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Managerial incentives and access price regulation

by

Øystein Foros
Hans Jarle Kind
Lars Sørgard

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Øystein Foros
Norwegian School of Economics and Business Administration
oystein.foros@nhh.no

Hans Jarle Kind
Norwegian School of Economics and Business Administration
hans.kind@nhh.no

Lars Sørgard
Norwegian School of Economics and Business Administration
lars.sorgard@nhh.no

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Abstract: Policy makers have identified the non-discrimination principle as a key instrument to regulate vertically integrated firms in control of upstream bottlenecks. Economists argue that the non-discrimination principle may create a level playing field, but at the expense of higher consumer prices. However, this rests on the assumption that the firms do not respond strategically to the regulation. We show that when the owners of the retail firms decide which type of manager to employ, they will respond to non-discrimination rules by hiring a more aggressive manager. Consequently, non-discrimination regulation rarely creates a level playing field. Neither does it necessarily lead to higher end-user prices. Indeed, we show that end-user prices may actually fall.

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1 Introduction

Governments often express concern that vertically integrated firms in control of essential upstream goods may abuse their market power and discriminate against downstream competitors. The European case law identifies the non-discrimination principle as a key instrument to regulate such vertically integrated firms.[2] The new sector specific regime for electronic communications in Europe is in line with such a view (The Access Directive, 2002).[3] Our starting point is the current regulatory regime in the telecommunications industry in the EU. We show that such a non-discrimination rule may not lead to higher end user prices, despite the fact that it imposes a high cost of network access on the vertically integrated firm's subsidiaries. The reason is that the vertically integrated firm may find it in its best interest to respond to such a regulation by hiring a more aggressive manager. This type of strategic behavior will reduce the effect of non-discrimination regulation, and in our particular setting all effects from such regulation are completely eliminated.

In the telecommunications industry we typically find regulated upstream monopolies that are required to sell network access to downstream competitors. The upstream monopolies typically have high fixed costs and low marginal costs, but all

[2]See for example Case IV/34.174 B&I Line plc v Sealink Harbours Ltd and Sealink Stena Ltd (1992) 5 C.M.L.R 255, discussed in Bishop and Walker (2002). The European Commission stated that access should be offered on "non-discriminatory and reasonable" terms. Sealink was a ferry operator that also was the owner of a harbour, while B&I was a ferry company that used the harbour to compete with Sealink. The Commission stated that Sealink used its monopoly position in the supply of access to the harbour to strengthen its position in the downstream market, and ".... in particular, by granting its competitor access to a related market on less favorable terms than those of its own service".

[3]This regime uses ex ante regulation remedies in the market we consider, and came into force in July 2003. The Access Directive (Article 9-13) and the Universal Service Directive (Article 17-19) contain a list of available remedies that may be imposed on operator with significant market power in the wholesale and retail markets, respectively. It states that "obligations of non-discrimination shall ensure, in particular, that the operator applies similar conditions in similar circumstances to other undertakings providing similar services, and provides services and information to others under the same conditions and the same quality as it provides for its own services, or those of its subsidiaries or partners". For a discussion, see Cave (2002).

regulatory cost allocation methods used to compute the access price are based on average costs (Laffont and Tirole, 2000, and Vogelsang, 2003). The wedge between the marginal cost and the average cost based access price creates a competitive advantage for the integrated subsidiary. The aim of the non-discrimination principle is then to create a level playing field by reducing this competitive advantage. As long as the access price is based on the average cost, the only way to create a level playing field is to increase the perceived cost of network access (the transfer price) for the vertically integrated downstream subsidiary.

A non-discrimination regulation must thus affect the internal organization of the integrated firm so that the retail subsidiary acts as if it were an independent retail firm.[4] If not, the subsidiary will obviously use the real marginal cost rather than the higher transfer price when it sets retail output.[5] Economists have generally jumped to the conclusion that such a principle of non-discrimination may create a level playing field, but that the policy comes at the expense of higher consumer prices and lower welfare. The reason is that the end-user price increases when the subsidiary's perceived cost of network access increases. However, we should not expect the vertically integrated firm to passively accommodate to an ex ante

[4]The list of remedies in the Access Directive (2002) includes a transparency obligation (Article 9), a non-discrimination obligation (Article 10), an accounting separation obligation (Article 11), an access obligation (Article 12), and a price control and cost accounting obligation (Article 13). The obligations on transparence and accounting separation support the non-discrimination obligation that rarely is an effective remedy on its own (European Regulators Group, 2003). Such obligations may be used to ensure that the manager of the subsidiary is compensated on the basis of the subsidiary's sales and profit.

