Endogenous market structure and the cooperative firm

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HIGHLIGHTS

- We study endogenous market structure when consumer coalitions are potential entrants.
- A first-mover profit maximizing (PM) firm does not enter when fixed cost is too high.
- Threat of entry by consumer coalitions restricts PM firm entry further.
- A consumer coalition may be viable when the first-mover PM firm is not.

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ABSTRACT

When the threat of entry by followers includes cooperative firms, the maximum fixed cost that a profit maximizing leader can endure is endogenous. The aggressive strategy required for entry-deterrence curtails the leader's expected profit and can discourage its initial entry. In such circumstances a cooperative firm may yet be viable, despite having a cost handicap and no first-mover advantage.

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1. Introduction

With fixed set-up costs, the free entry equilibrium in a large class of oligopolistic models typically exhibits an excessively large number of active firms (Mankiw and Whinston, 1986). An emerging literature has introduced the Stackelberg notion of leadership in this endogenous market structure (EMS) context—see Etro (2013) for a survey. A general insight is that a leader facing endogenous entry tends to behave more aggressively (relative to the situation when the set of followers is predetermined). In this context the leader is most interested in influencing the entry decision of the followers, rather than their production/price decision. Specific results depend on the nature of the model. But in general the excessive entry result disappears and equilibrium entails entry deterrence, i.e., there is only one firm (the leader)

in the market (Etro, 2008). We extend the EMS framework by posing that the leader, in addition to being concerned about entry by other profit maximizing (PM) firms, also faces the threat of entry by coalitions of consumers (i.e., "cooperative firms"). This prospect affects the strategy of the leader as deterrence of consumer coalitions may entail more aggressive behavior than that required to deter other PM firms. Because this limits the profit that can be realized, the leader may not enter in equilibrium, whereas a cooperative firm may remain viable.

2. EMS and entry deterrence

For all firms, the technology of production is represented by the cost function

$$C(Q) = cQ + K$$

where $c > 0$ is the constant marginal production cost, and $K > 0$ is the fixed setup cost that is required to enter the market. Following Etro (2008), the model is a three-stage game. In stage 1, the

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PM firm decides whether or not to enter after considering the prospect of competition by followers (other PM firms or coalitions of consumers). In stage 2, if the leader PM firm has entered, it will play the entry-deterrence strategy as needed. For some domain of K, other firms do not enter, the consumer coalition does not form, and the leader operates as the only firm in equilibrium. In stage 3, if the leader PM firm has not entered, a consumer coalition may form, without having to face deterrence.

For the demand side of the model, for concreteness we assume that there are N identical consumers with quasilinear preferences, such that the aggregate demand function is

$$D(p) = a - p,$$

with individual demand functions given by $D_i(p) = D(p)/N, i = 1, 2, \ldots, N$.

If the leader can behave as an unconstrained monopolist, given the assumed aggregate demand function, then it solves

$$\max_p \ (a - p)(p - c) - K$$

yielding the standard monopoly price $p^m = (a + c)/2$ and production level $Q^m = (a - c)/2$, provided that K is not too large. The monopolist earns positive profit as long as $K \leq K^m$ where K^m is the maximum fixed cost that can be sustained by a monopolist unconstrained by the threat of entry:

$$K^m \equiv \frac{(a - c)^2}{4}. \tag{1}$$

In the Stackelberg competition for homogeneous goods where, upon entry, firms compete in quantities, the leader can deter entry of other PM firms by producing $Q_L = a - c - 2\sqrt{K}$, provided that $K \leq ((a - c)/4)^2 \equiv \bar{K}$ (Etro, 2008). The limit price of this equilibrium is

$$p_L = c + 2\sqrt{K}. \tag{2}$$

Remark 1. The need to deter entry of other PM firms does not affect the maximum level of fixed cost that the leader can bear (because $\bar{K} < K^m$).

