Access Pricing Regulation

by

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Abstract

We consider some of the regulatory problems raised by the existence of a competitive market for a product which requires the use of a monopolized input. We review the existing literature on the optimal regulation of access pricing under different demand and supply conditions, and present some results on the appropriate industry configuration for this type of industry.

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1. Introduction

We consider some of the regulatory problems raised by the existence of a (more or less) competitive market for a product which requires the use of a monopolistically produced input. This situation arises in several utilities and in particular in telecommunications. Consider for instance the production of mobile telephony, or international calls. In order to be supplied these products require the use of fixed network services, produced by monopolies almost everywhere. We address two questions raised by the existence of this productive structure; (i) whether should vertical integration be allowed and (ii) how should access prices for the monopolized inputs be set by regulators in face of effective vertical integration.

In practice, the issue of whether network monopolists should be allowed to vertically integrate the two outputs has received different answers. In the US the fixed network local operators were, since 1984, forbidden to supply competitive outputs together with the monopolized ones while in Europe[1] regulatory authorities have allowed the vertical integration of competitive and monopoly supply in the former public operators.

It is well known that, in general, when there is only one firm operating in the both the upstream and the downstream markets, vertical integration is welfare improving since it avoids double marginalization. This proposition must be reassessed when there are several competitors in the downstream market. In this case, if the upstream monopolist is allowed to vertically integrate with one of the downstream competitors, it may in fact distort competition in the downstream market through discrimination of access prices or quality of access[2]. This problem does not occur if regulation works perfectly in a

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[1] The only exception is the UK, where OFTEL is now requiring BT to present separate accounts for the monopoly and competitive markets. See Cave and Doyle (1994).

[2] In fact, several operators have often complained about the high access charges practiced by the incumbent firms.

symmetric information setting, because in this case the regulator may control for anticompetitive behavior. In the case of perfect contestability or Bertrand competition in the downstream market, the perils of vertical integration are not present as well. However, if competition is not perfect and there are asymmetries of information between the regulator and the upstream monopolist, vertical integration may lead to the exclusion of the other competitors in the downstream market. In this case, divestiture from the downstream market may be prefered in spite of the double marginalization effect.

The question of the adequate structure of a regulated industry in which there is a monopolist provider of a bottleneck facility has been addressed by Economides and Woroch (1994), Gilbert and Riordan (1995) and Vickers (1995). Vickers (1995) analyzes the welfare effects of vertical integration in an industry where there is Cournot competition and free entry in the downstream market, (together these hypothesis imply that profits of the entrants are always equal to zero) the monopoly price is regulated by an welfare-maximizing regulator, and the regulator has asymmetric information concerning the regulated incumbent costs. He shows that the welfare effects of vertical integration versus divestiture are ambiguous: integration decreases welfare as long as the incumbent has incentives to raise competitors costs, but it increases welfare because fewer competitors enter the market. In his model, where each entrant faces a fixed cost of entry, less entry may imply welfare gains. The net effect depends on the specific characteristics of the markets analyzed. In the last part of this paper, we try to analyze the same type of question in a different setting (problems of asymmetric information are not considered).

In a different vein, Economides and Woroch (1994) analyze the private and social incentives for network interconnection as well as the impact of different industry structures on consumers welfare. Gilbert and Riordan (1995) also analyze the issue of the optimal degree of vertical integration in the presence of optimal regulation and asymmetric information. They conclude that vertical disintegration introduces an additional component of information cost on the regulator, similar to the double marginalization effect in the case of monopoly pricing of complementary products. Their result depends upon the assumption that disintegration will be accompanied by regulation in every market. Notice, however, that in the case of the telecommunications literature, when divestiture occurs, competition in the downstream market is often a substitute for regulation.

The other issue we want to address is the regulation of access prices. More specifically, and following the literature, we will consider an industry with a regulated and vertically integrated firm that faces competition in one of its markets. This firm is a monopolist in the production of an input, x_1, (local network services) required for the production of both outputs q_1 and q_2. (These outputs could be local calls and long-distance phone calls or mobile services). The firm is the sole supplier of q_1 but faces competition in the market for q_2. The question we want to address is the setting of an optimal price for x_1.