[5]European Regulators Group (2003) gives a comprehensive discussion of the appropriate use of remedies in the new European regulatory framework for electronic communications, and it is stressed that a non-discrimination obligation covers the firms' internal organization. The Group further emphasizes that the non-discrimination obligation must be combined with other remedies, such as transparency and/or accounting separation, to be effective. On behalf of the European Commission Cave (2003), Koboldt (2003) and Valletti (2003) evaluate remedies within the new framework for broadband services, narrowband services and mobile services, respectively. Regulation requiring that a vertically integrated firm with upstream monopoly can only enter downstream markets via fully separate subsidiaries is also commonly used in the US telecommunications sector (Sibley and Weisman, 1998).

requirement of non-discrimination. Indeed, we show that the strategic response by the vertically integrated firm may neutralize the non-discrimination policy.

In order to show this, we set up a model where we make three basic assumptions that we consider to be consistent with the sector-specific regulation paradigm for electronic communication services: First, regulators set an access price which is above marginal cost. Second, the regulators ex ante enforce regulation of the internal organization of the integrated firm through non-discrimination remedies. Third, there is no regulation of the end-user prices. In the present context, where a vertically integrated firm controls the upstream input, it follows from the new framework that the authorities will set a cost-oriented access price (European Regulators Group, 2003).[6]

By using the framework of the literature on strategic delegation, we analyze a two-stage game where a vertically integrated firm sells an essential upstream input to its downstream competitors. At stage 1 the owners of the firms make deliberate choices with respect to what type of managers they hire for the downstream firms; aggressive or non-aggressive.[7] At stage 2 the managers of the downstream firms compete à là Cournot. In an extension we show that the main results are valid also with Bertrand competition in the retail market.

We show that the response from the owner of the integrated firm to a stricter non-discrimination regulation is to hire a more aggressive manager for the downstream subsidiary. In fact, all downstream rivals respond by hiring managers that behave more aggressively. However, the owners of the integrated firm choose a more

[6] As discussed above, the average-cost based access price creates an advantage for the integrated subsidiary. Moreover, a cost-oriented regulation of the access price will create incentives to use non-price discrimination. Consequently, an obligation of non-discrimination (The Access Directive, 2002, Article 10) will be needed in addition to the obligation of a cost-based access price (European Regulators Group, 2003: page 97). Retail prices may be regulated according to the Universal Service Directive (2002). However, the new framework emphasizes that retail remedies are only justified if wholesale remedies cannot be used (The Universal Service Directive, 2002, Article 17).

[7] Pioneering papers on strategic managerial delegation are Fershtman and Judd (1987), Sklives (1987), Vickers (1985) and Fershtman (1985). These papers assume that an incentive contract is given to the manager. We interpret this as the type of manager analogous to González-Maestre and López-Cuñat (2001).

aggressive manager than do the owners of the downstream rivals. The reason is that the owners of the vertically integrated firm are in a different situation than the owners of the downstream rivals, since they take into account total profits, *i.e.*, upstream profits plus the subsidiary's downstream profit. The true cost for the latter is the real marginal cost, and not the (higher) regulated network access price that the downstream rivals face.

Fershtman and Judd (1987) emphasize that the two-stage game, where the manager type is chosen before retail competition, loses much of its appeal (without uncertainty) if all firms would have been better off if they all played the conventional one-stage Cournot game. In contrast, we show that with non-discrimination regulation, the integrated firm may find the two-stage game more profitable than the conventional one-stage Cournot game. Again, the reason is that the vertically integrated firm takes into account total profits.

The article is organized as follows. In section 2 we present the basic model with Cournot competition, and in section 3 we check the robustness of the model by assuming Bertrand competition. Finally, in section 4, we make some concluding remarks.

