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ANTITRUST AND REGULATION, COMPLEMENTS OR SUBSTITUTES? THE CASE OF A VERTICALLY INTEGRATED FIRM

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This paper studies the interaction between regulation and antitrust. We consider a situation where an incumbent provides access to an essential facility and competes downstream with an entrant such that the anticompetitive danger is twofold. First, abusive access charges reduce the benefits of competition and second the incumbent may engage in predatory pricing or "margin squeeze". We show that access regulation and antitrust are complementary instruments, i.e. tighter exante regulation that tends to fix lower access charge demands ex-post more antitrust monitoring aimed to deter predation.

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Competition Policy, Predation, Essential Facility, Access Charge.

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1 Introduction

The great benefit of the deregulation of network industries is the introduction of competition in services that were traditionally provided by regulated monopolists Replacing regulation by competition improves allocative efficiency, provides better incentives to reduce costs, increases consumer choice and at the same time reduces the scope for remaining regulatory failures. However, competition in all the stages is not always feasible and some segments stay natural monopolies. For potential entrants, the access to these essential inputs is crucial to compete in the unregulated segments. Additionally, the participation of the owner of the essential facility in the downstream market raises fears about anticompetitive practices in that unregulated segment. The vertically integrated firm or incumbent may obstruct competition in several ways such as discriminating the entrants in the access to the input, degrading quality, applying predatory prices, etc[1]. Hence, deregulation still requires some regulatory control from public authorities although the type of intervention changes. The traditional regulation that fixes final prices evolves to a more complex scenario where regulation focuses on the access to the essential input and antitrust institutions must deal with potential abuses from the vertically integrated firm in the downstream market.

One of the main issues that authorities have to solve, at the moment of liberalizing an industry, is how much should they count on regulation and how much on antitrust to make deregulation work. Defining the appropriate scope for each of these two policy instruments and understanding the relationship between them is a relevant question still without an extensive treatment in the literature.

In this article we attempt to capture the interaction between regulation and antitrust in the case just described, where a vertically integrated firm (the incumbent) owns a bottleneck input, sells access to downstream firms (the entrants) and competes with them in that segment of the market. In this market configuration, the concerns of the authorities are twofold. First, if the access charge to the essential input is set well above costs, it will leave rents to the incumbent and will be harmful to consumers. Second, the incumbent may try to monopolize the downstream market by engaging in predation, thus driving out financially weak but efficient downstream competitors. In other words, the incumbent may capture industry rents either upstream, due to imperfect access regulation, or downstream, due to weak antitrust enforcement.

[1] Brennan (1987) provides examples of potential anticompetitive actions in the telecommunication market. A more recent summary of this literature is found in Mandy (2000).

Two cases of abusive pricing, recently ruled by the European Commission (2003), are representative of the situation we want to describe: Deutsche Telekom (DT) and Wanadoo (The internet provider of France Telecom). The Commission found that DT applied an unlawful pricing scheme, since it was charging to intermediate users (internet providers) higher wholesale prices than some of the final consumers of DT had to pay for the service. Thus, competitors of DT´s internet branch had negative margins even if they were as efficient downstream as the DT subsidiary. In the second case, Wanadoo was charging a price below variable cost for a limited period of time in the ADSL internet service. The commission fined both companies on the basis of a margin squeeze test that was computed using predator's downstream costs. After the Commission solved the case, the firms were forced to end the abusive pricing strategies.

In the above cases, it is not clear whether the problem of abusive pricing was caused by imperfect regulation, poor antitrust enforcement or both[2]. For instance, the regulated services of DT operate under a basket price cap, which give the firm some degree of freedom to adjust prices in response to competitive pressures. Thus, the operator can rebalance its tariffs, increasing the access charge while lowering other prices. The structure and level of prices are approved or rejected by the German regulator upon the proposal of DT. On the other hand, the existence of a negative margin for a long period of time -three years- raises reasonable doubts about how persuasive the enforcement against predation was.[3]

In our model, there are two institutions, one is the regulator who sets the access charge and the other is the competition authority (CA) who is in charge of the detection and sanction of predatory prices in the downstream market. Hence, the question addressed in this paper is whether a softer regulatory regime will require more or less antitrust enforcement Each agency selects its own policy instrument ex-ante, without knowing how efficient the entrant is. The efficiency of the entrant is relevant because a more efficient firm -other things being equal- is better able to endure the predatory attack since the incumbent has to sacrifice more current profits in order to remove it from the market. From an ex-ante perspective, the choice of the instruments

[2]The way the Commission restored competitive conditions in these markets is a sign that the problem was somehow on both sides. The German incumbent, DT, had to reduce the access charges up to 20 %, additionally DT increased retail prices by 10 %. In the case of Wanadoo, the firm was forced to decrease the access charge to competitors by 30 %.

[3]As stated in the EC Competition newsletter (Autumn 2003) *Such negative spread constitutes a clear case of margin squeeze without any cost element to be taken into consideration.*

affects the likelihood of predation by moving the efficiency threshold below which predation is not feasible. Thus, a higher access charge reduces the incentives of the incumbent to predate (lowering the efficiency threshold) since selling upstream access looks more desirable than capturing the downstream market. At the same time, increasing monitoring effort makes predation more costly for the incumbent which also enlarge the range of efficiency where an entrant is able to resist predation.

Nevertheless, decreasing the likelihood of predation is not free for the agencies and there is a trade-off involved in the choice of each policy instrument. Moving up the access charge increases downstream prices, which is detrimental for consumers. Increasing antitrust effort is costly because it demands additional resources and also because it increases the downstream price when the entrant is efficient enough to resist predation without the help of the antitrust action.

The main result of this article is that regulatory and antitrust activities are complementary. A regulatory regime that is tough in reducing the access charge will demand a stricter antitrust monitoring of the downstream market, and vice-versa. This result is based on two effects that work in the same direction; one related with allocative efficiency and the other with productive efficiency. First, consumers gain more from competition in the downstream market when the access charge is lower. Under competition, the access charge is passed to consumers through the final price. Hence, conditional on entry, a lower access charge implies lower prices and higher consumers gains. Therefore, the CA has more incentives to deter predation when the consumer surplus at stake is bigger. Analogously, the gains from reducing the access charge are bigger when downstream competition is more likely to unfold, which depends on how effective the antitrust agency is in detecting predation. The second effect is related to productive efficiency. Entry is feasible only if the efficiency of the entrant is above a threshold, which depends negatively on the access charge. An additional increase in monitoring effort is socially more valuable when it allows, in the margin, the entry of a more efficient firm or equivalently when the entry threshold is higher, which corresponds to the case of a lower access charge.