The remainder of the paper is organized as follows. Sections 2 through 7 address the questions related to the regulation of access prices. In section 8 we depart from the existing literature on vertical integration and address the issue in the context of a model that mimics the current structure of many cellular telephony markets in Europe. Section 9 concludes the paper.

2. Baumol's Rule

The question of access pricing was first addressed by Baumol (1983 and 1994) and Willig (1979), who set the so-called Baumol's rule, or the "efficient component pricing rule" (*ECPR*). In Baumol's model the incumbent firm (*I*) uses two inputs, x_1 and x_2, to produce two outputs, q_1 and q_2. The supply of input 1 is monopolized by the firm. In order to supply one unit of output q_1 the firm uses one unit of input x_1. Production of one unit of output q_2 requires one unit of x_1 and one unit of x_2.

The entrant also produces output q_2 and each unit of q_2 produced by the entrant, denoted by q_3, requires one unit of x_1 and one unit of input x_3, specific to the entrant.

Total production of input *1* by the incumbent will thus equal $q_1+q_2+q_3$ while total production of x_2 will equal q_2. Total costs of the incumbent firm are denoted $C_I\,(q_1 + q_2 + q_3;\, q_2)$.

The incumbent has to charge the entrant a price for input x_1. According to Baumol, this price, p_a, should equal its direct incremental cost, plus the opportunity cost to the incumbent of production of q_2 by the entrant. This opportunity cost is the profit lost by the incumbent for each unit of q_2 sold by the entrant. In particular, if the price of q_2 is p_2, the opportunity cost will equal $p_2 - C_1 - C_2$, where C_1 and C_2 represent average incremental costs of inputs x_1 and x_2. p_a should then be set

$$p_a = C_1 + (p_2 - C_1 - C_2) = p_2 - C_2. \tag{1}$$

Notice that p_2 is exogenously set, implying that consumer welfare and allocative efficiency are not affected by p_a. The only problem is productive efficiency, which is, in effect, enhanced by his rule. In fact, facing this price for x_1 and incurring in an average incremental costs for x_3 of c, the entrant could survive only if

$$p_2 \geq p_a + c, \text{ i.e., } C_2 \geq c, \tag{2}$$

that is, if it could produce q_2 more efficiently than the incumbent.[3] Then, relatively inefficient producers would be kept out of the market.[4]

[3] A very similar result is obtained by Armstrong and Doyle (1994) in a model where there is ad-hoc regulation of final prices such that $p_2 > c_1 + c_2$ (some level of cross subsidization is allowed). Given this price, the regulator sets p_a in order to maximize welfare. It should be

Subsequent analysis of this problem has shown that the *ECPR* rule is optimal only in quite specific circumstances, and in particular if regulation of p_2 is non-optimal[5],[6]. In fact, in general, the access price, p_a, depends on several issues, namely, (i) on the type of regulation faced by the monopolist -welfare maximizing, *ad-hoc*, price-caps, rate of return regulation; (ii) on the markets that are effectively regulated -- only the monopoly or both outputs; (iii) on the number of firms that compete with the monopolist in the market for q_2 -- a competitive fringe, a single potential entrant, a small number of firms; (iv) on their behavior -- whether they are price-takers, competitive, Cournot; (v) on regulatory conditions faced by the competitors; (vi) on the degree of substitutability between the competitive outputs; (vii) on the existence or not of barriers to entry in the competitive market, like for instance fixed costs; (viii) on the existence of a break-even constraint for the monopolist; (ix) on the informational asymmetry between the regulator and the regulated firms; and, finally, (x) on the existence of the possibility of bypass and, in general, in the technological conditions of supply.

Some of these issues have been addressed in the literature, namely by Armstrong and Doyle (1994 and 1995), Economides and White (1995), Laffont and Tirole (1994), Armstrong and Vickers (1995) and Vickers (1995). Our purpose here is to present the already known main results and develop

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noticed that in Armstrong and Doyle the rule is specified in terms of marginal costs rather than incremental costs.