2 The Model

We analyze a market structure as illustrated in Figure 1, where we have a vertically integrated firm that produces two services; the monopoly input (network access) and the downstream output. We assume that the firm faces $(n-1)$ identical downstream rivals, and that one unit of the upstream good is needed in order to produce one unit of the downstream good. Let c denote the marginal costs of producing network access. The price that the upstream monopolist charges for network access from its downstream competitors is regulated, and equal to w. The cost of producing the downstream good is assumed equal to zero.

A significant part of the network costs is fixed, and these costs are covered by setting an access price that is above marginal costs. In the present context this means that the regulator will set $w > c$. Thereby the independent downstream firms face

higher marginal costs (w) than the vertically integrated firm (c). All else equal, this implies that the vertically integrated firm will have a competitive advantage in the end-user market. As argued in the Introduction, many countries therefore impose the principle of non-discrimination in order to create a level playing field. In its extreme form this implies that the vertically integrated firm is required to compete in the end-user market as though the marginal cost of network access were equal to w. More generally, the more strictly the non-discrimination principle is enforced, the higher is the perceived cost of network access for the vertically integrated firm's downstream unit. In order to capture this fact, we assume that the downstream subsidiary faces the cost function

$$C_d = \beta w + (1 - \beta)\, c, \tag{1}$$

where $\beta \in [0, 1]$. A higher β is then interpreted as a stricter non-discrimination requirement.

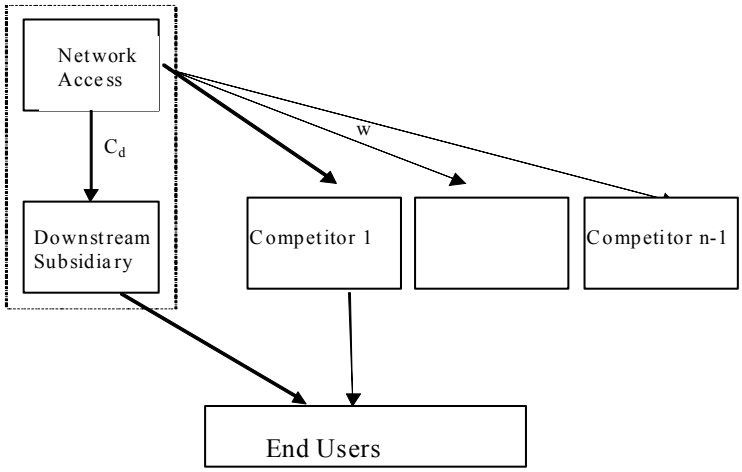

Figure 1: Market structure.

The inverse demand curve in the end-user market is given by

$$p = 1 - Q, \tag{2}$$

where p is the price and $Q = q_d + \sum_{j=1}^{n-1} q_{cj}$ is total quantity. The variable q_d denotes output by the integrated downstream subsidiary, and q_{cj} denotes output

by independent retailer j. Downstream profits to the integrated subsidiary and its rivals are thus respectively:

$$\pi_d = (p - C_d)\, q_d \tag{3}$$

and

$$\pi_{cj} = (p - w)\, q_{cj}. \tag{4}$$

Total profit of the vertically integrated firm can now be written as

$$\pi_I = (w - c)\, Q + \pi_d. \tag{5}$$

2.1 Benchmark: Profit maximizing retail managers

Suppose that the retail managers maximize profit with respect to quantities. Solving $\partial \pi_d / \partial q_d = \partial \pi_{cj} / \partial q_{cj} = 0$ $(j = 1, ..., n-1)$, we find

$$\hat{q}_d = \frac{1 - w + n\,(w - C_d)}{n+1} \text{ and } \hat{q}_{cj} = \frac{1 + C_d - 2w}{n+1}. \tag{6}$$

From this it follows that the end-user price equals

$$\hat{p} = \frac{1 + (n-1)w + C_d}{n+1}. \tag{7}$$

In order to interpret the subsequent equations, it is useful to note that the profit margin of the independent retailers can be written as

$$\hat{p} - w = (1 + C_d - 2w)\, \frac{1}{n+1}.$$

The independent retailers will thus be active in the market only if $w < (1 + C_d)/2$, and throughout we assume that this condition holds.