The policy recommendations to be drawn from this result are clear. First, if antitrust enforcement is weak, then there is no point in reducing upstream rents in the regulated segment because predation will obstruct the entry of downstream competitors. If there is no entry, final consumers will face a monopoly price regardless of the magnitude of access charge. Conversely, if the antitrust agency is reliable, the regulator has more incentives to decrease access charges because it is very likely that competition will develop in the unregulated market and consumer will benefit from it. This result is not consistent with the common belief that suggests that strong antitrust enforcement is the appropriate remedy for potential problems derived from an imperfect regulation. Under our framework a lenient regulation makes useless a fierce antitrust action.

Second, implementing deregulation requires a reduction of the informational gap between the dominant firm and the authorities in both segments: the regulated and the potentially competitive one. So far, most of the related literature has focused on the asymmetry of information regarding costs in the regulated segment[4]. This article highlights the importance of also considering the asymmetry of information in the segment of the market where competition is feasible. As we mentioned above, the efforts of the regulator to reduce the informational rents derived from the upstream segment induces the incumbent to behave more anticompetitively in the unregulated downstream segment. This non competitive behavior is sustained due to the ignorance of the authorities about downstream costs.

Third, we provide theoretical support for the introduction of an imputation test that is based on both entrant and incumbent downstream costs. The traditional margin squeeze test, that sanctions as predatory any price that is below the access charge plus downstream incumbent cost, has the drawback of providing excessive protection to the entrant even when it is not necessary. This protection is costly because it translates into higher downstream prices. This antitrust cost could be eliminated by implementing a contingent monitoring policy, where the traditional margin squeeze test is applied only if the entrant´s efficiency level is below a threshold. Our proposed test recognizes that prices set below the static opportunity cost of the incumbent are not always harmful for competition and the qualification of anticompetitive behavior depends on the level of efficiency of the entrant. This proposed policy is informationally more demanding since the competition agency, besides learning the incumbent´s cost needs also to learn the entrant´s cost.

Finally, we analyze the ability of the entrant to convey information that is useful for starting a predation case. Unlike other models such as Milgrom and Roberts (1982) and Scharfstein (1984) where the entrant does not know the incumbent´s costs, in this paper there is symmetric information between competitors about all the relevant market parameters and predation only occurs due to liquidity constraints of the entrant. Although the entrant knows

[4] See Baron & Myerson (1982) and Laffont & Tirole (1986) when the regulated segment represents the final market. Vickers (1995) and Lee & Hamilton (1999) analyze the case when regulation is applied to an essential facility and the owner of that input competes in an unregulated way downstream.

exactly when predation is taking place, he is not able to credibly transmit this information to the competition agency. Any entrant, independent of its level of efficiency, is better off with monitoring of downstream costs by the CA. The inefficient entrant benefits because it deters predation and the efficient entrant because it dampens competition and increases its profits. The agency would want to act in the first case but not in the second, yet it cannot distinguish either ex-ante or ex-post the true situation of the market.

The paper proceeds as follows: In the next section we set up the model. Section 3 solves the maximization problem of the agencies. Section 4 discusses about how results may change with differences in the objectives functions of both agencies. Section 5 proposes an imputation margin squeeze test that eliminates the antitrust cost. Section 6 analyzes the credibility of entrant´s claims about the existence of predation. Finally, section 7 concludes.

2 The Model

A vertically integrated incumbent owns an essential facility and also operates in the downstream market. There is a potential entrant in the downstream segment, who needs access to the facility in order to operate. The downstream segment is considered as competitive, thus it has no price regulation and works under normal antitrust oversight. The access to the upstream segment for third parties is mandatory and subject to access charge regulation. The technology of production requires for both the incumbent and the entrant one unit of upstream input in order to produce one unit of downstream output. The unit cost of providing service downstream is equal to γ for the incumbent. The entrant has to pay a fixed cost equal to K each period in order to compete plus a unit cost of $\gamma - \theta$. The parameter γ reflects a common shock of the industry and θ represents the cost advantage in the downstream market of the entrant relative to the incumbent. Both parameters, γ and θ, are random variables not known ex-ante by any of the agencies but are learned by the firms before competing. Firms offer non-differentiated goods downstream and compete through prices in a pure Bertrand fashion. We employ a simplified demand function such that only one unit of the final good is consumed with a reservation utility equal to $S + \gamma$. The common parameter γ represents the prevalent standard of quality on the market at a given point in the time. The fact that the parameter γ affects positively both the valuation of the downstream services and each firm marginal cost means that a higher level of quality is worth for consumers but at the same time it is more costly to provide it. Although S is known by the agencies, the fact that γ is not, makes the price that is observed in the downstream market totally uninformative. Hence, the Competition Authority is not able to tell whether the current downstream price corresponds to a monopoly, predatory or competitive price.

The regulatory agency fixes the access charge a, with the goal of maximizing a welfare function under the constraint that the incumbent in the upstream segment has to break even. For the sake of simplicity, we assume that the total cost of the upstream input provision is equal to a fixed cost K_I plus a variable cost that is equal to zero. The access charge has to cover only the fixed upstream cost K_I, hence, we need that $a \geq a_{\min} = K_I$, where without loss of generality we make $K_I = 0$. We further assume that $S \geq a$, which means that the monopoly downstream profits are big enough that the incumbent always prefers to be a monopolist downstream than selling upstream access to other firms.

The anticompetitive concern is about predation in the downstream market. We build a model based on the "long purse" rationale for predation. The entrant suffers financial constraints and is obliged to generate some minimum cash flow in order to stay active in the market. The incumbent, being aware of this weakness, has incentives to distort the competition downstream by applying a price squeeze that drives the entrant out of the market. Predation can be controlled by the action of the competition agency, who performs inspections in the market in order to resolve if the price charged by the entrant is predatory or not.

2.1 Timing

The sequence of actions of the different agents involved is shown in the following timing: At T=1, regulatory agency sets the access charge a and the competition agency commits to a monitoring policy represented by a probability of audit e and a penalty F. At T=2, cost parameters γ and θ are revealed to the firms. At T= 3, competition subgame takes place. Finally at T = 4, the monitoring policy is implemented

2.2 Competition Subgame

In order to capture the dynamic nature of the predatory action, the competition subgame unfolds in two periods. In each period, there are two stages, one corresponding to the entry decision and the other to the pricing game. At the beginning of each period, if entry is the choice, the entrant incurs the fixed and sunk cost K. If there was no entry, then the incumbent just sets the monopoly price in the second stage. Otherwise, the entrant and the incumbent compete downstream by setting prices simultaneously. The second period of competition is just a repetition of the first one (K has to be paid in each period the entrant competes). The incumbent does not incur any fixed cost and he always is active downstream. We can think of the incumbent as a big firm that is present in many markets and incurs in a joint fixed cost for being in all of them, so the decision to be active in all the markets is not affected by the existence of profits in the market we analyze.

