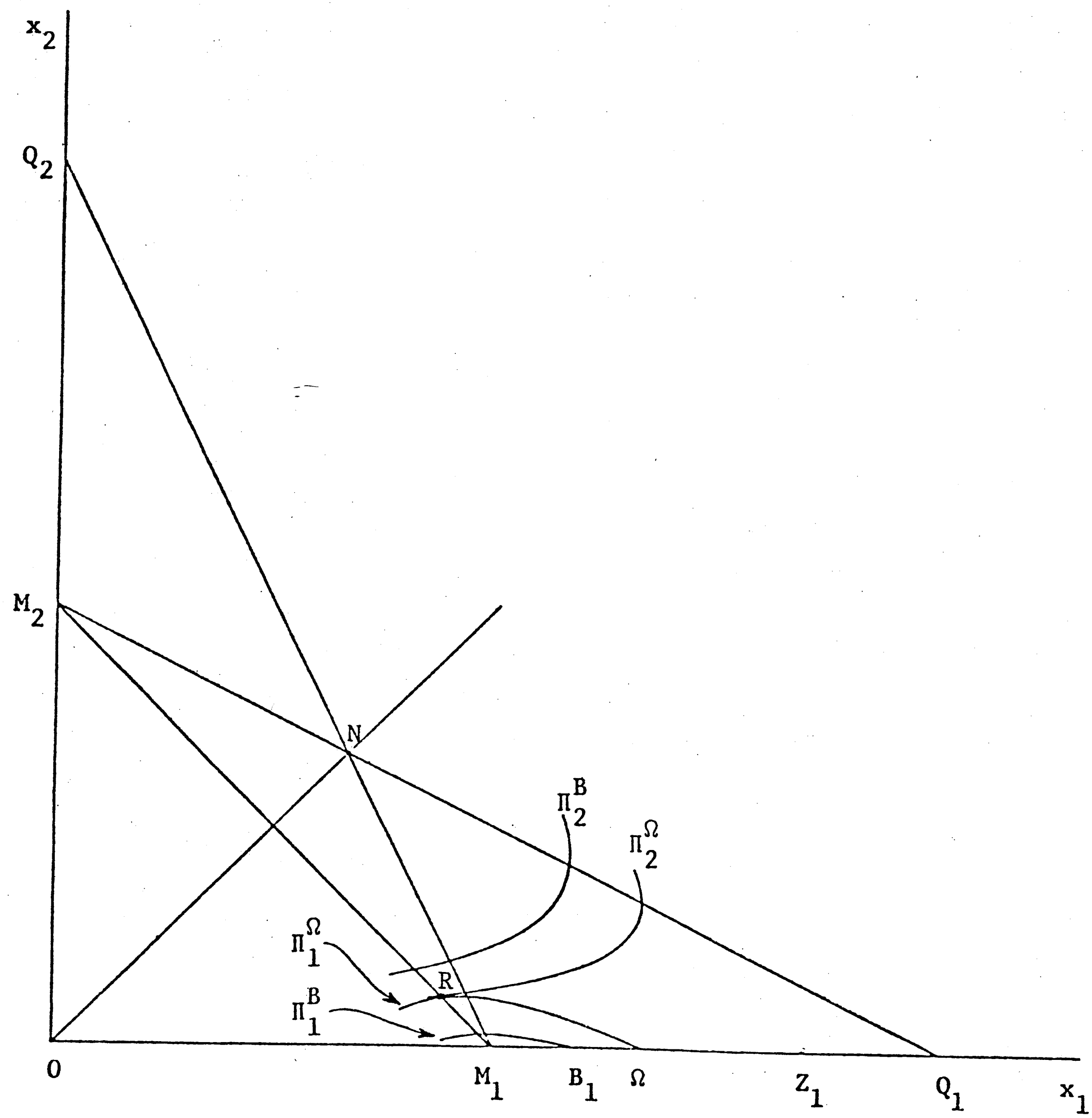
In the limit, as set-up costs continue to increase, B_1 approaches a critical value, Ω, and points J' and K' both approach point R. As this occurs, the collusion region shrinks to a single point as shown in Fig. 4.