Inserting for (6) and (7) we find that the profit level of each of the independent retailers equals

$$\hat{\pi}_{cj} = (1 + C_d - 2w)^2\, \frac{1}{(n+1)^2}, \tag{8}$$

while the profit level of the vertically integrated firm is

$$\hat{\pi}_I = (w - c)\, \frac{n\,(1 - w) + w - C_d}{n+1} + (1 + C_d - 2w)\, \frac{1 - w + n\,(w - C_d)}{(n+1)^2}. \tag{9}$$

From (6) we see that $\hat{q}_d$ is decreasing in C_d, while $\hat{q}_{cj}$ is increasing in C_d. Thus, the more strictly the non-discrimination regime is enforced, the smaller the vertically integrated upstream firm's advantage will be in the end-user market. The problem from a social point of view, though, is that the end-user price is increasing in C_d, as shown by equation (7). This indicates that even though the principle of non-discrimination may create a level playing field, the policy comes at the expense of higher consumer prices and lower welfare. This is one reason why the non-discrimination principle has been much criticized by economists.

2.2 Optimal choice of retailer manager types

In the following, we consider a two-stage game where the retailers compete in quantities at stage 2, and where the owners of the firms choose which manager type to employ at stage 1. Let the type of manager of retailer $k = d, cj$ be given by α_k. A high value of α_k means that the manager has strong preferences for profits, while a low value of α_k means that the manager has strong preferences for sales (quantity). More specifically, we assume that the object function of a manager of type α_k is given by

$$\phi_k = \alpha_k \pi_k + (1 - \alpha_k)\, pq_k \qquad (k = d, cj). \tag{10}$$

The regulator's choice of w and β is taken previous to this game, and will be considered as exogenous.

Note that we may interpret α_k as the incentive contract given to the retail manager, as in, e.g., Fershtman and Judd (1987) and Sklives (1987). González-Maestre and López-Cuñat (2001), however, use the interpretation of manager type. Regardless of interpretation, the owners must be able to commit themselves, and α_k must be observable to be used strategically.[8] González-Maestre and López-Cuñat (2001) argue that the manager type interpretation overcomes the commitment problem related to incentive contracts. With respect to observability in the present context, it is sufficient to assume that manager types (or contracts) are common knowledge

[8]Katz (1991) and Bagwell (1995) show that unobservable contracts do not have any strategic value, since they cannot be used as commitment devices.

among the managers and the owners.[9]

We follow González-Maestre and López-Cuñat, as we want to consider a tool available to the owners that may be used to react strategically to the ex ante remedies imposed by the regulator. The regulator may in principle regulate the incumbent's incentive contracts, but will hardly intervene with regard to the manager type hired for the downstream subsidiary. In consequence, we interpret α_k as representing the manager type.

Stage 2: The managers set quantities

At stage 2 the retail managers maximize ϕ_k with respect to quantity. Using equations (3), (4) and (10) we find that the reaction function of the subsidiary's manager is given by

$$q_d = \frac{1 - \sum_j q_{cj} - \alpha_d C_d}{2}. \tag{11}$$

Note that q_d is decreasing in α_d. This reflects the fact that the higher the value of α_d, the more the manager cares about profit and the less he cares about sales. Likewise, we find that the second stage reaction function of the manager of the independent retailer j is given by

$$q_{cj} = \frac{1 - q_d - \sum_{i \neq j} q_{ci} - w\alpha_{cj}}{2}. \tag{12}$$

All else equal, output from each retailer is higher the more aggressive its manager (the lower is α_k). If firm k hires a more aggressive manager, the response of the other retailers will therefore be to reduce their output, since quantities are strategic substitutes. Formally, this is shown by combining (11) and (12). We then find that the outcome of stage 2 is given by

$$q_d = \frac{1 - n\alpha_d C_d + w \sum_j \alpha_{cj}}{n+1} \tag{13}$$

and

$$q_{cj} = \frac{1 - nw\alpha_{cj} + \alpha_d C_d + w \sum_{i \neq j} \alpha_{ci}}{n+1}. \tag{14}$$

We thus see that $\partial q_k / \partial \alpha_k < 0$ and $\partial q_k / \partial \alpha_{-k} > 0$.