No Predation For illustrative purposes, we start with the case of no predatory danger. In this situation, the strategies played in the first period are the same as in the second period because there is no dynamic issue of inducing exit through the reduction of the entrant profits. If entry takes place, the nature of the competition downstream induces each firm to undercut its rivals prices up to its own marginal or opportunity cost. For the entrant the marginal cost c_E is equal to the sum of the access charge paid to the incumbent plus the downstream marginal cost, thus $c_E = a+\gamma-\theta$. In the case of the incumbent, the limit for undercutting is defined by the opportunity cost of serving the downstream market, which includes the marginal cost of provision, equal to γ, plus the opportunity cost of sacrificing the upstream profits by selling access to the entrant. By consequence the total opportunity cost c_I for the incumbent, is equal to $a+\gamma$.

In this Bertrand game between firms with different marginal cost, the most efficient firm gets the whole market at a price equal to the cost of the least efficient[5]. Thus, focusing only on the interesting case of $\theta \geq 0$, we have that the entrant captures the downstream market with an equilibrium price $p^n = a+\gamma$. The payoffs are, for the entrant $\Pi_E = p^n - (a+\gamma-\theta) = \theta$ and for the incumbent $\Pi_I = a$.

Notice that in the reaction functions, the access charge a enters as a common component of the marginal cost of both firms. For the entrant it is trivial, since he has to pay for the upstream input. For the incumbent it represents the opportunity cost of not obtaining revenue from the access to the upstream segment, thus a higher a gives less incentive to fight for lower prices. As a consequence, no matter who gains the downstream market, the access charge is totally passed on to consumers through the final price and thus does not affect either the entrant profits or the likelihood of entry.

Going backwards, entry occurs if and only if the ex-post benefit of the

[5] Strictly speaking, the Nash equilibrium of the game is a range of prices whose limits are the opportunity cost of both firms. For any price in this range, no firm is strictly better off by changing its strategy. However, for the incument, all the strategies of setting a price striclty lower that c_I are weakly dominated by the price of c_I. Using trembing hand or Pareto dominance refinements also yields to select $p = c_I$ as the unique Nash equilibrium of the game.

entrant is larger than the entry cost; i.e $\theta \geq K$. Under entry, downstream price is equal to $a+\gamma$ and consumer surplus is equal to $S+\gamma-(a+\gamma) = S-a$. In a scenario without predation, there is no need for antitrust action and the access charge that maximizes consumer surplus is $a = 0$, no matter what are the beliefs of the regulatory agency about θ.

Predation The possibility of predation arises from the fact that the entrant has limited liquidity. The financial weakness of the entrant that motivates the predatory action of the incumbent might be avoided if the victim gets money from the capital market. If a creditor is willing to provide funds to the firm, no matter the strategy played by the predator, an efficient entrant will survive in the market because predation is not an useful strategy for getting rid of the entrant and by consequence, the incumbent will not waste money by engaging in such aggressive pricing strategy. However, given the imperfections that exist in the capital market due to problems of asymmetry of information, it is not realistic to think that an investor will commit to keep providing liquidity independent of the results of the firm[6]. For simplicity, we do not model explicitly the agency problem, but we capture all its essence by assuming that the entrant has a limited amount of cash to spend in competing in the market.

Hence, the entrant needs to raise enough cash in the first period in order to be able to pay the fixed cost K and compete in the second period. The incumbent can apply a predatory strategy, through a price lower than the competitive one in order to induce the exit of the entrant. The benefit of this strategy is that when successful, the incumbent can reap the monopoly profits in the second period. We assume that the entrant, after investing in the first period, has a residual amount of cash equal to A, such that $0 \leq A \leq K$. The condition under which the entrant cannot remain in the

[6] In Holmstrom and Tirole (1997) the borrowing capacity of a firm is restricted by the incentive compatibility condition of the firm owner. If the latter has to pay back a big part of the return of the project to the lender, he will prefer not to exert costly effort, thus reducing the expected return of the venture and making infeasible any financial contract. The entrepreneur obtains a loan only if he counts has a minimum amount of own funds for the project.

In Bolton and Scharfstein (1990) the continuation of funding is contingent on the benefit of the first period, otherwise the manager of the firm may shrink and thus obtains private utility for not exerting effort. Knowing this lending policy, the predator has incentives to reduce the victim´s profits, thus provoking its exit. In both models the asymmetry of information plays a crucial role. In Bolton and Scharfstein the lender does not know whether a low level of profit is due to low effort or a predatory strategy applied by the rival. In Holmstrom and Tirole the lender cannot tell if a low return is due to low effort or just bad luck.

market is[7]: $\Pi_E + A \leq K$. If the incumbent decides to induce the exit of the rival, it must charge a price that reduces the entrant profits up to the point where the entrant cannot stay in the market. We denote by $\overline{p}$ the limit price in the market that induces the exit of the entrant. Using the no exit condition, we have that: $A + \overline{p} - (\gamma - \theta) = 0$, or:

$$\overline{p} \equiv a + \gamma - \theta + K - A. \tag{1}$$

Any price above $\overline{p}$ allows the entrant to raise enough cash to stay alive and compete in the next period. We next define $\widehat{p}$, the minimum price that the incumbent is willing to offer in order to prey on the competitor and remain as a monopolist in the second period. The price $\widehat{p}$ is obtained from the condition that predation is preferable to competing "fairly" in each period. Thus, we have:

$$\Pi_I^P(\widehat{p}) + \Pi_I^M = 2\Pi_I^N \tag{2}$$

The term $\Pi_I^N = a$, corresponds to the profits of playing or competitively in each period. Monopoly profits in the second period if exit was induced are denoted by $\Pi_I^M = S$. The term $\Pi_I^P = \widehat{p} - \gamma$, is the first period benefit from playing a predatory strategy. It assumes that the incumbent captures the whole market when charging $\widehat{p}$ at the risk that Π_I^P may be negative. From equation 2, we obtain:

$$\widehat{p} \equiv 2a + \gamma - S \tag{3}$$

These two threshold prices $\{\overline{p}, \widehat{p}\}$ modify the reaction function of the incumbent with respect to the case where firms meet just once or compete in a static fashion. The limit price $\overline{p}$ represents the feasibility of predation whereas $\widehat{p}$ represents its profitability. In order to see how this new behavior of the incumbent modifies the equilibrium and makes predation a plausible outcome we consider two cases.