4 Economides and White (1995) have shown that competition by an inefficient producer may increase total welfare if the unregulated incumbent is practicing a monopoly price for output q_2 and the decrease in final prices brought about by competition more than compensates the degree of entrant inefficiency. The decrease in the final price depends upon the type of strategic interaction between suppliers: if it is Bertrand like, the probability that the decrease in final prices is large enough to offset production inefficiency is very large. Under Cournot-like competition the same possibility holds, although to a lesser extent.

5 Laffont and Tirole (1994) also argue that this rule is irrelevant: either (2) is satisfied and the incumbent should produce only q_1, in which case there is no p_a to set, or (2) is not satisfied and no access should be provided.

6 In practice, regulation of p_a often works in this two-stage way: in a first phase output prices are set and given these p_a is set subsequently.

previous studies to analyze some hypothesis which have not been considered before.

We shall base the following analysis on the model used by Armstrong and Doyle (1994). In their setting, it is assumed a fixed proportions technology, as in Baumol's model[7]. Prices charged by the incumbent are p_1, p_2 and p_a. The monopolist has an increasing returns to scale technology on the production of x_1 and faces a break-even constraint. Total costs of the entrant are denoted by C_E, with $C_E = C(q_3) + p_a\, q_3 + F$, where F can be zero or assume a positive value.

3. Optimal regulation

Suppose now that all regulated prices are set simultaneously by a welfare maximizing regulator. He has complete information about quantities and costs. Outputs q_2 and q_3 are seen by consumers as perfect substitutes. Hence p_3 equals p_2.

The single potential entrant, E, faces no fixed costs of entry; its cost function is $C(q_3)$ and to produce q_3 units of output it incurs a total cost of $CE = p_a\, q_3 + C(q_3)$, where p_a is the access price it must pay for input x_1. This entrant is assumed to be a price-taker[8].

The regulator chooses p_1, p_2 and p_a so as to maximize consumer surplus plus the incumbent's profit subject to the incumbent's break-even constraint, *i.e.*,

$$\max V(p_1, p_2) + \Pi_E + p_1 q_1 + p_2 q_2 + p_a q_3 - C(q_1 + q_2 + q_3; q_2) + \tag{3}$$

[7] Armstrong and Vickers (1995) study the optimal access price problem in a setting where there are input substitution possibilities and possibility of bypass, and show that these two hypothesis reduce the opportunity cost of entry and hence the optimal access price.

[8] In this section and the next we follow Armstrong and Doyle (1994) closely.

$$+\beta(p_1q_1+p_2q_2+p_aq_3-C(q_1+q_2+q_3;q_2))$$

where Π_E stands for the entrantís profit, *i.e.*,

$$\Pi_E=\max(p_2q_3-C(q_3)-p_aq_3)=\Pi_E(p_2-p_a) \tag{4}$$

Notice that the derivative of Π_E, $\Pi'_E\ (p_2 - p_a) = q_3\ (p_2 - p_a)$. Since Π_E is necessarily convex in $(p_2 - p_a)$, q_3 is an increasing function of $(p_2 - p_a)$. If one further assumes no income effects, and no cross-price effects between q_1 and q_2, then:

$$\partial V / \partial p_2 = -q_2(p_2), \tag{5}$$
$$\partial V / \partial p_1 = -q_1(p_1).$$

Setting Q_2, total market demand for competitive services, equal to $q_2 + q_3$ (admitting that $q_3 < Q_2$ for all reasonable prices) and substituting q_2 in expression (3), **the solution to the optimal regulation problem can be written as a set of Ramsey prices:**

$$(p_1^* - c_1)/p_1^* = k/\mu_1, \tag{6}$$

$$(p_2^* - c_1 - c_2)/p_2^* = k/\mu_2, \tag{7}$$

$$(p_2^* - p_a - c_2)/(p_2^* - p_a) = -k/\mu_3, \tag{8}$$

where Ci represents the marginal cost of output i, $CI = CI\ (q_1 + Q_t,\ Q_t - q_3(p_2 - p_a))$, k equals $\beta/1+\beta$, where β is the Lagrange multiplier of the break-even constraint, μ_1 and μ_2 are the elasticities of demand for outputs 1 and 2, and μ_3 is the entrant's elasticity of supply, $\dfrac{\partial q_3}{\partial(p_2-p_a)}\dfrac{(p_2-p_a)}{q_3}$.