[9]Hence, it is not necessary to assume that manager types or contracts are public information.

Inserting for (13) and (14) into (2) we find that the end-user price can be written as

$$p = \frac{1 + w\sum_j \alpha_{cj} + \alpha_d C_d}{n+1}. \tag{15}$$

All else equal, the consumer price is thus increasing in C_d (as above) and in α_k. This suggests that also in this case the end-user price is higher the more strictly the non-discrimination is enforced (the higher is C_d), but that the price is lower the more aggressive the mangers are (the smaller is α_k).

Stage 1: The owners decide manager types

At stage 1 the owners decide which type of manager to hire. Inserting for (13), (14) and (15) and solving $\partial\pi_c/\partial\alpha_c = \partial\pi_I/\partial\alpha_d = 0$ we find that

$$\alpha_c = 1 - \underbrace{(1+2c-3w)\frac{n-1}{(n^2+1)\,w}}_{\text{Business stealing effect}} - \underbrace{(w-c)\frac{n-1}{(n^2+1)\,w}}_{\text{Integration effect}} \tag{16}$$

and

$$\alpha_d = \left(1 - \underbrace{(1+2w-3c)\frac{n-1}{(n^2+1)\,c}}_{\text{Business stealing effect}} + \underbrace{4(w-c)\frac{n-1}{(n^2+1)\,c}}_{\text{Integration effect}}\right)\left(\frac{c}{C_d}\right). \tag{17}$$

The business stealing effect captures the fact that each firm has incentives to hire an aggressive manager in order to steal business from its competitors, c.f. the reaction functions of the firms at stage 2. From equations (16) and (17) we see that the size of the business stealing term is higher in the expression for α_d than for α_c, indicating that the integrated firm hires the more aggressive manager. The reason is that this firm de facto has a larger downstream profit margin. The vertically integrated firm takes into account the fact that c is the downstream firm's true marginal cost, not the transfer price C_d imposed by the regulator.

The integration effect reflects the fact that the integrated firm has upstream revenue from the downstream rivals, and from (17) it is clear that this effect makes the integrated firm less aggressive. The intuition is that since quantities are strategic substitutes, the other retailers will reduce their output if the integrated firm hires a more aggressive manager. Hence, a lower α_d reduces upstream profit from the rivals, and, all other things equal, vertical integration increases α_d.

The second bracket in equation (17) reflects the effect from non-discrimination regulation. When $\beta > 0$, the second bracket is below 1, and the integrated firm then hires a more aggressive manager when β increases.

It is straightforward to show that $\alpha_d < \alpha_c$ even when $\beta = 0$, and from these two equations we can derive the following:

Proposition 1: *Both the owners of the independent retailers and the owners of the vertically integrated firm choose aggressive retail mangers* ($\alpha_k < 1$). *The manager of the vertically integrated firm will be more aggressive than the managers of the independent retailers* ($\alpha_d < \alpha_{cj}$).

It should further be noted that

$$\lim_{n=\infty} \alpha_c = 1 \text{ and } \lim_{n=\infty} \alpha_d = \frac{c}{C_d} < 1 \text{ (if } \beta > 0)$$

The fact that $\lim_{n=\infty} \alpha_c = 1$ is consistent with results in Fershtman and Judd (1987), and shows that the independent retailers will choose profit maximizing managers in the limit as $n \to \infty$. This simply reflects the fact that there is no room for strategic behavior for the independent retailers if they operate in a perfectly competitive setting. Note, though, that the non-discrimination policy artificially reduces output from the integrated firm's subsidiary ($q_d(C_d) < q_d(c)$ if $\beta > 0$). Therefore the integrated firm will choose an aggressive manager even as $n \to \infty$ as long as $\beta > 0$.

