Strategic Bypass Deterrence

Francis Bloch*and Axel Gautier†

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Abstract

In liberalized network industries, entrants can either compete for service using the existing infrastructure (access) or deploy their own infrastructure capacity (bypass). In this paper, we demonstrate that, under the threat of bypass, the access price set by an unregulated and vertically integrated incumbent is compatible with productive efficiency. This means that the entrant bypasses the existing infrastructure only if it can produces the network input more efficiently. The incumbent lowers the access price compared to the ex-post efficient level to strategically deter inefficient bypass by the entrant. Accordingly, from a productive efficiency point of view, there is no need to regulate access prices when the entrant has the option to bypass. Despite that, we show that restricting the possibilities of access might be profitable for consumers.

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*Ecole Polytechnique

†CREPP, HEC-Université de Liège, Bat B31, Boulevard du Rectorat 7, 4000 Liège, Belgium, and CORE. E-mail: agautier@ulg.ac.be, Tel: +32-4-366.30.53.

1 Introduction

In liberalized network industries, competitors of the historical operator have the choice between two modes of competition: service-based and facility-based competition. In the former case, competing firms offer retail products and services using the incumbent's installed infrastructure for which they pay an access fee (the 'buy' or the 'access' option). In the later case, firms develop their own infrastructure to compete on the retail market (the 'make' or the 'bypass' option).

Then, it is of prime importance to know whether the most efficient mode of competition ultimately emerges in a liberalized market. Or, to put it differently, whether the lease price for the infrastructure, the so-called access price, is set at the efficient level i.e. at the level that induces efficient technological choices and/or welfare maximizing choices by incoming firms. This question has received a lot of attention in the literature both from a static and a dynamic point of view.

In dynamic models, facility-based competition is often considered as a long-term objective. The question then is to know whether allowing for service-based competition accelerates the development of facility based competition (the so-called step-stone effect identified by Cave and Vogelsang, 2003) or delays the installation of new infrastructure (Bourreau and Doğan, 2005). For Cave and Vogelsang (2003), service-based competition allows new comers in the industry to invest progressively in their own infrastructure, first in replicable assets (e.g. long-distance conveyance facility) then in less replicable ones (e.g. local loop). When there are ladders of investment, leasing part of the existing infrastructure is then essential for the development of facility-based competition. Accordingly, a low access price accelerates the deployment of alternative infrastructures. For Bourreau and Doğan (2005), allowing for access delays investment in competing infrastructures because the cost of a new infrastructure includes an opportunity cost equals to the profit realized under service-based competition (an effect that is similar to the replacement effect in innovation races). Following that, a lower access price increases the opportunity cost of bypass and should delay further infrastructure building.[1]

[1]In an international study using a sample of OECD countries, Bouckaert *et. al* (2010) do not find support for the ladder of investment theory. They found that a more important market share of service-based competitors on the DSL platforms is associated with lower rates of broadband penetration. Accordingly, mandatory access to the incumbent DSL

In a static setting, Sappington (2005) demonstrates the irrelevance of the access price for the choice between service- and facility-based competition and he shows that the most efficient mode of competition always emerge in an unregulated market. The entrant develops its own infrastructure only if it can provide the network input more efficiently than the incumbent. Sappington's argument is constructed using an Hoteling model with a fully-covered market. Gayle and Weisman (2007) demonstrates that, in more general setting, the access price matters for the choice of a mode of competition. Thereby, setting the access price appropriately is of prime importance to induce efficient technological choices. Mandy (2009) demonstrates that productive efficiency can be achieved by pricing access at the *entrant's* marginal cost. With such a price, the entrant bypass the incumbent's network only when it is more cost effective.

Our work is directly connected to the three above mentioned paper. We consider, as in Gayle and Weisman (2007), models where the access price is relevant for the choice between access and bypass, namely price competition with differentiated products and Cournot competition. In these set-ups, we analyze, as Sappington (2005) the question of productive efficiency or, differently, whether the access prices identified by Mandy (2009) emerge from an unregulated market scenario. Our conclusion is that productive efficiency is achieved in these markets. More precisely, under the threat of bypass, the incumbent strategically sets the access price below the ex-post optimal level to deter bypass by the entrant. By doing so, it induces an efficient make-or-buy choice by the entrant, and, consequently, from a productive efficiency point of view, there is no need to regulate the wholesale price.

