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Ex Post Regulation Facilitates Collusion

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Abstract

Under ex ante access regulation entrants often claim that access fees are excessive. I show that this is only the case if further entry is admitted. If the entrant is protected from further entry it would agree with the incumbent upon a strictly positive access fee which may exceed the efficient level. Ex post regulation facilitates this type of collusion and should be abandoned.

Keywords: entry deterrence, access regulation, network infrastructure, vertical differentiation

JEL: K21, K23, L42, L51

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1 Introduction

Following the liberalization of formerly publicly provided utilities, e.g. telecommunications and electricity, often access regulation has been set up where competing service providers rely on access to the infrastructure which is an essential facility and which constitutes a natural monopoly (Hellwig, 2008). Under ex ante regulation a regulation authority imposes an access fee for service providers who are connecting to the incumbent's network. Ex post regulation relegates this process to after the incumbent and the entrant(s) have or have not come to an agreement. The regulator has to balance the beneficial effect of downstream competition on the service market against the network provider's incentive to maintain and enhance the network infrastructure. It is beyond the scope of this article that to some extent access regulation is a negotiation process involving the incumbent network provider, entering firms, and the regulation authority such that is adopts traits of collusion and price control (Rey, 2003).

The model relies on previous research by Gabszewicz and Thisse (1979) and Gabszewicz (1980) on consumer choice under vertical differentiation products, Shaked and Sutton (SS) (1982, 1983) providing the foundation of a natural oligopoly in markets with vertically differentiated products, sequential entry (Hung and Schmitt (HS), 1988), and quality dependent costs (Lutz, 1997).

I go beyond this literature in analyzing the potential for collusion under ex ante and ex post access regulation with (limited) entry in a market with vertical product differentiation. Section 2 presents a simple model of vertical differentiation, which is analyzed in section 3. Section 4 provides a discussion of the results: Ex post regulation creates an incentive to collude with respect to the access fee, free entry prevents incentive for such collusion, and access should be facilitated.

2 Model

Consumers, which have unit mass, differ by their uniformly distributed income m on the interval $[a, b]$. Their utility is defined by $U(m, t) = m \cdot t$ where $t \in [\underline{t}; \overline{t}]$ is the quality of the product of which they purchase exactly one unit or none at price p.[1] The price of the reservation quality is zero. $y_1 = (p_1 t_1 - p_2 t_2)/(t_1 - t_2)$ defines the consumer who is indifferent between quality and price (t_1, p_1) and (t_2, p_2) where t_1 and t_2 are the qualities of the two products. For the analysis I assume $t_1 > t_2$ and I will show later that firm 2 prevents the entrant's offering superior quality. Consumers $y > y_1$ prefer 1 over 2. Similarly, $y_2 = p_2 t_2/(t_2 - \underline{t})$ is indifferent between $(\underline{t}, 0)$ and (t_1, p_1). Further, assume $a < y_2 < y_1 < b$. An entering firm bears sunk cost $f > 0$ and a per unit access fee c payable to the incumbent. The firms' profits are given by

$$\pi_1 = p_1(b - y_1) + (y_1 - a)c$$
$$\pi_2 = (p_2 - c)(y_1 - a) - f.$$

The sequence of the game is as follows: The incumbent decides upon c before entry occurs. We will see that at most one firm enters the market in the case where further entry would be admissible. Then, the incumbent sets his quality before the entrant and finally both firms compete in prices simultaneously. We solve for the subgame perfect equilibrium.

The equilibrium prices after the firms have set t_1 and t_2 in the previous stage are

$$p_1 = A\left(1 - \frac{t_2}{t_1}\right) + \frac{2t_1 + t_2}{3t_1}c \tag{1}$$

$$p_2 = B\left(\frac{t_1}{t_2} - 1\right) + \frac{t_1 + 2t_2}{3t_2}c \tag{2}$$

where

$$A = \frac{2b - a - c}{3} \quad ; \quad B = \frac{b - 2a + c}{3}$$

and the payoffs resulting from the price stage are

$$\pi_1 = A^2\left(1 - \frac{t_2}{t_1}\right) + c(b - a) \tag{3}$$

$$\pi_2 = B^2\left(\frac{t_1}{t_2} - 1\right) - f. \tag{4}$$

[1] This utility function has the property that consumers differ in their valuation for quality according to their wealth or in come. It has been employed in all six papers listed as previous research.

3 Analysis

Relying on the result by SS that at most two firms can be profitably active under vertical differentiation I show that the incumbent has an incentive to raise the access fee and the entry cost. Further, a higher entry cost results in a higher degree of product differentiation, thus approaching the same degree of product differentiation as under free entry, but with higher prices. I start with the analysis of free entry, which is analogous to HS before considering protected entry.

3.1 Free Entry

Lemma 1 of HS states that for $2a < b < 4a$ there are at most two firms having positive market share and covering the entire market with goods of distinct qualities. To ensure that it is active on the market the entrant chooses its quality

$$t_2 = t_1 \cdot \frac{B^2}{B^2 + f} \tag{5}$$

such that $\pi_2(t_1, t_2) = 0$ in order to prevent further entry. If it earned strictly positive profit, a third party could offer $(t_2 - \varepsilon, p_2)$ and drive it out of the market.