Inserting for α_c and α_d into the second stage equilibrium outcomes yields quantities

$$q_d = \frac{(w-c)(n-1)^2 + n(1-c)}{n^2+1} \text{ and } q_c = (1+c-2w)\frac{n}{n^2+1}. \tag{18}$$

Total quantity and end-user price are thus equal to

$$Q = \frac{(w-c) + n^2(1-w)}{n^2+1},\ p = \frac{1 + n^2 w - (w-c)}{n^2+1} \tag{19}$$

The striking feature of (18) and (19) is the fact that the end-user price and quantities are independent of β. The intuition for this result is that if the regulator enforces a stricter non-discrimination requirement (higher β), the integrated firm will respond by engaging a correspondingly more aggressive manager in the downstream unit (i.e., a reduction of α_d). We can therefore state:

Proposition 2: *Ex ante requirements of non-discrimination ($\beta > 0$) have no effects on equilibrium prices and profits as long as the firms ex post can decide on the manager type of their downstream units.*

Hence, non-discrimination regulation has no effect. Even if the result that all effects of regulation are eliminated may seem extreme, we believe that the outcome that strategic behavior more or less neutralizes the effect of non-discrimination regulation holds more generally.

Since all the retailers choose to hire aggressive managers, total output will be higher and the end-user price lower than if the firms instead hire profit maximizing managers. Formally, this is seen by using equations (7) and (19) to find

$$p - \hat{p} = -(1 + c - 2w)\frac{n(n-1)}{(n^2+1)(n+1)} - \frac{\beta(w-c)}{n+1}, \tag{20}$$

where the difference is increasing in β. This is because an increase in β has no effect on the price in the two-stage game, while it increases the price in the conventional one-stage Cournot game. Note further that the price difference goes towards zero as $n \to \infty$, because we then approach perfect competition in the end-user market.

The fact that the consumer price is lower in the two-stage game than in the one-stage game, raises the question of whether the owners have incentives to avoid the two-stage game. Fershtman and Judd (1987) emphasize that the conventional one-stage Cournot game, where the owners dictate the output, also constitutes an equilibrium. In their model the one-stage Cournot equilibrium may be a focal point since the two-stage game is strictly Pareto inferior for the firms.

In contrast, in the present setting the owner of the vertically integrated firm may have higher profit in the two-stage game than in the one-stage game. In order to show this, we insert for (18) and (19) into (5) and (4), respectively. We then find that the profit levels of the firms are equal to

$$\pi_{cj} = (1 + c - 2w)^2 \frac{n}{(n^2+1)^2} \tag{21}$$

and

$$\pi_I = (w - c)(1 - w) + (1 + c - 2w)^2 \frac{n}{(n^2+1)^2}. \tag{22}$$

By comparing the vertically integrated firm's profit in the two-stage game (equation (22)) and in the one-stage game (equation (9)) we find that:

Proposition 3: *The vertically integrated firm makes a higher profit in the two-stage game than in the one-stage game if*

$$\beta > \bar{\beta} \equiv (1 + c - 2w) \frac{n-1}{(w-c)(n^2+1)}, \tag{23}$$

in which case also the independent retailers will employ aggressive managers.

To see the intuition for this result, recall from Proposition 2 that β has no effect on profits in the two-stage game. In contrast, the profit level of the integrated firm is decreasing in β in the one-stage game.[10] If β is sufficiently high, the profit of the integrated firm will thus be higher in the two-stage game than in the one-stage game. However, the independent retailers will always prefer the one-stage Cournot game (see Appendix for proof).

From equation (23) we find that

$$\frac{\partial \bar{\beta}}{\partial w} = -(1-c) \frac{n-1}{(w-c)^2 (n^2+1)} < 0.$$

We see that the higher the access price that the vertically integrated firm is allowed to charge for the upstream good, the lower is the value of β above which the two-stage game is profitable for the vertically integrated firm.

As a consequence of Proposition 3 the two-stage game is not strictly Pareto inferior to all firms if $\beta > \bar{\beta}$. Hence, in contrast to Fershtman and Judd (1987), the one-stage game is not necessarily a natural candidate as a focal point. Therefore we make the following assumption:

Assumption 1: *The firms coordinate on a one-stage Cournot game if, and only if, all the firms make higher profits by not engaging autonomous downstream mangers ($\alpha_k = 1$ if $\pi_I < \hat{\pi}_I$ and $\pi_{cj} < \hat{\pi}_{cj}$), ie., if $\beta > \bar{\beta}$.*

Given Assumption 1 we have the following result:

[10] Formally, this can be verified from equation (5).

