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Abstract

This paper considers the incentive for non-price discrimination of a monopolist in an input market who also sells in an oligopoly downstream market through a subsidiary. Such a monopolist can raise the costs of the rivals to its subsidiary though discriminatory quality degradation. We find that the monopolist always has the incentive to raise the costs of the rivals to its subsidiary in a discriminatory fashion, but does *not* have the incentive to raise costs to the whole downstream industry including its subsidiary. Moreover, increasing rivals' costs nullifies the effects of traditional imputation floors, and prompts the creation of imputation floors that account for the artificial costs imposed on downstream rivals. The results of this paper raise concerns about the potentially anti-competitive effects of entry of local exchange carriers in long distance service.

Key words: monopoly, discrimination, vertical integration

JEL classification: L1, D4

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1. Introduction

Often, a vertically integrated firm sells its upstream output to its downstream competitors. In some cases, the downstream competitors have little choice but to buy the input from their competitor because this integrated firm dominates or monopolizes the market for that essential input to the downstream firms. For example, before divestiture, AT&T dominated local access markets and its competitor in the long distance market, MCI, had to buy access and termination of calls from AT&T. Microsoft dominates the operating systems market for personal computers, but competes with many other firms in the complementary markets for applications software. Presently, local exchange carriers ("LECs") that dominate the local access markets, are proposing to enter long distance service and compete with a number of interexchange carriers ("IXCs").

In this paper, we focus on a vertically integrated firm with very significant market power in the market of an essential input for a downstream market where the integrated firm faces a number of independent competitors. It has been alleged that such a vertically integrated firm will use its market power to impose discriminatory costs on the competitors of its downstream subsidiary.[1] Such costs may arise in a number of ways, including poor quality of interconnection in telecommunications, delays in processing orders, etc. In the computer software market, costs of competitors may be raised through the creation of incompatibilities[2] or by the incorporation in the operating system of "hidden" features that

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[1] See Beard, Kaserman and Mayo (1996) and Bernheim and Willig (1996).

[2] See Economides (1996).

are helpful to complementary applications and are disclosed to the monopolist's subsidiary but are not disclosed to downstream competitors.

Intuitively, it seems plausible that a firm with market power will try to "soften" competition for its downstream subsidiary by increasing the costs of its rivals. Beard, Kaserman, and Mayo (1996) argue strongly in favor of this point of view, and present a model demonstrating the incentive of a regulated dominant firm to engage in anti-competitive "sabotage" against downstream rivals. Others, including Gilbert and Panzar (1996) claim that once a LEC starts providing long distance service it will *not* have an incentive to raise the costs of long distance companies that are rivals to its subsidiary. They base this view on Sibley and Weisman (1995) who claim that there is no such incentive even when the vertically integrated firm is a monopolist in the essential input market.

This paper finds that a monopolist in the essential input market has an incentive to practice non-price discrimination against its downstream rivals. This result is established under very general demand conditions. In the special case when the downstream demand is linear, this result is established for any parameter values that fulfill second order conditions.

The divergence between the very strong results of this paper and the opposite results of Sibley and Weisman (1995) can be attributed to two reasons. The first reason is that, unlike the present paper, Sibley and Weisman (1995) assume that the subsidiary tries to maximize its own profits only and does not take into account the effects of its decisions on the profits of the integrated company. Such behavior would be irrational and against the interests of the shareholders of the integrated firm. The second reason for the difference between the results of this paper and those of Sibley and Weisman (1996) is that, unlike in the present paper, Sibley and Weisman (1995) confuse the issue by comparing incentives to

increase the cost to the rivals of the downstream subsidiary versus increasing the costs to the whole downstream industry (including the subsidiary). The present paper shows that the monopolist has an incentive to increase costs to all rivals of its subsidiary, but has no incentive to increase costs to the whole downstream industry.

The rest of the paper is organized as follows. Section 2 describes the basic model. Section 3 describes the incentive for a monopolist to increase cost of rivals to its subsidiary. Section 4 describes the incentive for a monopolist to increase cost to all downstream firms. Section 5 describes the consequences of raising rivals costs on the effectiveness of imputation rules. Section 6 contains concluding remarks.