Case 1: $\overline{p} \geq \widehat{p}$. This case corresponds to the situation where the maximum price that allows predation is above the minimum price the incumbent is willing to charge in order to predate. In other words, whenever predation is feasible is also desirable. Intuitively, in this case, predation would be the equilibrium

We first describe the best response function of each firm and then we find the equilibrium. The incumbent best response to a price p_E charged by the entrant is the following: (i) If $p_E \geq \overline{p}$, the best strategy of the incumbent is

[7] Due to an openess problem that shows up in the predatory equilibrium, we require that the entrant needs to have funds strictly larger than K.

just to undercut that price and capture the downstream market. This leaves the entrant with no profit and thus induces its exit for the second period. It is profitable to undercut since we are in the case of $\overline{p} \geq \widehat{p}$. (ii) If $p_E < \overline{p}$, the best strategy for the incumbent is to give up the downstream market. At that price p_E, the entrant is leaving the market anyway, because the profits it obtains do not allow the entrant to cover the minimum cash necessary to stay in the second period. In this case, the incumbent does not need to undercut the price in order to induce the exit of the entrant.

Summarizing, the incumbent is willing to undercut any entrant price above $\overline{p}$, otherwise he does not fight for the downstream market. This is equivalent to say that the opportunity cost of the incumbent switches from c_I to $\overline{p}$. Using the definition of $\overline{p}$, we can re-write the incumbent´s new opportunity cost as $\overline{p} = c_I - (A + \theta - K)$, which is equal to the static one minus a term that corresponds to the financial strength of the entrant. Therefore, the more efficient the entrant is or the higher is the level of remaining cash, the more the incumbent has to decrease the price in order to predate.

The entrant´s behavior is the same as in the case of no predatory threat. It always tries to get as much profit as possible in each period, no matter whether the incumbent is trying to prey on him or not. Therefore, the entrant will undercut any price above its marginal cost $c_E = a + \gamma - \theta$. Having defined the best response function of each firm, the competition is now between two firms having different opportunity cost; $\overline{p}$ for the incumbent and c_E for the entrant. Consequently, given that $\overline{p} \geq c_E$, the Nash equilibrium of the pricing game is at price equal to $\overline{p}$[8]. The entrant captures the whole downstream market, but the profits it gets are not enough to continue in the second period, since the minimum cash condition is not satisfied.

Lemma 1: *If $\overline{p} \geq \widehat{p}$, the equilibrium price is equal to $\overline{p}$ and predation is the outcome of the competition sub-game.*

Case 2: $\widehat{p} \geq \overline{p}$. Proceeding like in case 1, the reaction function of the incumbent is described as follows: (i) If $p_E \geq \widehat{p}$, the incumbent undercuts the entrant price because by capturing the downstream market the entrant is preyed and is profitable to do it. (ii) If $p_E \leq \widehat{p}$, it is too costly for the

[8] From the definition of $\overline{p}$ and c_E, we have that $\overline{p} \geq c_E \Leftrightarrow a + \gamma - (\theta - K + A) \geq a + \gamma - \theta$ $\Leftrightarrow K \geq A$, which is true by the assumption of financial weakness.

Like in the case of no predation, we also have a problem of multiplicity of equilibria. However we can discard all the incumbent prices $p_I < \overline{p}$ because they are weakly dominated by the strategy of playing $p_I = \overline{p}$. In other words, for all entrant prices in the range $[c_E, \overline{p}]$, does not exist an incumbent price p_I such that the net benefit of playing that price be greater than playing $\overline{p}$. At the same time for some entrant prices in the same range, the incumbent is strictly better by playing $\overline{p}$

incumbent to undercut and to prey the entrant, therefore the incumbent gives up the downstream market. From its best response function, we infer that the new opportunity cost of the incumbent corresponds to $\widehat{p}$, such that $\widehat{p} = c_I - (S - a)$. This new opportunity cost is equal to the static cost minus the difference in second period profits between being monopolist and selling access. Hence, the higher is this relative monopoly gain, the more willing is the incumbent to reduce its price and the lower becomes its first period opportunity cost.

The entrant best response is the same as in case 1, he always undercuts an incumbent price that is above c_E. Since $\widehat{p} \geq c_E$[9], the Nash equilibrium of the game is at price equal to $\widehat{p}$. The entrant serves the whole downstream market and is not preyed upon because $\widehat{p} > \overline{p}$.

Lemma 2: *If $\widehat{p} \geq \overline{p}$, the equilibrium price is equal to $\widehat{p}$ and predation is not the outcome of the competition sub-game.*

We summarize both cases in the proposition that follows:

Proposition 1 *Under predatory behavior, the equilibrium price is equal to p^*, which is defined as $p^* = \max[\overline{p}, \widehat{p}]$, such that $c_E \leq p^* \leq c_I$*

Proof. Using the definition of the threshold prices $\{\widehat{p}, \overline{p}\}$ we verify that the property established above is satisfied. First, we have that $\overline{p} \leq c_I \Leftrightarrow \overline{p} \equiv a + \gamma - \theta + K - A \leq a + \gamma \Leftrightarrow K - A \leq \theta$. The last inequality is always satisfied whenever entry is feasible (without predation) which is the relevant case. Secondly, $\widehat{p} \leq c_I \Leftrightarrow 2a + \gamma - S \leq a + \gamma \Leftrightarrow a \leq S$. This is true by assumption, otherwise the incumbent will never have incentives to capture the downstream market since the upstream business is more profitable. The property of $p^* \geq c_E$ was already verified within Lemma 1 and Lemma 2. ■

Proposition 1 says that when the incumbent wants to prey the entrant, the equilibrium price that we should observe in the market is lower than c_I, the direct single period opportunity cost of the incumbent. This result holds even if in equilibrium the entrant does not exit. Although they know that predation is not feasible, the firms will not be able to coordinate on an equilibrium with higher prices because it is not credible, given the predatory nature of the incumbent. For any price played by the entrant bigger than $\widehat{p}$, the incumbent is better off undercutting that price and thus totally capturing the downstream market. This strategy leaves the entrant with zero profits and force him to quit the market afterwards. The entrant, being aware of this behavior, will not give the incumbent the opportunity to undercut him.

[9] The proof of $\overline{p} \geq c_E$ on lemma 1 is of general validity since it depends only on the condition of $K \geq A$. Since we are in the case of $\widehat{p} \geq \overline{p}$, then it is also true that $\widehat{p} \geq c_E$.

With respect to the occurrence of predation as equilibrium outcome, we establish the following proposition:

Proposition 2 *Predation is successful if and only if* $\overline{p} \geq \widehat{p}$

Proof. See Lemma 1 and Lemma 2. ■

Proposition 2 says that predation is successful if and only if the price at which predation is feasible is not too small to make it unprofitable this strategy for the incumbent. If the inequality of proposition 2 is satisfied, the incumbent is willing to cut his price down to the level required to have predation, which is equal to $\overline{p}$. This strategy is profitable for him since $\overline{p}$ is bigger than $\widehat{p}$, the minimum price the incumbent is willing to charge. Otherwise predation is too costly for the incumbent and he will not charge a price lower than $\widehat{p}$.