The Ω point is of particular importance because it defines conditions under which entry will be effectively impeded with collusion considered. Under the regimes considered, when $B_1 = \Omega$, Firm 1 is indifferent to producing Ω or colluding. In the simple case of classical homogeneous duopoly it can be established that $\Omega = (4/3)M_1$. In this instance, Firm 1's maximum and minimum shares converge to 8/9 of the market and Firm 2's share to 1/9. It is interesting to note that in this case, Ω is equal to the output associated with the Cournot-Nash solution. Thus, when the locus converges to a single point, collusion does not benefit the established firm and the entrant is left with zero excess profit.

When set-up costs are great enough to establish B_1 is to the left of Ω, as in Figure 4, the isoprofit curve Π_1^B cuts the monopoly solution locus to the left of the intersection of Π_2^B with the monopoly solution locus. The maximum obtainable output for Firm 1 is below the minimum output which it will accept. For Firm 2, the maximum output which it can obtain is below the minimum necessary to cover its set-up costs. The viable collusion region no longer exists. Firm 1 can earn greater profits by excluding Firm 2 from the industry rather than permitting entry and entering into a collusive arrangement. Firm 1 will produce an output slightly greater than B_1.

FIGURE 4

EFFECTIVELY IMPEDED ENTRY WITH COLLUSION CONSIDERED



The following classification summarizes the above cases.

(1)	$B_1 < M_1$	Entry is blockaded. Firm 1 has a pure monopoly at $x_1 = M_1$.
(2)	$M_1 < B_1 < \Omega$	Entry is effectively impeded. Collusion is unprofitable. $x_1 = B_1$.
(3)	$\Omega < B_1 < Z_1$	Entry can be effectively impeded but may occur because collusion is more profitable.
(4)	$Z_1 < B_1$	Entry is ineffectively impeded. Collusion is profitable.

3. Conclusion

This paper has considered the interaction of collusion and entry when an established firm faces a large prospective entrant. Previous analyses have considered the consequences of adopting Cournot-Nash and Stackelberg leadership rules. We consider a collusive regime and find that being first in the market place allows the established firm to preempt the market to a degree. This creates an asymmetry that is likely to affect any collusive arrangement to the advantage of the established firm. This conclusion importantly depends upon the barriers to entry created by set-up costs. As higher levels of set-up costs are considered, the range of collusive shares potentially agreeable to both parties becomes smaller. At a unique level of set-up cost that defines the point Ω, the contract locus converges to a single point. For higher levels of set-up cost, collusion is unprofitable and entry is not feasible. Collusion can alter the conditions under which entry occurs as the homogeneous duopoly example in this paper illustrates.

Although the adoption of rules of post-entry behavior sacrifices much of the interesting dynamics, the compensation is a clearer exposition of the interaction of collusion and entry. The consideration of a regime founded upon mutual collusive benefit but conditioned by the asymmetrical advantage of the established firm should prove useful in further analysis of the interaction of collusion and entry.

FOOTNOTES

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[1]See particularly, Bain (1956), Scherer (1980), Wenders (1971), Osborne (1973), and Dixit (1979) for discussions of conditions under which it may be in the interest of the established firm to allow entry.

[2]Dixit (1979, p. 23) points out that fixed costs do not affect the shapes of the isoprofit curves, but only the magnitude of profit associated with each curve.

[3]Dixit (1979, p. 24).

[4]The definition of the collusion region should be a matter of bitter contention when the assumptions of perfect knowledge and static profit maximization are relaxed and the full range of possible market shares is at stake. Firm 1 may threaten Firm 2 with exclusion even though that option implies lower profits than those available under von Stackelberg leadership. The advantage of this is to increase Firm 1's maximum obtainable share under collusion. The disadvantage is that it also reduces the minimum share which Firm 1 can expect. The case is easily analyzed. The only difference is that the collusion region is larger than the case in which point S is the relevant reference point for defining the collusion region. Nothing of importance emerges from the case's analysis that cannot be obtained from the analysis in the text.

[5]Calculations for determining market shares are available from the authors. See Formby and Smith (1979) for a demonstration that Firm 1's von Stackelberg leadership isoprofit function Π_1^Z cuts the monopoly solution locus at its midpoint and is tangent to Firm 2's von Stackelberg leadership isoprofit function.

[6]The intersection of the isoprofit function associated with leadership profits, Π_1^Z, with the x_1 axis identifies the point Z_1.

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