2. The Model

Suppose that an upstream market is a monopoly and a downstream market is a n-firm oligopoly. Suppose further that one of the n firms is a subsidiary of the upstream monopolist. The monopolist sells the monopolized input at a non-discriminatory price of w. The monopolist can impose an extra cost to the rivals of its subsidiary, equal to r. This extra cost arises out of quality degradation, delays, etc., and is not realized as a revenue by the upstream firm. We investigate the incentives for the monopolist to impose a positive cost, $r > 0$, to the rivals of its subsidiary.

2.1 The Upstream Market

We assume that the upstream monopolist has fixed cost F^U, constant marginal cost c and sells all units at price w. Given demand Q, the profits of the monopolist from the upstream market are

$$\Pi_1^U = (w - c)Q - F^U.$$

2.2 The Downstream Market

The downstream market consists of the subsidiary of the upstream monopolist (firm 1) as well as $n - 1 \geq 1$ independent competitors. Let the inverse demand for the output of the downstream market be $p(Q)$ where

$$Q = q_1 + \Sigma_{i \neq 1} q_i.$$

Let the marginal cost of inputs to a downstream firm other than those bought from the upstream monopolist be denoted by s, and assume that units are normalized so that one unit of upstream input is used for one unit of downstream output. Then the downstream profits of the monopolist's subsidiary are

$$\Pi_1^D = (p - s - w)q_1 - F^D,$$

so that overall profits of the vertically integrated monopolist are

$$\Pi_1 \equiv \Pi_1^U + \Pi_1^D = (w - c)Q + (p - s - w)q_1 - (F^U + F^D).$$

Independent downstream firms face an extra cost, denoted by r, that reflects the actions of the upstream monopolist to raise the costs of the rivals of its subsidiary through quality degradation and other actions. Thus, a typical independent firm i has profits

$$\Pi_i \equiv \Pi_i^D = (p - s - w - r)q_i - F^D.$$

3. Equilibrium

3.1 General Demand

We assume that the downstream market is a Cournot oligopoly.[3] Profit maximization by firm 1 on the choice of q_1 requires:[4]

$$d\Pi_1/dq_1 = p + q_1p' - (c + s) = 0. \quad (1)$$

Profit maximization by firm $i \neq 1$ on the choice of q_i requires:[5]

$$d\Pi_i/dq_i = p + q_ip' - (w + s + r) = 0. \quad (2)$$

Thus, the marginal cost to an independent firm (rival) is higher than to the subsidiary of the monopolist. This is for two reasons: first, the cost of the upstream input is effectively higher for the rivals, $w > c$; second, because of the extra cost r imposed exclusively on the rivals, their cost is higher. Nevertheless, it is clear that the rivals face higher upstream input cost than the subsidiary even in the absence of non-price discrimination, i.e., when $r = 0$. This occurs despite the fact that, on the surface, the monopolist sells to all downstream firms at the same price w. As a direct consequence of facing lower marginal cost, the subsidiary produces more in equilibrium than an independent firm, $q_1 > q_i$.

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[3] It is well known that competition a-la-Cournot for homogeneous goods is equivalent to competition a-la-Bertrand for *differentiated* products, which approximates the reality of the interexchange market.

[4] The second order condition is $d^2\Pi_1/dq_1^2 = 2p' + q_1p'' < 0$.

[5] The second order condition is $d^2\Pi_i/dq_i^2 = 2p' + q_ip'' < 0$.

Let the Cournot equilibrium quantities that solve (1) and (2) be $q_1 = q_1^*$, $q_i = q_i^*$,[6] and similarly, denote the industry equilibrium sales by $Q^* = q_1^* + (n - 1)q_i^*$. It is helpful to combine (1) and (2) to create an expression that is dependent only on the total industry output. Multiplying (2) by $n - 1$ and adding to (1) we have

$$np(Q^*) - ns - c - (n - 1)(w + r) + Q^*p'(Q^*) = 0. \tag{3}$$

The equilibrium profits of firm 1 are:

$$\Pi_1^* = (w - c)Q^* + (p - s - w)q_1^* - (F^U + F^D). \tag{4}$$

The incentive that the upstream monopolist has to raise the costs of the rivals of its downstream subsidiary is measured by

$$d\Pi_1^*/dr = (w - c)(dQ^*/dr) + (q_1^*p')(dQ^*/dr) + (p - s - w)(dq_1^*/dr). \tag{5}$$

Since there are no closed form solutions for the case of general demand, we calculate dQ^*/dr and dq_1^*/dr from the system of the first order conditions. Totally differentiating (3) we derive

$$dQ^*/dr = (n - 1)/[(n + 1)p' + Q^*p'']. \tag{6}$$

This is negative when

$$(n + 1)p' + Q^*p'' < 0. \tag{7}$$

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[6] Inspection of (2) implies that all independent firms produce equal amounts.