Several features of this solution should be noticed. First, if the break-even constraint of the monopolist is not binding, $k = 0$, and the solution to the above problem implies that $p_1^* = C_1$, $p_2^* = C_1 + C_2$, and $p_a^* = C_1$, i.e, all prices should be set equal to marginal costs, the first-best solution. If $k > 1$, (due to increasing returns to scale in the production function of the incumbent firm), then $p_1{}^* > p_2{}^* - C_2$ or $p_a{}^* > C_1$. That is, the optimal access price is larger than the one implied by Baumol's rule, the reason being that the increase in p_a easens the break-even constraint of the incumbent.

Notice that, contrary to Baumol's work, the trade-off between productive and allocative efficiency is introduced in this analysis by the fact that access prices and the prices for the final output are set simultaneously.

The problem of optimal regulation of p_1, p_2 and p_a has also been addressed by Laffont and Tirole (1994), although in a slightly different setting. In particular, they assume that instead of one entrant there is a regulated **competitive fringe**. Also they allow for imperfect substitutability, an hypothesis that Armstrong and Doyle (1994) consider only in the framework of non-optimal regulation; this hypothesis, together with the fact that the competitive market is regulated, gives the regulator an additional regulatory instrument, p_3. **The incumbent** receives transfers from the regulator, so it **does not have to cover costs.**[9] The solution reappears as a set of Ramsey-type prices in p_1, p_2 and p_3. The hypothesis that the fringe is regulated (the same result holds if it is competitive) guarantees that the entrant's profits are led to zero, *ie*, that

$$p_a = p_3 - c. \tag{9}$$

Substituting p3 by its optimal value, one gets

$$p_a > C_1, \tag{10}$$

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[9] In the paper by Laffont and Tirole (1994) it is usually assumed that the incumbent receives transfers from the government and so does not face a break-even constraint. However it should be noticed that this transfer is financed out of taxes paid by consumers. Hence in the welfare-maximizing problem of the regulator, the break-even constraint of the monopolist reappears and leads to Ramsey type solutions. The only difference, relative to Armstrong and Doyle's analysis, is that now the multiplier is the shadow price of taxation, instead of being the incumbent's shadow price of the break-even constraint.

ie, p_a is greater than the direct marginal cost of access, with the difference decreasing in the elasticity of demand for good 2[10].

4. Imperfect substitutes

Now assume that the outputs produced in the downstream market are imperfect substitutes. In this case, the opportunity cost of a unit sold by the entrant is smaller than in the case of perfect substitutes. This problem was addressed by Armstrong and Doyle (1994). Once again, it is assumed that the incumbent is regulated in both markets, while the entrant is not[11],[12]. The two outputs of the incumbent firm are regulated, while the entrant's output is not; p_a is optimally set by the regulator, given p_1 and p_2; $q_3(p_3)$ is the demand for the entrant's output, given that the incumbent is charging p_2 for the competing output and $q_2(p_2)$ is the demand for the incumbent output when the entrant sells at p_3. Demand for output *1* depends only on price p_1.

The entrant maximizes profit, given p_a; it chooses p_3 so as to

$$max\ (p_3 - p_a).\ q_3(p_3) - C(q_3(p_3)) = \Pi_E(p_a) \tag{11}$$

The regulatorís problem is then to choose p_a in order to maximize welfare, given that p_1 and p_2 were previously fixed, *i.e*, p_a is chosen to

$$max\ V(p_3(p_a)) + \Pi_E + \Pi_I. \tag{12}$$

10 And increasing in the shadow price associated with the problem's break-even constraint.

11 Notice than when the two outputs are perfect substitutes and the regulator sets price p_2 the hypothesis that the entrant is not regulated is irrelevant: p_2 is the price at which it sells q_3, so in fact it is regulated although indirectly.