Using the definition of the threshold prices $(\overline{p}, \widehat{p})$, the inequality of proposition 2 is equivalent to the following condition:

$$S - a + K - A - \theta \geq 0 \tag{4}$$

Equation 4 says that predation is more desirable when monopoly gains are larger, when the liquidity constraint of the entrant is more stringent and when the entrant´s efficiency advantage is lower. Note that a higher access charge reduces the incentive of the incumbent to predate[10]. For the entrant, the access charge is neutral, since it is completely passed through in consumer prices but for the incumbent, a higher access charge makes the option of selling the upstream input to the entrant more attractive with respect to the alternative of capturing the downstream market.

Entry Stage The entry decision depends on which case we are. First, if predation is the expected outcome (case of $\overline{p} \geq \widehat{p}$), the firm will not enter, otherwise the entrant would obtain in the first period negative profits (net of fixed cost) equal to $\Pi_E(1) = \overline{p} - (a + \gamma - \theta) - K = -A$. Secondly, if predation is not successful (case of $\overline{p} \leq \widehat{p}$) entry depends on the ex-ante profitability of the decision, taking into account the net profits of the two periods where firms compete. In the first period, profits are equal to

$$\Pi_E(1) = \widehat{p} - (a + \gamma - \theta) - K = \theta - K - (S - a) \tag{5}$$

[10] Biglaiser and De Graba (2001) also obtain this relationship using a model of imperfect competition downstream. Sibley and Weisman (1998) found similar result in a framework where the anticompetititve action is a rising rival cost activity instead of predation.

In the second period, since there is no predation, net profits are equal to $\Pi_E(2) = \theta - K$. Adding profits of both periods, entry occurs if and only if : $2(\theta - K) - (S - a) \geq 0$.

Hence, the occurrence of entry is represented by the two following constraints.

No predation constraint

$$\theta + a \geq S + K - A \tag{6}$$

Entry profitability constraint:

$$2\theta + a \geq S + 2K \tag{7}$$

The first constraint (equation 6), that is directly derived from equation 4, says that no-predation is a necessary condition for having entry in the downstream market. It is obvious that the entrant, after learning γ and θ, will not enter if he anticipates that he will be victim of predation. The second constraint tells us that even if predation is not feasible, we may not observe entry in the market. The explanation rests in the more aggressive behavior of the incumbent that reduces the equilibrium price in the first period, even if in the end predation is not successful. Resisting the predatory attack is costly for the entrant in the first period, and he may eventually incur in losses in that period. However, the entrant may decide to enter anyway if he is sufficiently efficient such that the second period gains compensate the losses suffered in the first period.

In order to better appreciate how the predatory behavior affects entry, we have represented both constraints in the $\{a, \theta\}$ space (see figure 3).

Without predation, entry occurs for any $\theta \geq K$, independently of the value of the access charge a. With predatory threat, the set of values $\{a, \theta\}$ where entry is feasible is reduced, and the access charge plays now a role. The likelihood of entry is positively affected by the access charge in both the predation and in the entry constraint. This is due to the already mentioned fact that the incumbent is discouraged form fighting for the downstream market when the option of selling upstream access looks more profitable. Entry is also more likely when the cost advantage of the entrant, represented by θ, is higher. The incumbent has to push down the predatory price more when the entrant has lower marginal cost in order to satisfy the condition of $\overline{p}(\theta) \geq \widehat{p}$. On the other hand, higher θ gives more profits to the entrant, in both periods, thus making entry more attractive. Notice that the effect of θ in the entry constraint is stronger because it plays twice, once in each period.

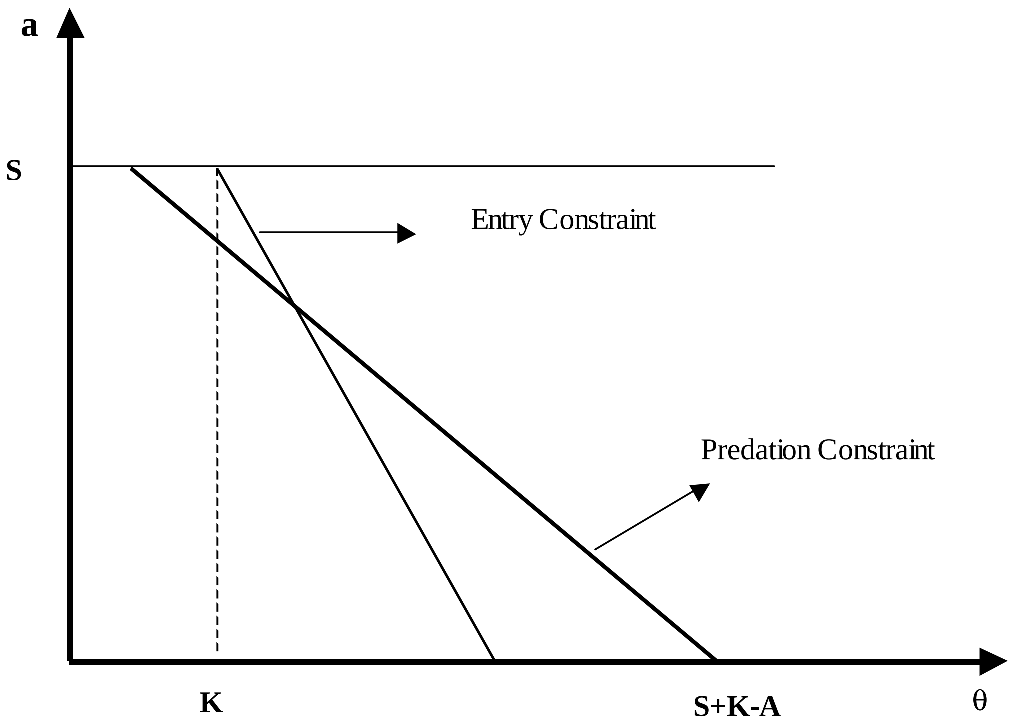

Figure 1: Representation of predation and entry constraints in the $\{a,\theta\}$ space.

Hence, other things being equal, it is more likely that the entry constraint will be binding for high values of the parameter θ.

Using a comparative statics analysis, we can observe the effect of A, the availability of cash of the entrant, on the relevance of each constraint. For low values of A, which means a financially weak entrant, the predatory constraint dominates the entry constraint for almost all values of θ. Conversely, if A is large, the predatory constraint moves inward, making the entry constraint binding for a larger range of values of θ[11].

Antitrust Action So far we have not included any antitrust activity in the competition game. The Competition Agency is in charge of detecting and punishing predatory prices. This agency freely observes market prices and access charges but observes neither downstream cost nor the profits of any of the firms. The cost parameters γ and θ are known by the firms but not by the CA.

The CA defines as predatory any price p_I charged by the incumbent such that: $p_I - a \leq \gamma$. This is the definition of predatory pricing or margin squeeze that has been commonly suggested and employed as a test. Under this test, a vertically integrated firm cannot set a price that leaves a downstream margin lower than its own marginal cost[12]. Note that the minimum non-predatory price that the incumbent may charge, $a + \gamma$, corresponds exactly in our model to p^n, the static equilibrium price in the downstream market when firms compete fairly.