Condition (7) is a standard regularity condition in Cournot oligopoly that is equivalent to an equal increase in marginal cost of all firms resulting in a decrease in output and an increase in price, i.e.,

$$dQ^*/ds < 0 \Leftrightarrow dp(Q^*)/ds > 0 \Leftrightarrow (n + 1)p' + Q^*p'' < 0. \tag{8}$$

Similarly, total differentiation of (1) implies

$$dq_1^*/dr = -(dQ^*/dr)(p' + q_1^*p'')/p'. \tag{9}$$

This is positive when

$$p' + q_1^*p'' < 0. \tag{10}$$

Condition (10) is also a standard regularity condition in Cournot oligopoly that is equivalent to a downward sloping best reply function of firm 1, or equivalently, that q_1 and Q are strategic substitutes.

We have shown that a discriminatory increase in the cost of downstream rivals results in a decrease in the industry output, an increase in final output price, a decrease in the output of each independent firm, and an increase in the output of the monopolist's subsidiary. An increase in r unambiguously reduces welfare since total industry sales are reduced, and a production inefficiency is incurred.

We are now in position to evaluate the incentive of the monopolist to raise the cost of downstream rivals. The total effect of increases in r on profits, $d\Pi_1^*/dr$, can be dissected (from (5)) in three parts. The first part, $(w - c)(dQ^*/dr) < 0$, represents the reduction of profits of the monopolist in its upstream operations. The second part, $(q_1^*p')(dQ^*/dr) > 0$,

represents the positive effect on the downstream subsidiary's revenues (holding the subsidiary's output constant) precipitated by the downstream price increase that results from increasing the costs of the independent competitors. The third part, $(p - s - w)(dq_i^*/dr) > 0$, represents the increased revenues from expanded sales of the subsidiary keeping price constant. The essence of our proof that $d\Pi_1^*/dr > 0$ relies on the fact that the combination of the first and the second parts is positive. Since the third part is positive, the result follows.

Profit maximization downstream implies marginal revenue equals marginal cost for every firm. This implies that the difference in marginal cost between an independent firm and the monopolist's subsidiary is equal to the difference in their marginal revenues, i.e.,

$$MC_i - MC_1 = MR_i - MR_1 \Leftrightarrow w + r - c = (q_i^* - q_1^*)p'. \tag{11}$$

This implies

$$w - c + q_1^*p' = q_i^*p' - r < 0, \tag{12}$$

and therefore the combination of the first and second term in (5) is positive:

$$(w - c + q_1^*p')(dQ^*/dr) > 0. \tag{13}$$

Since the third term is positive, if follows that $d\Pi_1^*/dr > 0$.

Formally, we substitute (9) in (5):

$$d\Pi_1^*/dr = (dQ^*/dr)[(w - c + q_1^*p' - (p - s - w)(p' + q_1^*p'')/p' =$$

$$= (dQ^*/dr)(-r + q_i^*p')(2 + q_1^*p''/p') > 0, \tag{14}$$

because the first two parentheses are negative and the last one is positive (from second order conditions).[7] Therefore *any* increase of rivals' costs above zero results in increased profits for the integrated monopolist and subsidiary. Finally notice that this result does not depend on the level of the input price w. We have proved:

Proposition 1: A monopolist in an upstream market has an incentive to increase the costs of rivals to its downstream subsidiary.[8]

Proposition 2: Any increase in rival's costs increases the subsidiary's output, decreases the output of rivals, decreases industry output, increases the downstream price, and decreases social welfare.

The effects of raising rivals' costs in the results we present are tempered by our assumption that the number of independent downstream firms is fixed. Essentially we have described a short run equilibrium. In fact, in the long run, we expect that the number of firms will adjust in response to the implementation of the strategy of raising rivals' costs. Raising rivals' costs allows the monopolist to "manage" the downstream market and force independent incumbents to exit. Thus, in the medium and long run, the consequences of non-price discrimination can be much more adverse to social welfare than the short run consequences that we have described.

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[7] In the last step we used the fact that $p - s - w = r - q_i^* p'$ from the profit maximization condition of an independent downstream competitor.