Depending on the relative network costs of the incumbent and the entrant, we identify three possible competition regime: accommodated bypass, deterred bypass (constrained access) and access (blocked bypass).[2] When the entrant is less cost effective than the incumbent, the access price set by the incumbent is such that bypass is not the most profitable option for the entrant. When the incumbent's cost advantage is large, the incumbent can set the ex-post optimal access price, that is the price that would be applied in the absence of the threat of bypass. This corresponds to the blocked bypass regime where the possibility of bypass by the entrant has no influence on neither the retail nor the access prices. When the incumbent's cost advan-

networks negatively affect the incentives to invest in alternative broadband networks.

[2]Bloch and Gautier (2008).

tage is not high enough, the incumbent must lower the access price below the optimal level to deter bypass by the entrant. In this deterred bypass regime, the incumbent lowers the access price to prevent (inefficient) bypass by the entrant, with consequences, lower prices on the retail market compared to the blocked bypass regime. Notice that, in price competition models, the optimal access price is set above the entrant's marginal cost. Finally, when the entrant is more cost effective than the incumbent, deterring bypass turns out to be too costly and bypass is allowed (accommodated bypass). Notice the analogy between our model and entry deterrence games. In both case, the incumbent player strategically reduces its price in order to deter undesirable behavior from the competitor, entry in the entry deterrence game, bypass in our case.

We show that from a productive efficiency point of view, there is no need to regulate the access price. But, there is still room for regulation in this market. The access price is set above the marginal cost. Moreover, competition under access is smoother than under bypass (Sappington, 2005). For these reasons, allowing for access may not be the consumer's preferred option despite its lower cost of providing the service. Indeed, we show that restricting the possibilities of access may be welfare improving despite the fact that it may inefficient bypass. Or differently, a regulator may wish to increase the access price above the level set by an unregulated infrastructure owner in order to favor inefficient bypass but lower retail prices.

The paper is organized as follows. In sections 2 and 3, we develop our main results using the price competition model with differentiated products. Section 4 looks at market regulation and section 5 concludes. The results for the Cournot competition game are developed in the Appendix.

2 The model

We consider a model of price competition between two firms: a vertically integrated incumbent, hereafter firm 1, and a competitor, firm 2. To produce for the retail market, firms need a network input. Firm 1 has an installed network and it can produce one unit of network input at unit cost c_1. Firm 2 has no installed network. To produce, it has two options: *access* or *bypass*. The entrant either buys access to the the firm 1's network at unit price w or it installs its own network infrastructure and produces the network input at unit cost c_2. The quality of the good produced by firm 2 is independent of the technology chosen to produce it. Without loss of generality, we assume that all other costs are normalized to zero.

In the retail market, the demand for product supplied by firm $i = 1, 2$ at prices (p_i, p_j) is given by $x_i(p_i, p_j)$. Products are differentiated, the demand functions have standard properties and products are demand substitute.

When firm 2 chooses the access option, the incumbent sells two products: the retail good 1 at price p_1 and access to its network at price w. Both goods are produced at unit cost c_1 and the firms' profit in the access regime ('subscript a') are given by

$$\pi_1^a(p_1, p_2, w) = (p_1 - c_1)x_1 + (w - c_1)x_2 \quad (1)$$
$$\pi_2^a(p_1, p_2, w) = (p_2 - w)x_2 \quad (2)$$

When firm 2 chooses the bypass option ('subscript b'), each firm is a single product firm and the profits are

$$\pi_1^b(p_1, p_2) = (p_1 - c_1)x_1 \quad (3)$$
$$\pi_2^b(p_1, p_2) = (p_2 - c_2)x_2 \quad (4)$$

The entrant chooses between infrastructure-based competition (bypass) and service-based competition (access) after the incumbent firm has set the access price to its network, a standard framework (Sappington, 2005; Gayle and Weisman, 2007; Mandy, 2009). Then firms simultaneously name prices p_1 and p_2. To summarize, the the timing of the game is as follows:

1. Firm 1 sets the access price w,
2. Firm 2 decides to buy access or to bypass the existing infrastructure,
3. Firms compete in price.