In order to determine whether predation took place, the CA needs only to learn the value of γ, since the other two parameters $\{p_I, a\}$ are observable. The CA can learn the value of γ through costly monitoring that is performed after firms have set prices in the first period. Further, the CA commits to a monitoring policy represented by the parameter e which corresponds to the intensity of monitoring[13]. Thus, with probability e, the CA monitors the incumbent downstream cost and learns the real value of γ with probability 1. If the value of γ is bigger than the "margin" $p_I - a$, then predation happened and the CA applies a penalty F to the incumbent. Otherwise no action is

[11] In the extreme case of $A = 0$, the entry constraint is always dominated by the predatory constraint. In the other extreme case, when $A = K$, predation never works because the entrant always has cash remaining for competing in the second period. Thus, the nature of the game changes and entry just depends on the condition of $\theta \geq K$, just like in the case of no predatory incumbent.

[12] This is the test officially applied by the European Commission. See Access Notice in Telecommunication. C-265.

[13] We employ a similar setting as in Besanko and Spulber (1989), where antitrust monitoring is aimed at detecting collusion among firms.

undertaken. The intensity of monitoring has a cost $C(e)$ for the CA, where $C()$ is a twice differentiable function such that $C'() \geq 0$ and $C''() \geq 0$. A higher intensity of monitoring means that the CA assigns more costly resources to auditing the market. The cost $C(e)$ is incurred by the CA ex ante, before the agency has observed any price. Also, the monitoring policy defined by e, cannot be modified ex-post on the basis of any market variable observed by the agency. Finally, we assume that antitrust action acts as an ex-ante prevention device by dissuading the incumbent to engage in predation in the first period. Once predation takes place and CA detects it, the punishment ex-post does not prevent the exit of the victim.

The existence of antitrust oversight changes the incentives of the incumbent to prey the entrant and the possibility of having entry as well. The incumbent now makes a balance about whether to apply predation, internalizing the cost of being detected and fined. Now, playing predation is less attractive due to the expected cost of the penalty. This cost is added to the left hand side of equation 2, which changes the threshold to: $\widehat{p} = 2a + \gamma - S + e\digamma$. As we can observe, the antitrust action induces the incumbent to price less aggressively, yielding an equilibrium with higher prices and rendering the predation condition ($\overline{p} \geq \widehat{p}$) less likely to satisfy.

At the same time, a higher $\widehat{p}$, induced by the antitrust action, increases entrant´s first period profits and in consequence makes entry more likely.

Hence, the constraints are modified in the following way:

The no predation constraint becomes:

$$a + e\digamma \geq S - \theta + K - A \tag{8}$$

and entry constraint becomes:

$$\frac{1}{2}a + e\digamma \geq \frac{1}{2}S - \theta + K \tag{9}$$

Compared with the case of no antitrust, the constraints are modified equally by adding a term that corresponds to the expected cost of being fined. Using figure 1, the antitrust presence is represented by a inward shift of both constraints with a magnitude proportional to the monitoring effort.

Note that the effect of antitrust monitoring is not always desirable for consumers. This is the case when an efficient firm enters downstream even in the absence of antitrust action ($e = 0$). Any additional oversight effort translates into higher consumer prices and increases entrant profits without affecting the probability of entry. We will talk later about the implications of this negative effect of antitrust.

3 Choice of Agency Parameters

The agencies have two instruments to affect the feasibility of entry; the access charge a and the monitoring effort e. If the agencies have perfect information about the set of parameters on the right hand side of equations 8 and 9, then a and e are substitute instruments. Agencies are successful on deterring predation and making entry easier through any mix of instruments that satisfy both constraints, where for a higher access charge, we need a lower level of monitoring effort and vice-versa. The two instruments are useful to fight predation in different ways. The access charge affects the profitability of the upstream segment and in consequence the opportunity cost of capturing the downstream market through predation. The monitoring effort makes the detection and punishment of predation more likely, which obviously dissuades the incumbent from engaging in this practice. However, to better understand the interaction between these instruments we need to know how the choice of a affects the optimal choice of e and vice-versa, taking into consideration the ignorance of agencies about θ, the level of efficiency of the entrant. As a first step, we need to specify the objective function that formalize the policy goal of the agencies.

We first assume that both agencies have the same objective function. This is equivalent to have one agency using two instruments to achieve its purpose. Later on, we discuss how results would change when the agencies have some degree of divergence in objectives. The shared objective function of the agencies is given by the following expression:

$$U = E_\theta[W_1(\theta, a, e) + W_2(\theta, a)] - c(e) \tag{10}$$

This function is equal to the expected welfare gains due to downstream competition minus the cost of monitoring the market. The terms W_i represent the increase in welfare, for each period, compared with the situation of no entry. The welfare function includes both the consumer surplus and the firms profits, giving more weight to the consumer gains than to the benefits of the firms[14]. In the first period, if both firms are present in the market, the price is equal to $\widehat{p}$, so the consumer surplus is negatively related to that price and in consequence to the access charge a and to the monitoring effort e. In the second period the price is equal to $a + \gamma$, and consumer surplus is equal to $S - a$. Conditional on entry, the cost advantage of the entrant, θ, plays no role in the equilibrium price but affects positively the profits of that firm.

[14] Since we are employing an inleastic demand function, any reduction in consumer surplus is totally translated into profits. However, since we are attaching more weight to consumer gains than firms profits, any price increase has a negative effect on W_i.

Accordingly, we have that $\frac{\partial W_i}{\partial a} \leq 0$ and $\frac{\partial W_i}{\partial \theta} \geq 0$ for $i = 1, 2$, and , $\frac{\partial W_1}{\partial e} \leq 0$. Finally, agencies do not place any value on funds raised from the fine F.