[8] The derivation shows that condition (7) by itself is sufficient for the result.

Our setup this far has been of a discriminatory strategy that increases the costs of downstream rivals but does not affect the demand functions of the subsidiary or of the independents. However, inspection of the profit maximization conditions (1) and (2) shows that our results also hold for a discriminatory degradation of the quality of the input offered to rivals which decreases the willingness to pay for the rivals' downstream output but leaves costs unaffected. In such a setup, independent downstream firms have marginal cost $w + s$, but, since they have a lower quality product, consumers are willing to pay only $p - r$ for their product (while consumers pay p for the subsidiary's output). That is, the independents face a demand curve that is a parallel downward shift by r of the demand faced by the subsidiary. In this setup, clearly the marginal profit of each firm is the same as before, and therefore the equilibrium quantities and profits are also the same. Thus, we have proved that our results hold if the strategy of raising rivals' cost is substituted by a discriminatory strategy of degrading the quality of the input supplied to the rivals so that the quality of the output of the rivals is degraded.[9]

3.2 Linear Demand

We present here the illustration for the case of linear demand. Of course this is a special case where $p'' = 0$, and the results of the general case hold. However, the linear case gives us the additional ability to write the equilibrium prices and production in closed form. For a linear demand

$$p = a - bQ, \tag{15}$$

[9] See Economides (1994) and Economides and Lehr (1995) for a discussion of the quality of goods composed of more than one component.

with $a > w + s + r > 0$, $b > 0$, the Cournot equilibrium is

$$q_1^* = [a - s - c\,n + (n - 1)(w + r)]/[b(n + 1)], \tag{16}$$

$$q_i^* = [a + c - s - 2(w + r)]/[b(n + 1)], \quad i \neq 1, \tag{17}$$

$$Q^* = [(a - s)n - c - (w + r)(n - 1)]/[b(n + 1)], \tag{18}$$

$$p^* \equiv p(Q^*) = [a + c + ns + (n - 1)(w + r)]/(n + 1), \tag{19}$$

and the realized profits are

$$\Pi_1^{U*} = (w - c)[(a - s)n - (w + r)(n - 1) - c]/[b(n + 1)] - F^U, \tag{20}$$

$$\Pi_1^{D*} = (a + c - s + r(n - 1) - 2w)(a - s - cn + (w + r)(n - 1))/[b(1 + n)^2] - F^D, \tag{21}$$

$$\Pi_i^* = (a + c - s - 2(w + r)]^2/[b(n + 1)^2] - F^D. \tag{22}$$

To assess the incentive for the monopolist to raise the costs of the rivals of its subsidiary, we evaluate the effects of raising r on the profits $\Pi_1^* = \Pi_1^{U*} + \Pi_1^{D*}$ of the integrated firm 1:

$$d\Pi_1^*/dr = d(\Pi_1^{U*} + \Pi_1^{D*})/dr = 2(n - 1)(a + c - s + r(n - 1) - 2w)/[b(n + 1)^2]. \tag{23}$$

Positive production by independent firms implies

$$q_i^* > 0 \Leftrightarrow w < (a + c - s - 2r)/2. \tag{24}$$

Therefore, substituting (24) in (23),

$$d\Pi_1^*/dr > 2r(n - 1)(n + 1)/[b(n + 1)^2] > 0 \tag{25}$$

for any $r > 0$. Thus, there is an unambiguous incentive for the vertically integrated monopolist to increase the costs of downstream rivals.

It is also easy to show that the strategy of raising rivals costs decreases their profits, $d\Pi_i^*/dr < 0$, but increases the profits of the combined upstream and downstream industries, $d(\Pi_1^* + (n-1)\Pi_i^*)/dr > 0$. Thus, the use of the discriminatory strategy increases the combined profits of the two industries and redistributes profits from the independents to the integrated firm.

4. The Incentive to Raise Costs to All Downstream Firms

It has been claimed that the monopolist will also, under some conditions, have the incentive to increase the costs of all downstream firms, and therefore, the *discriminatory* behavior described in Proposition 1 will not be observed.[10] We investigate this claim next.