The incumbent prevents leapfrogging by the entrant, i.e. the latter does not offer higher quality than the incumbent. By choosing $t_1 > \theta'$ the entrant cannot earn positive profit even when offering the highest quality. The condition

$$A^2 \cdot \left(1 - \frac{t_1}{\bar{t}}\right) - f < 0$$

transforms into

$$t_1 > \left(1 - \frac{f}{A^2}\right) \cdot \bar{t} \equiv \theta'.$$

Observing (5), the entrant sets t_2. It covers its fixed cost f as long as

$$t_1 > \left(\frac{f}{B^2 - 1}\right) \cdot \underline{t} \equiv \theta''.$$

If $\theta'' > \theta'$ there is no leapfrogging and the entrant earns negative profit. Otherwise, entry is accommodated according to Lemma 2 in HS.

Now, I analyze the incumbent's incentive to set c. The proportionality of t_2 and t_1 implies that (3) is not affected by the choice of c when $c = 0$, such that the incumbent is indifferent between all $t_1 \in [\max(\theta', \theta''), \bar{t}]$, which follows from Proposition 1 of HS. Inserting (5) into (3) yields

$$\pi_1 = \frac{A^2 f}{B^2 + f} + c(b-a) = \frac{(2b-a-c)^2 f}{b-2a+c)^2 + 9f} + c(b-a).$$

Proposition 1 *The incumbent's profit is increasing in the access fee c and the entry cost f.*

Proof. $\partial\pi_1/\partial c > 0$ and $\partial\pi_1/\partial f > 0$ are shown in the appendix. □

Remark 1 The access fee increases the entrant's price. This relaxes price competition, thus allowing for both prices to rise (See (1), (2)).

Remark 2 The access fee drives t_2 towards t_1, but this effect is mitigated by:

Remark 3 An increase in f forces t_2 to stronger differentiate from t_1 (See (5)).

3.2 Protected Entrant

The firms maximally differentiate, $t_1 = \bar{t}$ and $t_2 = \underline{t}$ in order to relax competition. This follows immediately from firm 1 and 2 maximizing profits (3) and (4) with respect to t_1 and t_2, respectively. This result is in line with SS and HS. This effect is mitigated as quality dependent costs reduce the incentive to offer the maximum quality (Lutz, 1997).

Lemma 1 *The incumbent benefits from a high access fee.*

Proof. Inserting $t_1 = \bar{t}$ and $t_2 = \underline{t}$ into (3) results in $\pi_1 = A^2 \cdot d + c(b-a)$ where $d = (\bar{t} - \underline{t})/\bar{t}$.

$$\frac{\partial \pi_1}{\partial c} = \frac{5b - 7a + 2c}{9} + \frac{4b - 2a - 2c}{9} \cdot \frac{\underline{t}}{\bar{t}} > 0. \tag{6}$$

□

Lemma 2 *The entrant benefits from a high access fee.*

Proof. $\partial \pi_2 / \partial c > 0$ follows immediately from inserting d into (4). □

Remark 1 The entrant's price is rising in c. This is technically limited by the assumption $y_2 < y_1 < b$. For $c = 2b - a$ the incumbent has no sales, but has revenue purely from access fees $c(b - a)$.

Remark 2 The effect of the access fee on the incumbent's price is ambiguous, because a rise in p_2 relaxes price competition while a rise in p_1 lowers overall demand.

Remark 3 The positive access fee serves as a commitment for the entrant not to lower its price.

Proposition 2 *Both firms will agree upon a strictly positive access fee.*

Proof. This follows immediately from the two Lemmata. □

4 Policy Implications

The model advocates ex ante access regulation because ex post regulation creates incentives for excessive access fees. An entrant tends to mandate a review of an allegedly excessive access fee if it faces potential competition. Otherwise, if further entry is inhibited, it is willing to agree upon a strictly positive access fee and any such fee necessarily exceeds the marginal cost which is normalized to zero in this model. Consequently, ex post regulation is ineffective for inhibiting this form of collusion. Thus, ex post regulation may delay the regulator's setting an efficient access fee when quality is the prevalent dimension of competition. This effect is amplified because balancing the efficiency of the service provision and the incentive to invest in the network infrastructure opens a range of discretion to the regulator.

Moreover, the regulator has to enforce free access by entrants to and compatibility with the network. The fixed entry costs are due to technical issues on interconnection and compatibility, which are to some extent subject to the incumbent's discretion. They constitute a sunk investment and provide to the incumbent a subtle instrument to afflict service competition. Thus, the incumbent may hinder compatibility in order to prevent entry through narrowing the parameter ranges where he accommodates entry.

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Appendix

Proof of Proposition 1

$$\frac{\partial \pi_1}{\partial c} = \frac{-2f(2b-a-c)[(b-2a+c)(3b-3a)+9f]}{[(b-2a+c)^2+9f]^2}$$

Inserting the smallest admissible value for $b = 2a$ yields

$$\frac{-2f(3a-c)[3ca+9f]}{[(b-2a+c)^2+9f]^2} + a$$

and $a/3 > 0$ for $c = 0$.

$$\frac{\partial \pi_1}{\partial f} = \frac{(2b-a-b)^2(b-2a+c)^2}{[(b-2a+c)^2+9f]^2} > 0.$$

□