12 Optimal regulation with imperfect substitutability and an entrant with some market power is analyzed by Laffont and Tirole (1994) in an asymmetric information setting. To make the model manageable, the authors assume some specific properties of the cost functions which assure that optimal prices are independent of the incentive problems. Their conclusions are qualitatively similar to the ones in Armstrong and Doyle (1994).

Given p_a, the entrant sets p_3 according to (11). Consumer surplus is $V(p_3(p_a))$ and its derivative is $-q_3(p_3)$.

Total welfare is

$$W(p_a) = V(p_3(p_a)) + \Pi_E(p_a) + p_1 q_1 + p_2 q_2(p_3(p_a)) +$$

$$p_a q_3(p_3) - C_I(q_1 + q_2(p_3(p_a)), +q_3 (p_3(p_a), q_2(p_3(p_a)))$$

Differentiating (11) and denoting differentiation with respect to p_3 by primes, one gets

$$p_3(p_a{}^*) = C_1 + c + s(p_2 - C_1 - C_2), \tag{13}$$

which, together with condition (11), implies that

$$p_a{}^* = C_1 + s(p_2 - C_1 - C_2) + q_3/q'_3 \tag{14}$$

where $s = q_2'/q_3'$ measures the degree of substitutability between q_2 and q_3 while q_3/q'_3 is a proxy for the entrant's market power.

In general p_3 should then equal the direct marginal cost of q_3, plus a term (usually positive) which reflects the fact that the price of q_2 differs from its own marginal cost. $p_a{}^*$ equals the direct cost to the incumbent of providing access, plus the opportunity cost to I of providing a marginal unit of access to E, plus a term (always negative) that accounts for the entrantís market power. When the two outputs are close substitutes, s approaches 1 and $q'_3 = -\infty$ and expression (14) is equal to the Baumol rule presented before.

This model shows that, **implicit in the optimality of Baumol´s rule** are: (i) the hypothesis that p_1 and p_2 are not set optimally; (ii) the hypothesis that q_2 and q_3 are perfect substitutes and (iii) the hypothesis that the entrant does not have any market power.

5. Barriers to entry in the competitive market: Fixed costs of entry

Armstrong and Doyle (1994) point out that even when p_a is set at marginal cost there are still a number of factors that may deter entry in the downstream market (advertising costs, consumer inertia, not to mention the quality of access that is controlled by the incumbent). This fact alone calls for the possibility of the existence of welfare gains from entry subsidization, i.e., from setting access price lower than the direct marginal cost of entry. Suppose then that the cost function of the entrant is now $C_E = C(q_3) + F$, with $F>0$.

Given p_a, the firm will choose to enter only if $\Pi_E(p_a) \geq F$. Then, as Π is decreasing in p_a, there is a threshold level p_a^* that makes entry profitable. However, for levels of p_a lower than this threshold, entry, although privately unprofitable, may still be welfare increasing. If consumers value diversity enough it may be useful to subsidize entry.

However, this will never happen when the two goods are perfect substitutes, since then welfare will not increase as a result of entry (because p_2 is fixed by the regulator). Then, if the incumbent has increasing returns to scale on the production of q_2, entry should never be subsidized.

6. Optimal regulation with asymmetric information

The problem of the optimal regulation of p_a in face of asymmetric information has been addressed by Laffont and Tirole (1994) and by Vickers (1995), in the context of the analysis of the virtues and pitfalls of vertical integration versus separation. Laffont and Tirole assume that the industry is vertically integrated and that there is a competitive fringe producing an imperfect substitute of q_2, q_3. The incumbent receives transfers from the regulator, so it does not have to cover costs. Further, they assume that the regulator observes separately C_1 and C_2. Optimal prices are, once again, Ramsey-type, but now corrected by "incentive correction terms". The impact of these additional terms on the optimal level of p_a is ambiguous and depends on fine characteristics of the cost functions.[13]

7. Access pricing and the possibility of bypass

When the entrant has the possibility to obtain all or part of input x_1 elsewhere, then the existence of high access prices to cover the fixed cost of the network and alleviate the budget constraint of the regulator may induce inefficient bypass. The technological possibility of bypass calls for values of the access charge lower than the ones which are optimal when bypass is impossible. In other words, bypass reduces the opportunity cost of entry from the incumbent's point of vue. Laffont and Tirole (1994) address this problem and suggest that, when bypass is feasible, the fixed costs of the network should be financed through taxes levied on the output of the incumbent.