Proposition 4: *A sufficiently strict non-discrimination requirement ($\beta > \bar{\beta}$) increases consumer surplus and welfare by making it profitable for the owner of the vertically integrated firm to hire an aggressive manager in the downstream market.*

Corollary 1: *A non-discrimination policy reduces consumer surplus and welfare if the price that the vertically integrated firm is allowed to charge for network access is below a critical level ($w < \bar{w}$).*

Figure 2 summarizes how a requirement of non-discrimination affects the consumer price. Here we assume that $c = 0$ and $w = 0.25$. If there is no requirement of non-discrimination ($\beta = 0$) the consumer price is equal to p_1. A requirement of non-discrimination will then raise the consumer price until we reach $\beta = \bar{\beta}$, because total output falls. However, for $\beta > \bar{\beta}$ it becomes profitable for the vertically integrated firm to employ an aggressive manager. We will then see a significant increase in industry output, since it is profitable also for the independent retailers to employ aggressive managers. Thus, the end-user price falls to $p_2 < p_1$. Thereby the requirement of non-discrimination has a beneficial welfare effect.

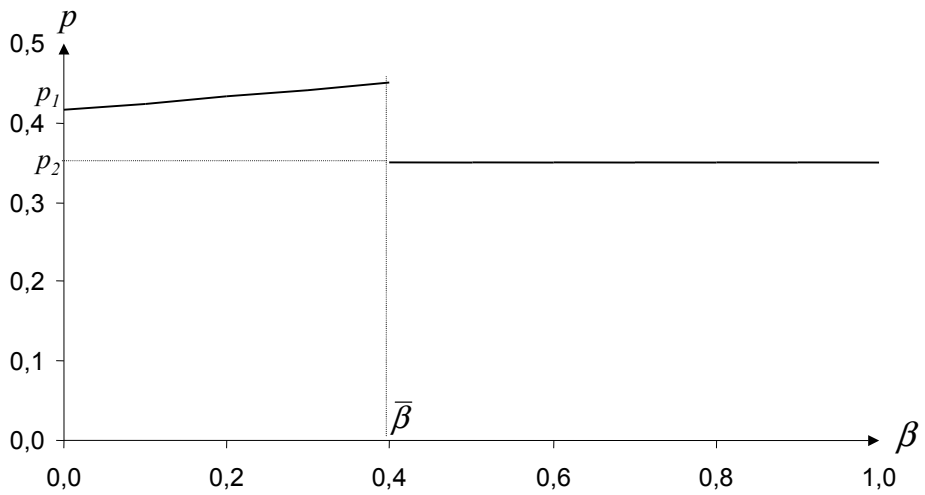

Figure 2: *Non-discrimination requirement and consumer surplus.*

3 Extension: Price competition in the retail market

Suppose that there is price competition between retailers, and assume for simplicity that there is just one competitor to the integrated subsidiary. Demand is now given by:

$$q_k = 1 - p_k + ap_{-k}$$

where $k, = d, c$. We assume that $a < 1$, implying that each firm's own price has a higher effect on its sales than the price charged by its competitor. As in the previous case the managers of d and c will act so as to maximize the object function $\phi_k = \alpha_k \pi_k + (1 - \alpha_k) p_k q_k$. Stage 2 equilibrium prices decided by the managers are, respectively:

$$p_d = \frac{2 + a + a\alpha_c w}{4 - a^2} + \frac{2\alpha_d C_d}{4 - a^2}$$
$$p_c = \frac{2 + a + a\alpha_d C_d}{4 - a^2} + \frac{2\alpha_c w}{4 - a^2}$$

By differentiating the profit of the integrated firm π_I and the competitor π_c with respect to α_d and α_c, respectively, we find the stage 1 equilibrium:

$$\alpha_d = A_I / BC_d \quad \textit{and} \quad \alpha_c = A_c / Bw$$

where

$$A_I = 4a^2 + 2a^3 - a^4 + w(8a - 2a^3 - a^5) + c(16 - 8a - 16a^2 + 4a^3 + 4a^4)$$

$$A_c = 4a^2 + 2a^3 - a^4 + w(5a - 16a^2 + 16) + c(2a^3 - 4a^5 - a^4)$$

$$B = a^4 - 12a^2 + 16$$

We see that A_I, A_c and B are independent of C_d. Hence, if we insert α_d into p_d and p_c it can be verified that:

Proposition 5: *Analogous to the outcome in Proposition 2 (Cournot competition), the owner of the integrated firm under price competition eliminates the effect of stronger non-discrimination requirements, i.e. an increase in β, by choosing a more aggressive manager.*

4 Some concluding remarks

A common concern of governments is that a vertically integrated firm with upstream monopoly power will discriminate retail competitors. In the new European sector-specific regulation on electronic communication networks and services the non-discrimination principle is identified as the key tool to prevent such behavior. Economists commonly argue that the non-discrimination principle may create a level playing field, but at the expense of higher consumer prices. This conclusion rests on the assumption that firms do not strategically respond to the regulation. However, the firms' toolbox to strategic behavior after such a regulation is imposed is large, and in this paper we have shown that the effects of non-discrimination remedies may be neutralized by the choice of manager type.

The question is, will this be good or bad news for the regulator? We argue that the non-discrimination principle does not create a level playing field. This is probably bad news for the regulator. However, the fear of higher end-user prices that is stressed by many economists is probably exaggerated. Indeed, we demonstrate that even if the non-discrimination principle cannot ensure a level playing field, the principle may reduce prices under given conditions. The reason is that the principle may force the integrated firm to enforce a more aggressive downstream market structure than it would otherwise have done.

If the regulator's goal is to ensure that the integrated subsidiary and the independent rivals are on equal footing in the retail market, the regulator needs to ensure that the retailers face the same marginal cost of access. In the telecommunication industry and other network industries, the marginal cost of access and the average costs of access differ. Hence, a level playing field cannot be achieved as long as current methods of access pricing based on average costs are used. The divergence in marginal costs faced by the subsidiary and the downstream competitors could be reduced by a non-linear structure of access prices such that the unit access charge is equal to the marginal cost. However, in telecommunications and other network industries there are multiple cost drivers, and we will rarely observe a structure of non-linear access prices that mirrors costs (see discussion by Cave, 2002). More-

over, the authorities are usually reluctant to non-linear access prices, since such price schedules may be used as a tool to exclude smaller retail rivals (Vogelsang, 2003).

5 Appendix

Proof of equations (13) and (14)

Summing (12) over the $(n-1)$ independent retailers we have

$$\sum_j q_{cj} = \frac{(n-1)(1-q_d) - w\sum_j \alpha_{cj}}{n}. \tag{24}$$

Inserting for (24) into (11) we find (13).

By subtracting $q_{cj}/2$ on each side of (12) we can write

$$nq_{cj} = 1 - q_d - nw\alpha_{cj} + w\sum_j \alpha_{cj}. \tag{25}$$

Using (13) and (25) we find (14). Q.E.D.

Proof of Proposition 3

From equations (8) and (21) we find that

$$\hat{\pi}_{cj} - \pi_{cj} = \left((1 + C_d - 2w)^2 \frac{(n^2+1)^2}{(n+1)^2 n} - (1 + c - 2w)^2 \right) \frac{n}{(n^2+1)^2}.$$

Since $C_d \geq 1$ and $(n^2+1)^2 / \left[(n+1)^2 n\right] > 1$ it follows that $\hat{\pi}_{cj} > \pi_{cj}$. Thus, the independent retailers make the higher profit in the one-stage game.

Equations (9) and (22) imply that

$$\hat{\pi}_I - \pi_I = \frac{\left[((1+c-2w)(n-1) - (w-c)(n^2+1)\beta)\right]\left[(1+c-2w)(n^3-1) + (w-c)(n^2+1)n\beta\right]}{(n+1)^2(n^2+1)^2}.$$

The second square bracket in the numerator is always positive. However, the first square bracket is negative if $\beta > \bar{\beta}$ and positive if $\beta < \bar{\beta}$. It thus follows that $\hat{\pi}_I - \pi_I \lessgtr 0$ if $\beta \gtrless \bar{\beta}$. Q.E.D.

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