2.1. The cooperative firm

Owing to their distinctive governance structure, cooperative firms behave differently from PM firms, but in ways that eschew a single modeling approach. Cooperatives might make production decisions that are more or less efficient than a PM firm (Hansmann, 1994, 2013; Hart and Moore, 1996; Mikami, 2011). They are more responsive to the consumption needs of their members and thus pursue more efficient production plans, but they also have coordination and governance costs that a PM firm does not face. We follow Innes and Sexton (1993) and capture such governance costs unique to cooperative firms by a function $G(n)$ that is increasing and concave in the size $n \leq N$ of the cooperative. Effectively, therefore, a cooperative firm faces the higher fixed cost of entry $K + G(n)$. It is assumed that the objective of the cooperative is to maximize the consumer surplus of its members, net of all production and governance costs. Hence, the cooperative firm produces the efficient amount $D(c)$, which is then allocated to members by marginal cost pricing $p^c = c$. Furthermore, if market conditions are such that a coalition of consumers is formed, then it is reasonable to focus on the case $n = N$ (i.e., the grand coalition) because $[K + G(n)]/n$ is decreasing in the cooperative size. In what follows, therefore, we simply write G rather than $G(N)$ for the total governance cost of the cooperative.

Given efficient production, the combined payoff of the cooperative firm is

$$U = \frac{(a - c)^2}{2} - K - G. \tag{3}$$

Hence, the maximum fixed cost that the cooperative firm can sustain and still be viable is

$$K^c \equiv \frac{(a - c)^2}{2} - G. \tag{4}$$

2.2. Deterrence of cooperative entry

Deterrence of a consumer coalition by an incumbent monopolist who relies on a policy of uniform price offers was considered by Sexton and Sexton (1987). Innes and Sexton (1993) extend this analysis by allowing the incumbent firm to pursue a "divide-and-conquer" entry-deterrence strategy, leading to a form of price discrimination. Our approach here is consistent with their "model II", which maintains the appealing condition that consumers can evaluate their individual offers vis-à-vis the gains from various possible coalitions (which, *inter alia*, rationalizes the focus on the grand coalition invoked earlier). When all consumers have identical demands, as in our case, the entry-deterring monopolist does not price discriminate. Hence, to deter the cooperative formation the leader must commit to a price (or production plan) that grants to the grand coalition as much surplus as the latter could generate by itself if it integrated into production.

The total net surplus enjoyed by the grand coalition is given by (3). When consumers instead buy from the leader at any given price p, they get a total surplus $S(p) = (a - p)^2/2$. Hence, the price p_D that just deters the formation of a cooperative solves $S(p_D) = U$ yielding

$$p_D = a - \sqrt{(a - c)^2 - 2(K + G)}. \tag{5}$$

Remark 2. For sufficiently low governance cost, $p_D < p_L$. To deter the formation of a cooperative firm the incumbent may need to behave more aggressively than to deter other PM firms.

3. Equilibrium entry

In the first stage the would-be monopolist has to decide whether or not to enter the market. Let π_D^m denote the *ex post* profit of the monopolist (that is, exclusive of the fixed setup cost K). First, note that deterrence can be achieved by the unconstrained monopoly price p^m if

$$\frac{(a - c)^2}{2} - K - G \leq \frac{(a - p^m)^2}{2} \rightarrow 3\bar{u} \leq K + G \tag{6}$$

where $\bar{u} \equiv (a - c)^2/8$ is the consumer surplus at the monopoly price p^m. In this case entry is blockaded and the monopolist achieves its highest possible profit, which defines the maximum fixed cost that it can incur in stage 1 and still be viable, as identified in (1): $\pi_D^m|_{p^m} = 2\bar{u} \equiv K^m$.

When $K + G < 3\bar{u}$, on the other hand, blockaded entry is not possible and the monopolist must use p_D given in (5) to deter entry. The *ex post* profit of the monopolist $\pi_D^m = (p^D - c)(a - p^D)$ in this case depends on the fixed costs K and G that must be incurred by the cooperative:

$$\pi_D^m(K, G) = 2\left(\sqrt{4\bar{u}\,[4\bar{u} - (K + G)]} - 4\bar{u} + (K + G)\right).$$

The relevant regions of the parameters are illustrated in Fig. 1. For a given K this *ex post* profit is non-decreasing in the cooperative's
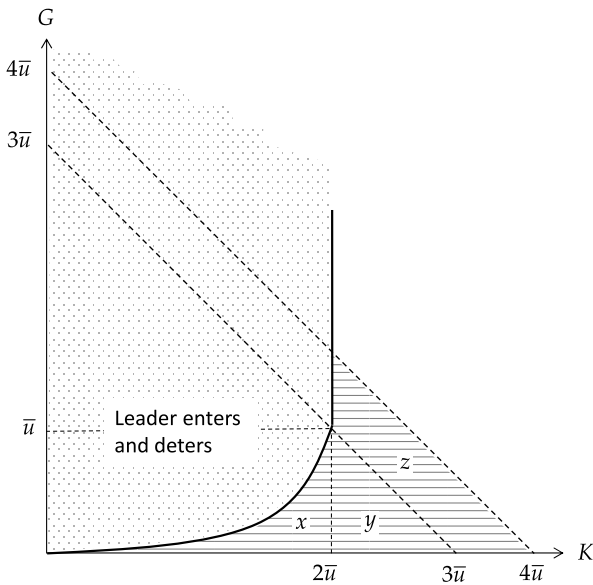
Fig. 1. Coordination cost and entry deterrence.