Before competition unfolds both agencies set their parameters a and e without knowing θ and therefore without knowing how real the danger of predation is. Since they share an objective function the agencies solve the following problem :

$$Max_{\{a,e\}}\ U = \int_{\theta \in \Omega} (W_1(\theta, a, e) + W_2(\theta, a))dF(\theta) - c(e)$$

Where Ω is the set of values of θ where entry is feasible for given parameters a, e. This set depends on the two constraints that affect entry, the predation constraint and the entry constraint. We present the results for the scenario where only the predatory constraint is binding, which is the case when the entrant is severely cash limited[15]. The relationship between liquidity of the entrant and the relevance of the constraints was explained above (see footnote 12). Therefore, entry will occur if and only if $\theta \geq \theta^*(a, e) \equiv S + K - A - a - eF$.

$$Max_{\{a,e\}} U = \int_{\theta^*(a,e)}^{\theta_{\max.}} (W_1(\theta, a, e) + W_2(\theta, a))f(\theta)d\theta - c(e)$$

First order conditions for a and e give us:

$$[W_1(\theta^*, a, e) + W_2(\theta^*, a)]f(\theta^*) + \int_{\theta^*(a,e)}^{\theta_{\max.}} [\frac{\partial W_1}{\partial a} + \frac{\partial W_2}{\partial a}]f(\theta)d\theta = 0 \tag{11}$$

$$[W_1(\theta^*, a, e) + W_2(\theta^*, a)]F f(\theta^*) + \int_{\theta^*(a,e)}^{\theta_{\max.}} \frac{\partial W_1}{\partial e} f(\theta)d\theta - c'(e) = 0 \tag{12}$$

Equation 11 shows the trade-off involved by the choice of the access charge. For any level of antitrust monitoring, a higher access charge makes predation less likely but at the same time, by increasing the downstream price, it reduces consumer surplus when predation does not occur. These effects are represented respectively by the first and second term of the left hand side of equation 11. Note that decreasing the probability of predation increases welfare in both periods since entry is made easier[16]. The selection of the level of market oversight also involves a similar trade-off. In equation 12,

[15] In appendix A3.2, we solve the maximization problem, for the case of uniform distribution function, considering all the possibilities about binding constraints.

[16] In equilibrium, we never observe exit in this model. Since there is symmetry of information between firms, the entrant knows after learning θ, a and e whether predation will

the first term is positive, and has the same interpretation as the equivalent term in equation 11; increasing the monitoring effort renders predation less likely and in consequence entry more likely. The second term is negative, because when e increases, the incumbent prices less aggressively and that leads to higher prices in the first period. Welfare is reduced when the price goes up for the values of θ where predation is not a problem. Finally the third term is the additional cost of monitoring. For a welfare function that is linear respect to a and e, we provide in the appendix A-.1 the sufficient conditions for having a maximum[17].

Proposition 3 *Antitrust and Regulatory efforts are complementary activities.*

Proof: If the second order conditions are satisfied, the effect of one variable in the other is given by the cross derivative of the utility function evaluated at the optimum.

$$\frac{\partial^2 U}{\partial a \partial e} = f(\theta^*)[-(\frac{\partial W_1}{\partial a} + \frac{\partial W_2}{\partial a})h'(\theta)F - (\frac{\partial W_1}{\partial \theta} + \frac{\partial W_2}{\partial \theta})F + \frac{\partial W_1}{\partial e}] \tag{13}$$

Under the condition of a monotone decreasing hazard rate[18], the three terms on the right hand side of equation 13.are negative. In consequence, having a cross derivative with negative sign means that the variables are strategic substitutes. This result has the interpretation that a lower access charge induces higher monitoring effort in the downstream market and vice-versa.

To better understand the intuition behind the result, we will analyze each term separately. The first term inside the brackets corresponds to the allocative efficiency. It says that deterring predation is more valuable when the access charge is lower because consumers enjoy lower prices derived from the possibility of having competition downstream. For a given access charge, increasing monitoring makes entry more likely by moving down the threshold

occur and will enter accordingly. Therefore, we either observe entry in both periods or no entry at all. The CA does not know whether the no entry scenario is due to inefficiency of the entrant or to a credible predatory threat.

[17] The condition for having a interior solution for a and e is that the cost of monitoring has to sufficently big compared with the magnitude of the fine F. Otherwise it would be always optimal to count only with monitoring effort in deter predation and the optimal access charge would be the minimal one. In the example of uniform distribution function, that is developed in the Appendix A3.2, this explanation becomes more clear.

[18] The hazard rate is defined as: $h() = \frac{1-F()}{f()}$. Most of the known distribution functions satisfy the condition of monothone decreasing hazard rate.

θ^*. For consumers this means that they will have entry and competition for a wider range of θ. This gain from additional entry depends negatively on the equilibrium prices in the downstream market in both periods; $\widehat{p}$ and p^n. Since both prices are increasing in access charge, the benefit of deterring predation and having competition is bigger when the access charge is lower. Thus, a low access charge acts as a device that induces the antitrust agency to devote more resources to monitoring prices, not because predation is more likely but because it is more valuable for consumers to deter it.

The second term represents the gains in productive efficiency from increasing e. For the entrant, a marginal movement on θ^* is more attractive when that threshold is bigger because profits to the entrant depend on θ in a one to one basis. Hence, the value of an infinitesimal increase in antitrust effort has more value when the threshold θ^* is higher, and this happens for lower values of the access charge. This result hinges on the fact that welfare is increasing in the parameter θ and on the relationship of substitutability between of a and e for a given value of θ^*.

The third term represents the antitrust error that is born by consumers and it has a similar explanation than the first term. The regulatory agency has more incentives to promote entry through the access charge when the negative effect of monitoring on prices is lower, which corresponds to the case of a low monitoring effort. On the contrary, there is no big gain of encouraging entry -by moving down θ^* through the access charge- if the consumer prices are high due to the excessive antitrust monitoring.

The result obtained suggests that there exists a direct and unidirectional relationship between the access charge and the level of the antitrust monitoring in the downstream market. Another way to interpret this relationship is in terms of the intensity of regulation and antitrust. A more intense or tougher antitrust action is represented in this model by a higher value of the parameter e. On the other hand, a more severe regulator cares more about reducing the rents in the upstream part of the market, which are increasing in the access charge. Although not explicitly modeled, we can interpret the severity of the regulator in terms of how much effort the agency exerts in reducing its informational gap with the vertically integrated firm about upstream cost[19]. Even if we introduce explicitly the cost of reducing this gap the relationship of complementarity between both activities -antitrust and regulation- would remain invariant.

[19]Using a model of costly verification state -Gale and Hellwig (1989)-, the agency can spend resources in improving the cost monitoring technology yielding to a wider interval of truthfull revelation about upstream costs. In expected term, this costly improvement would reduce the informational rents and by consequence the access charge to the essential input.