3 Results

3.1 Price competition in the access regime

Suppose that the entrant has chosen to buy access at price w. At the price competition stage, firms' behavior is represented by the following best reply functions.

$$\phi_1^a(p_2) \equiv \underset{p_1}{\operatorname{argmax}}\, \pi_1^a(p_1, p_2, w) \tag{5}$$

$$\phi_2^a(p_1) \equiv \underset{p_2}{\operatorname{argmax}}\, \pi_2^a(p_1, p_2, w) \tag{6}$$

These functions are continuous and increasing (strategic complementarity).

Equilibrium prices in the access regime, denoted hereafter $(\hat{p}_1^a, \hat{p}_2^a)$, are the solution of $\langle \hat{p}_1^a = \phi_1^a(\hat{p}_2^a),\, \hat{p}_2^a = \phi_2^a(\hat{p}_1^a)\rangle$. Assume that this system admits a unique solution. Plugging the equilibrium price in the profit functions (1) and (2), we have the equilibrium profits in the access regime. To simplify notations, we denote $\hat{\pi}_i^a(w) = \pi_i^a(\hat{p}_1^a, \hat{p}_2^a, w)$. It is straightforward to show that $d\hat{\pi}_2^a(w)/dw < 0$, that is a higher wholesale price reduces the profit of the entrant should it choose the access option.

3.2 Price competition in the bypass regime

Suppose that the entrant has chosen to have its own infrastructure. Best reply functions in the bypass regime are defined as:

$$\phi_1^b(p_2) \equiv \underset{p_1}{\operatorname{argmax}}\, \pi_1^b(p_1, p_2) \tag{7}$$

$$\phi_2^b(p_1) \equiv \underset{p_2}{\operatorname{argmax}}\, \pi_2^b(p_1, p_2) \tag{8}$$

Equilibrium prices under bypass $(\hat{p}_1^b, \hat{p}_2^b)$ are the unique solution of $\langle \hat{p}_1^b = \phi_1^b(\hat{p}_2^b),\, \hat{p}_2^b = \phi_2^b(\hat{p}_1^b)\rangle$ and equilibrium profits under bypass are denoted $\hat{\pi}_i^b = \pi_i^b(\hat{p}_1^b, \hat{p}_2^b)$.

3.3 Access vs. bypass

The 'make-or-buy' decision made by firm 2 depends on the comparison between the profits under access $\hat{\pi}_2^a(w)$ and bypass $\hat{\pi}_2^b$. Firm 2 obviously chooses the production technology that leads to the highest profit and this choice is driven by two elements: (1) the wholesale price level relative to the production cost c_2 and (2) the intensity of competition on the retail market. As shown by Sappington (2005), the nature of competition on the retail market changes when the entrant buys the network input rather than producing it. Indeed, under access, when the incumbent reduces its retail price p_1, it partially cannibalizes the demand for its other product, access to the network. At the margin, reducing the retail price p_1 has thus, in addition to the physical cost of expanding output $-c_1 dx_1/dp_1$, an opportunity cost equals to $(w - c_1)dx_2/dp_1$, that is the lost profit on the access market.[3] Consequently, if the incumbent realizes a positive margin on the access product ($w > c_1$), it will be smoother at the price setting stage. Conversely, should the access price be set below the incumbent's cost c_1, the incumbent will be more aggressive in the price game. Formally we have $\phi_1^a(p_2) > \phi_1^b(p_2)$ if $w > c_1$ and $\phi_1^a(p_2) < \phi_1^b(p_2)$ if $w < c_1$. Thus, the entrant's make-or-buy choice is not only driven by the cost/price of the two alternative technologies. The following lemma describes the optimal choice made by the entrant.

Lemma 1 *(i) There exists a wholesale price level $\tilde{w}$ such that if $w \leq \tilde{w}$, the entrant prefers access to bypass and if $w > \tilde{w}$, the entrant prefers bypass to access. (ii) If $c_1 < (>)c_2$, then $\tilde{w} > (<)c_2$.*

Proof: The proof is based on Mandy (2009, proposition 1) and the fact that $\hat{\pi}_2^a(w)$ is decreasing in w.

1. Consider $c_1 < c_2$. If $w = c_2$, we have $\phi_2^a(p_1) = \phi_2^b(p_1)$ and $\phi_1^a(p_2) > \phi_1^b(p_2)$ since $w > c_1$. Therefore $\hat{\pi}_2^a(c_2) > \hat{\pi}_2^b$.