coordination cost G. For $G \geqslant 3\bar{u} - K$, entry is blockaded by the unconstrained uniform price p^m and the leader reaches the maximum *ex post* profit: $\pi_D^m = 2\bar{u}$. But as the coordination cost decreases below $\bar{u}$, price concessions are necessary to deter the formation of a consumer coalition, i.e., $\pi_D^m(K, G)$ decreases in G for a given K. Hence, the maximum fixed cost that the would-be monopolist can endure in stage 1 also decreases. The region of parameters where the monopolist will make nonnegative profit (from a stage 1 perspective, meaning $\pi_D^m \geqslant K$) is represented by the dotted–shaded area in Fig. 1. To the East and South of the boundary of this region, the PM firm does not enter.

The horizontal-line-shaded area in Fig. 1 illustrates the parameter space (K, G) where the PM firm does not enter – and therefore cannot deter the cooperative firm formation – and yet a coalition of consumers can be viable. There are two distinct regions of interest. Areas y and z denote the region of the parameter space where the cooperative remains viable, while the PM firm is not (regardless of whether or not it faces potential competition by followers). This parametric region is related to the too-few-by-one case of insufficient entry that arises in Mankiw and Whinston (1986). Area x pertains specifically to the EMS framework analyzed in this paper and illustrates our main result. Here, $K < 2\bar{u} \equiv K^m$, and a PM leader who only needs to deter entry by other PM firms would find it profitable to be in the market. The prospect of competition by a cooperative firm, however, erodes the parametric region where the PM firm can profitably enter. As the coordination cost G of the cooperative firm decreases, the level of fixed cost that the leader is able to sustain decreases.

Main result. The need to deter the formation of cooperative firms, in addition to the entry of other PM firms, curtails the leader's *ex post* profit which affects the viability of entry. Thus no PM firm may find it desirable to enter the market, despite having a first-mover advantage. A cooperative firm may remain viable under the same production conditions, despite having to bear coordination costs that the PM firm does not have.

4. Conclusion

An incumbent PM monopolist has an incentive to practice entry-deterrence strategies not just with respect to profit maximizing followers, but also to deter the formation of coalitions of consumers (Sexton and Sexton, 1987; Innes and Sexton, 1993). In this paper, rather than taking the position of the incumbent as given, we have followed the EMS literature and assumed that an entry cost applies to all active firms (although cooperative firms also have additional coordination costs). In this setting, the maximum fixed entry cost that a leader can endure is endogenous and depends on whether or not it faces the threat of entry by a cooperative. Further, a cooperative firm may be viable, despite being handicapped (relative to a PM firm) by the need to bear an additional coordination cost. This effect is particularly important in the case of nonconvexities because, as shown by Mankiw and Whinston (1986), the free-entry equilibrium number of PM firms may well be one or zero.

The role by which increasing returns to scale may explain the existence of cooperative firms has typically been cast somewhat differently: increasing returns lead to monopolies, and patrons may be induced to form cooperatives to avoid price exploitation (e.g., Hansmann, 2013). Our analysis points to an additional mechanism: fixed costs may be such that no PM firm finds it profitable to operate, especially when it faces the threat of entry by consumer coalitions. The cooperative organization might be the only viable solution in such an environment.

The analysis of this letter, similarly to other studies in this area, has relied on simple representations of the production technology and of the cooperative firm's coordination costs. But we note that an analogous result can be obtained with more general representations of the cooperative decision problem, for example one which allows for consumer heterogeneity and where decisions are made by majority voting, as in Hart and Moore (1996). Of course, with more general functional forms, it is also possible to find parametric domains where the possibility of consumer coalitions does not affect the behavior of the PM firm (this also happens in our model when the cooperative's coordination costs are prohibitively high).

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