The implications for p_a of the possibility of bypass was also considered by Armstrong and Vickers (1995). They also reach the conclusion that p_a should be lower when bypass is feasible.

8. Vertical integration under Cournot competition

In this section we depart from the work of Armstrong and Doyle (1994) and Vickers (1995) and build a model where the entrant is not taken as a price taker -- as in Armstrong and Doyle (1994) -- and where the number of players in the downstream market is not endogenous -- as in Vickers (1995)[14]. The model

[13] To be able to reach unambiguous conclusions they assume that the cost functions observe (i) dichotomy and (ii) sub-cost observability. With these two properties imposed, optimal prices are independent of incentive problems.

[14] Hence, profits in the downstream market are not driven to zero.

intends to be a representation of the cellular telecommunications market in many European countries where there is a vertical integration of the fixed-link monopolist provider and one of the cellular firms operating in the cellular market. This is usually organized as a legal duopoly, in which the vertically operated firm competes with a non-integrated private competitor.

It is considered a two stage game in which it is assumed that, in a first stage, both the monopolist firm and the entrant act as Cournot players in the downstream market. The equilibrium for this stage defines a pair of quantities, q_1 and q_2 and the corresponding price levels p_2 and p_3, all parametric on the access charge, p_a. This and the price for q_1 are set by a welfare maximizing regulator. That is, price regulation affects only the price of the monopolized output and the bottleneck facility.

The Cournot game in the downstream market (henceforth, second market) is represented by:

$$\Pi_I = \max \Pi_I^{'} = p_1 q_q + p_2 q_2 + p_a q_3 - c_1(q_1 + q_2 + q_3) - c_2 q_2$$

and,

$$\Pi_E = \max_{q_3} \Pi_E^{'} = p_2 q_3 - p_a q_3 - c q_3 .$$

The first order conditions for this problem can be written as

$$\begin{aligned} p_2(1+\frac{\alpha}{\eta}) &= c_1 + c_2 \\ p_2(1+\frac{1-\alpha}{\eta}) &= p_a + c, \end{aligned} \tag{15}$$

where α is the market share of the incumbent firm in the second market, $q_2/(q_2 + q_3)$, and η the elasticity of demand for "trunk services". The equilibrium value of α is given by $\alpha = -\eta + (1+2\eta)\beta$. $\beta = (c_1 + c_2)/(c_1 + c_2 + p_a + c)$ is a proxy for the relative incumbent efficiency, given by p_a. We also assume that $\eta < -1$ and that the demands are iso-elastic.

From (15) and the expression for α, we can write:

$$\begin{aligned}&\frac{p_2-(c_1+c_2)}{p_2}=-\frac{\alpha}{\eta},\text{ and}\\&\frac{p_2-(p_a+c)}{p_2}=-\frac{1-\alpha}{\eta}.\end{aligned}\tag{16}$$

Let p_a^{max} denote the maximum value of p_a so that the entrant does not exit the downstream market, and p_a^{min} denote the lowest access charge so that the incumbent does not exit the downstream market. p_a^{max} and p_a^{min} are given by:

$$p_a^{\max}=(c_1+c_2)\frac{\eta}{1+\eta}\text{ and }p_a^{\min}=(c_1+c_2)\frac{1+\eta}{\eta}.$$

Of course, when $\alpha < 1$, $\beta > (1+\eta)/(1+2\eta)$ and $p_a < p_a^{max}$, with both firms operating in the downstream market. When $\alpha > 0$, $\beta < 1/(1+2\eta)$ and $p_a > p_a^{min}$. Notice that when $\eta \to -\infty$, $p_a^{max} = p_a^{min}$, that is, there is a unique value of p_a that retains both players in the downstream market. When $\eta = -1$ any reasonable access charge keeps both players in the downstream market. Define $|\eta+|$ *as* $(c_1 + c_2)/(c_1 + c_2 - c)$. Then, if $|\eta| < |\eta+|$, the incumbent firm is never excluded, *i.e.*, when the demand elasticity is low enough the vertically integrated player always remains in the downstream market, however low the access charge may be.