An increase in all downstream costs is equivalent to increasing cost s, since s is faced equally by all firms. The effect on the monopolist's profits is

$$d\Pi_1^*/ds = (2d - 2a - c + cn(2 + n) - 2r(n - 1) - w(n - 1)(n + 3))/[b(n + 1)^2]. \quad (26)$$

Evaluating $d\Pi_1^*/ds$ at $r = 0$, $w = c$ yields:

$$d\Pi_1^*/ds = -2(a - c - d)/[b(n + 1)^2] < 0. \quad (27)$$

Increasing w and/or r decreases $d\Pi_1^*/ds$:

$$d^2\Pi_1^*/dsdw = - (n - 1)(n + 3)/[b(n + 1)^2] < 0, \quad (28)$$

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[10] See Sibley and Weisman (1995).

$$d^2\Pi_1^*/dsdr = -2(n - 1)/[b(n + 1)^2] < 0. \quad (29)$$

Thus,

$$d\Pi_1^*/ds < 0 \quad (30)$$

for any r, w, and s, and therefore it does *not* pay to increase costs to *all* downstream firms.

Proposition 3: The monopolist has no incentive to increase costs to *all* downstream firms, including its subsidiary.

In combination with Proposition 1, Proposition 3 shows that it is desirable for the monopolist to use a *discriminatory* strategy of raising costs only against the rivals of its subsidiary, rather than to the whole industry.

5. The Effects of Raising Rivals' Costs on Imputation

Imputation has been proposed as a regulatory safeguard against the effects of discrimination. By definition, the regulatory rule of strict imputation imposes a price floor for the output of the monopolist's subsidiary, equal to the upstream input price plus the cost of other inputs to a downstream firm. We show next that, when the monopolist raises the costs of its rivals, traditional imputation rules fail to safeguard against discrimination. In particular, we show that imputation fails to safeguard even against foreclosure of downstream rivals. It follows that imputation also fails to safeguard against less extreme effects of discrimination.

An independent firm is foreclosed when the actions of the monopolist make its profits negative. For simplicity, we limit the analysis to the case of zero downstream fixed cost, $F^D = 0$. To survive, an independent firm has to have positive production,

$$q_i^* > 0 \Leftrightarrow w + r < (a + c - s)/2. \tag{31}$$

Substituting in equation (19), independents' survival implies that the downstream market price should follow

$$p^* \geq w + s + r \Leftrightarrow p^* - (w + s) \geq r, \tag{32}$$

i.e., that the downstream market price should exceed a floor equal to the sum of three costs: (1) the monopolist's price of the upstream input to the rivals w; the cost of other inputs to the downstream process s; and, the cost to rivals that results from the monopolist's discrimination r.

Therefore, we have shown that for downstream rivals to survive, the imputation floor price has to exceed the traditional imputation floor of $w + s$ by the artificial cost r imposed on the rivals by the monopolist. If the imputation floor is set at the traditional level of $w + s$, the independent firms will be foreclosed.

Notice moreover, that, as long as the artificial cost imposed on the rivals is zero, $r = 0$, the traditional imputation floor of $w + s$ works effectively to eliminate foreclosure. However, when the monopolist imposes a positive artificial cost on its rivals, $r > 0$, the traditional imputation rule fails to have the desired effect, and the independents/rivals are foreclosed.

Proposition 4: The monopolist can use the strategy of raising downstream rivals' costs to circumvent traditional imputation floors and foreclose its rivals.

In light of Propositions 1-4, it is prudent policy for a regulator to set imputation floors reasonably higher than the traditional level of upstream input plus other downstream costs, with the difference reflecting the degree to which the monopolist can artifficially increase the costs of its downstream rivals through non-price discrimination.[11]

6. Concluding Remarks

We showed that a monopolist in an input market has a strong incentive to increase the costs of the rivals to its downstream subsidiary. Such action "softens" competition downstream and increases the profits of the vertically integrated monopolist. Moreover, we showed that the monopolist does not have an incentive to raise the costs to the whole downstream industry, but just to the rivals of its subsidiary. We also showed that raising rivals' costs effectively circumvents traditional imputation rules, and allows the monopolist to foreclose its downstream rivals. In the presence of non-price discrimination, to be effective, imputation floors have to be adjusted upwards to account for the artificial costs imposed on the rivals. The collection of these results raise significant concerns about the potentially anti-competitive effects of entry of local exchange carriers in long distance service.

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[11] For an imputation policy to have the desired effect, full observability of costs is required -- a condition that is unlikely to be fulfilled. This may be particularly difficult since typically firms do not have an incentive to accurately reveal their costs to the regulator.

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