2. Consider $c_1 > c_2$. If $w = c_2$, we have $\phi_2^a(p_1) = \phi_2^b(p_1)$ and $\phi_1^a(p_2) < \phi_1^b(p_2)$ and therefore $\hat{\pi}_2^a(c_2) < \hat{\pi}_2^b$.

3. $\hat{\pi}_2^a(w)$ is decreasing in w.

Combining 1, 2 and 3, we have the proof. ∎

Lemma 1 establishes that there exists a cut-off level for the wholesale price such that, for higher values, the entrant prefers to have its own network, while for a lower value, it prefers to access the existing one. Interestingly, this cut-off level is above the entrant's own production cost c_2 when the incumbent is more cost effective. This implies that the entrant may not necessarily choose the cheapest option.[4] Indeed, for $w \in (c_2, \tilde{w}]$, the entrant chooses to buy

[3] In the Hoteling case with a fully covered market (Sappington, 2005), the sum of the physical cost c_1 and the opportunity cost $(w - c_1)$ of decreasing p_1 is equal to w. Consequently, under access, the two firms compete as if they have an identical cost w and the profit of the entrant are independent of w (irrelevance of input price). Therefore, the entrant will choose to bypass only if it can benefit from a relative cost advantage, that is if $c_2 < c_1$.

[4] This is in contrast with models of Cournot competition on the retail market (Gayle and Weisman, 2007) or perfectly competitive entrant (Bloch and Gautier, 2008) where the entrant chooses the cheapest technology: access if $w \leq c_2$ and bypass otherwise.

access while bypass is cheaper. This pattern is explained by the fact that retail competition in the access regime is softer than under bypass. And, as long as w is smaller than $\tilde{w}$, the softening of competition effect dominates the higher cost effect.

3.4 Setting the wholesale price

We now analyze the first stage of the game where the incumbent sets the wholesale price w. We first establish that the technological choice induced by the incumbent are efficient (proposition 1) before fully describing the wholesale price (proposition 2).

We start by establishing that:

Lemma 2 *(i) If $c_1 > c_2$, $\nexists w$ such that $\hat{\pi}_1^a(w) \geq \hat{\pi}_1^b$ and $\hat{\pi}_2^a(w) \geq \hat{\pi}_2^b$. (iia) If $c_1 < c_2$, $\nexists w$ such that $\hat{\pi}_1^b \geq \hat{\pi}_1^a(w)$ and $\hat{\pi}_2^b \geq \hat{\pi}_2^a(w)$. (iib) If $c_1 < c_2$, $\exists w$ such that $\hat{\pi}_1^a(w) \geq \hat{\pi}_1^b$ and $\hat{\pi}_2^a(w) \geq \hat{\pi}_2^b$.*

Proof: (i) From Lemma 1: access is preferred by the entrant if $w \leq \tilde{w} < c_1$. But with such an access price, the incumbent is making losses on the access product and strictly prefer bypass i.e. to increase the wholesale price above $\tilde{w}$. (iia) To induce bypass, the access price must satisfy $w > \tilde{w} > c_2$. But, for any $w \geq c_2$, the incumbent strictly prefers access. (iib) For instance $w = c_2$. ■

From lemma 2, it directly follows that:

Proposition 1 *The market induces a technologically efficient make-or-buy choice by the entrant: access when $c_1 \leq c_2$ and bypass when $c_2 < c_1$.*

Under the threat of bypass, unregulated wholesale markets induce technologically efficient choices. The entrant buys the network input only when it cannot produce it at a lower cost than the incumbent. This result generalizes the main result of Sappington (2005, proposition 1). In the Hoteling model considered by Sappington, the wholesale price is irrelevant for the make-or-buy decision and the entrant chooses the least costly alternative. In our more general set-up, input price matters for the make-or-buy decision (lemma 1) but the incumbent chooses an input price level that is compatible with productive efficiency. In other words, the market selects a wholesale price in the set of efficient prices identified by Mandy (2009). Unregulated markets lead to productive efficiency and there is no need to regulate the access price level to induce efficient technological choice by the entrant.

Using proposition 1, the optimal access price is the solution of

1. For $c_2 < c_1$, $max_w \hat{\pi}_1^b$ subject to $w > \tilde{w}$.
2. For $c_1 \leq c_2$, $max_w \hat{\pi}_1^a(w)$ subject to $w \leq \tilde{w}$.