Given the equilibrium in the second market represented by (16) the regulator sets p_1 and p_a so as to maximize welfare subject to the incumbent's break even constraint, *i.e.*,

$$\begin{aligned}&\max_{p_1,p_a}\ W=V(p_1,p_2)+\Pi_I+\Pi_E\\&\text{subject to }\Pi_I\geq 0.\end{aligned}\tag{17}$$

The first order condition with respect to p_1 yields,

$$\frac{p_1 - c_1}{p_1} = -\frac{\lambda}{1+\lambda}\frac{1}{\varepsilon_1} = -\frac{k}{\varepsilon_1}, \tag{18}$$

where λ is the Lagrange multiplier associated with the restriction in (17) and ε_1 is the price elasticity of the demand faced by the incumbent in the upstream market. Define $\varepsilon_a = \partial q_3/\partial p_a.(p_a/(q_2+q_3))$. From the FOC of problem (17) we have that:

$$\frac{p_a - c_1}{p_a}.F(\beta(p_a)) = \frac{-k}{\varepsilon_a}, \text{ with } F(b(p_a^{\max}) = 0. \tag{19}$$

Hence, the access price will always be set such that $c_1 \leq p_a < p_a^{max}$, and the entrant will never exit the cellular market. Of course, if the restriction is not binding, $p_a = c_1$.

9. Conclusions

We have considered an industry where production in the downstream market requires the use of an input which is monopolistically produced. In this setting we have raised two main questions : (i) how to set the access price for an entrant in the downstream market, in an optimal regulation framework, and (ii) whether the monopolist supplier of the bottleneck facility should be allowed to operate in the second market in competition with other suppliers.

When the price of the output in the downstream market is fixed -- either because it is regulated prior to the decision concerning the price of the input, or because there is perfect contestability in this market -- then, the optimal second best level for the access price -- given the price of the output -- does not influence consumer welfare. It only affects productive efficiency. The optimal level is given by a "Baumol-type" rule: the price for access should reflect the direct marginal cost of access plus its opportunity cost.

Recent departures from Baumol's original framework have shown that the entrant's opportunity cost depends upon several characteristics of both he supply and demand conditions prevailing in the market: imperfect substitution between the incumbent and the entrant's outputs, the exertion of some degree of market power by the entrant, the feasibility of bypass, variable coefficients technology in the production of the downstream output, all contribute to decrease the "opportunity cost" of entry and hence the optimal level of the access charge. Notice, however, that the optimal access charge remains above its marginal cost, the exception being some extreme cases in any of the above conditions.

When the price of the downstream output is not fixed ex ante -- either because it is unregulated and competition is not perfect or because it is regulated simultaneously with the access price -- the level chosen for the access charge has both productive and allocative effects: an increase in the price of access allows the downstream output price to decrease. The result of this trade-off is captured in a Ramsey-type pricing structure.

The question of whether the incumbent monopolist should be allowed -- as happens in the mobile telephony markets in many European countries -- or not -- as in the US for long-distance telecommunications -- to operate in the downstream market was also considered, although in a very preliminary way. The incentives for the incumbent to distort competition in the downstream market are fairly clear and, in most scenarios, this possibility should not be ruled out. Hence, if some degree of competition is doomed desirable in this market -- because of the welfare enhancing effects of diversity when the outputs are not perfect substitutes or because of the decrease in final prices brought about by competition more than compensates the double marginalization effect -- the upstream integration of one of the downstream competitors may be undesirable. However, disintegration may turn out to be harmful, namely if interconnection is not guaranteed or when it implies the duplication of bottleneck facilities.

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