Proposition 2 *The optimal access price satisfies:*

- $w > \tilde{w}$ *for* $c_2 < c_1$
- $w = \tilde{w}$ *for* $c_1 < c_2 \leq \tilde{c}_2$
- $w = w^*$ *for* $c_1 < c_2$ *and* $c_2 > \tilde{c}_2$

where $w*$ is given by $w^* \equiv \text{argmax}_w \hat{\pi}_1^a$ i.e. w^* is the price that would prevail on the market in the absence of the bypass possibility and $\tilde{c}_2$ is the solution of $\tilde{w} = w^*$.

From Proposition 2, we can identify three competition regimes. When $c_2 \geq c_1$, access is technological choice made by the entrant and it is efficient that it does so. When the entrant has a relatively high cost ($c_2 \geq \tilde{c}_2$), the threat of bypass is ineffective and the incumbent sets the access price at the profit-maximizing level.[5] We refer to this regime as the access or blocked bypass regime. With a cost $c_2 \in [c_1, \tilde{c}_2]$, at the ex-post efficient wholesale price w^*, that is independent of c_2, the entrant would find it profitable to bypass the incumbent's network. Therefore, to deter bypass (and from the incumbent's point of view it is efficient to do so, see lemma 2), the incumbent must lower the access price below w^*. With, as a consequence, a more intense competition on the retail market. The access price is set at the bypass deterring level $\tilde{w}$ and this price decreases with c_2.[6] As the access price is sub-optimal to deter bypass, we refer to this parameter space as the constrained access or deterred bypass regime. Like in the entry deterrence games, the incumbent reduces its price (here the wholesale price) to shape the entrant's behavior (here to deter bypass). The particularity of this competition regime is that the access price is sub-optimal. That is, once the entrant has decided not to bypass, the incumbent has incentives (or would like to or increases its

[5]Note that if products are not sufficiently differentiated, this level may foreclose the downstream retail market (reference).

[6]Notice that most of the papers that consider access vs. bypass decision by incoming firms neglect this possibility of sub-optimal access price that effectively deter bypass by the entrant.

profit) to raise the access price above $\tilde{w}$. Finally, when $c_2 < c_1$, bypass is productive efficient and bypass emerges at the optimal access price. We call this regime *accommodated bypass*.

4 Regulation

From a productive efficiency point of view, there is no need to regulate the wholesale price level. However there is potentially a conflict between productive and allocative efficiency. Productive efficiency is achieved in an unregulated market but it is possible to increase allocative efficiency. For that, there are two possibilities: a regulation of the access price level, to stimulate competition at the retail level or to change the conditions under which access is allowed.

In fact, there are parameters for which access is productive efficient but consumers would prefer bypass because competition is more intense. In other words, the lower competition effect dominates the higher cost effect. Thus retail prices are higher under access despite lower cost. Consider for instance an entrant that is slightly less efficient than the incumbent: $c_2 = c_1 + \epsilon$. The access price $\tilde{w}$ is such that (i) $\tilde{w} > c_2$ and (ii) access is the entrant's preferred option. But this means that at the price competition stage, retail prices will be higher compared to the bypass case because (i) the entrant has a higher marginal cost and (ii) the incumbent is softer when the entrant uses the existing infrastructure to compete on the retail markets. We thus have

Proposition 3 *Restricting the possibilities of access benefits to consumers when* $c_2 \in [c_1, \hat{c}_2]$.

Unregulated markets induce efficient technological choices but, for a consumer's point of view, lower production cost is not associated with lower retail prices. Restricting the possibility of third-party access to the infrastructure leads to higher production cost but lower retail prices for consumers. Generous access conditions may thus hurt both allocative and dynamic efficiency (Bourreau and Doğan, 2005).

5 Concluding remarks

Building on the following results:

- Competition is softer under access because there is an opportunity cost of decreasing the retail price that corresponds to the profits lost on the access product (Sappington, 2005).
- In most of the models of oligopoly competition, the access price matters for the make or buy decision (Gayle and Weisman, 2007).
- There exist a range of access price that induce an efficient make-or-buy choice by the entrant (Mandy, 2009).

We establish that

- Unregulated markets lead to wholesale price in the range identified by Mandy. Thus the entrant always chooses the most efficient option to compete.
- Restricting the possibility of access might be welfare improving despite the induced productive inefficiency.

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