Note that even if the second order conditions do not allow an interior solution, the property of substitutability still holds. This is the case of a relatively costless monitoring, in terms of resources, or when the magnitude of fine F is significant. For any level of deterrence of predation (or for any value of the parameter θ^*) it is better to achieve it using only monitoring because access charge affects negatively more prices than monitoring does. In consequence the optimal solution is setting the access charge equal to the minimum, and only equation 12 represents the first order conditions of the maximization problem. However, out of equilibrium, the best response in terms of monitoring effort is still decreasing in the access charge[20]. In equilibrium, the CA consistently assumes that the access charge will be equal to zero and it fixes the optimal level of effort accordingly

Note that our main result -the complementarity of efforts between antitrust and regulation- does not depend exclusively in the negative relationship between level of access charge and incentives to apply predation, which is represented by equations 9 and 10. We may obtain the same result even if the competition model predicts the opposite: that a higher access charge increases the incentive to prey upon the entrant. If we are in the latter case, the optimal choice of instruments is the following: (i) The regulatory agency always sets the access charge to the minimum, no matter what is the level of antitrust oversight existing in the downstream market. There is no benefit form increasing the access charge above the upstream costs since it accomplishes no useful purpose. (ii) There is an interior solution for the level of monitoring exerted by the competition agency, and this optimal level of e depends on the access charge chosen by the regulator. In order to see whether the property of strategic substitutability between a and e may hold, we obtain the cross derivative from equation 11, the first order condition of the CA. Assuming uniform distribution function for θ, we obtain:

$$\frac{\partial^2 U}{\partial a \partial e} = (\frac{\partial W_1}{\partial a} + \frac{\partial W_2}{\partial a}) f(\theta^*) F + (\frac{\partial W_1}{\partial \theta} + \frac{\partial W_2}{\partial \theta}) \frac{\partial \theta^*}{\partial a} f(\theta^*) F - \frac{\partial W_1}{\partial e} \frac{\partial \theta^*}{\partial a} f(\theta^*) \tag{14}$$

Like in our standard case, the cross derivative has three terms, each of them reflecting the same effects already described above. Only two of the elements are affected by the relationship between access charge and incentives to predate. The first term is still negative, but the other two are now positive, since $\frac{\partial \theta^*}{\partial a}$ changes to positive sign. The first term, that represents the

[20]For instance, if $c(e) = 0$ for all e, then the cross derivative evaluated at the optimum is given by: $\frac{\partial^2 U}{\partial a \partial e} = f(\theta^*) F [(\frac{\partial W_1}{\partial a} + \frac{\partial W_2}{\partial a}) - (\frac{\partial W_1}{\partial \theta} + \frac{\partial W_2}{\partial \theta}) + h'()]$, which is negative under the monotone decreasing hazard rate property.

allocative efficiency, always has the same sign. A lower access charge makes the benefit of deterring predation higher for consumers independently on how the behavior of the incumbent is affected by the access charge. Thus, a result with a negative cross derivative may still exists even if $\frac{\partial \theta^*}{\partial a}$ is positive[21]

Although we are not sure that a model of competition could predict that a higher access charge gives more incentives to prey, we have considered this case in other to show what are the forces that drive our result. Thus, the negative relationship between access charge and incentives to engage in anticompetitive action found by Biglaiser and De-Graba (2001) and Sibley and Weisman (1998) is a sufficient but not necessary condition for the result of complementarity between antitrust and regulatory efforts.

4 Changes in the objective function

Results are robust if we allow for some differences in the objective functions between the agencies. Under the public interest paradigm, all agencies should pursue the same objective, which is the maximization of the social welfare. However, we find in practice that inside the government, agencies that perform different activities usually have different objective functions. The reasons of this separation are multiple. Martimort (1996) presents a model where separation of powers reduces the risk of non-benevolent behavior of the agencies. Dewatripont and Tirole (1995) show that the separation of functions induces agents to search more for information if they are rewarded for what they find. In Olsen and Torsvick (1993), separation makes renegotiation of contracts harder which reduces the scope for opportunistic behavior by regulated firms.

We will not enter in the problem of capture. Instead we will see how results are modified if some degree of divergence between the objectives pursued by each of the agencies is included. This divergence, we assume, is based on the impossibility of an authorities to properly measure the effects of its decision on all the dimensions of the global objective function. If the CA cares only about making entry easier, ignoring the negative effect that excessive monitoring has on first period prices, then the second term of the first order condition (represented in equation 3.10) is suppressed, and more oversight effort is exerted than in the previous case. The complementarity between both activities remains unchanged because the other two terms

[21]For instance, if the agencies place no value in firm profits and $\frac{\partial \theta^*}{\partial a} = 1$ (the opposite of our standard case), then the second term dissapears and the third term is likely to be dominated by the first one, since access charge affects prices in more periods than monitoring effort does.

of the cross derivative are negative (equation 3.11). Although the slope of the reaction function of e respect to a changes, the sign of this slope remains negative. Overall, divergences between objective functions due to incomplete measurement of effects will affect the equilibrium levels of antitrust effort and access charge but will not alter the result of substitutability between the two instruments (or complementarity between both efforts) because all the terms in the cross derivative of the welfare function are negative[22].

5 Antitrust Cost

One surprising result of our model is an antitrust cost that come out due to unnecessary monitoring. The intertemporal maximization of profits of the incumbent leads to a price that is lower than the static level, no matter whether predation is successful or not. If the entrant is not preyed upon, the price will be equal to $\widehat{p}(e)$ where, as we demonstrated: $\widehat{p}(e) \leq a + \gamma$. The term $a+\gamma$ represents the equilibrium price of the static pricing game between firms and also corresponds to the standard of cost employed for the margin squeeze test. Any price below that standard is considered as predatory and, if detected, will be punished by the CA, whether it induced exit or not. Thus, the probability of being fined is what induces the incumbent to price less aggressively which makes the value of $\widehat{p}(e)$ increasing in e. The question that emerges is whether antitrust law should penalize prices that are harmless to competition even if they fail an imputation test. For instance, if firms produce under a technology of learning by doing, the equilibrium prices will be lower than the Nash-static level. Then, it is not clear that CA must force firms to move their prices up to the level of an equilibrium that ignores the dynamic effect of prices. It may be argued that the difference is in the attempt, since in the latter case lower prices have an efficiency reason and are not aimed at eliminating rivals, whereas in the predatory case they are. However it is not evident that both strategies are totally different, since the exit of a rival can be the (intended or unintended) result of the reduction in costs that one firm has attempted[23].

[22] This is not strictly true when the regulator does not foresee the effect of the access charge on the probability of predation. In this situation, the optimal access charge is equal to the minimum, no matter of big e is. However, if we include a cost of reducing access charge, then the property of substitutability is restored.

[23] Cabral and Riordan (1997) illustrate exactly this point. They present a model with learning intertemporal externalities. There, a firm has incentives to produce more today because reduces tomorrow costs but at the same time decreases rival profits making more likely its exit. Faure-Grimaud (1997) shows that there is a trade-off for the regulator between inducing cost reduction of the incumbent and deterring predation. He argues

This adverse side effect of monitoring can be suppressed by applying a contingent margin squeeze test, where the penalty is imposed only if the entrant is not efficient enough to resist the predatory attack. Formally speaking, if $\theta \leq \theta^*$ the penalty is administered as before, but if $\theta \geq \theta^*$ there is no intervention by the CA and firms are free to set their prices without any constraint. This policy deters predation when it is desirable to do so and at the same time eliminates the higher prices induced by the monitoring, that at the end translate into rents to the entrant. Cancelling this negative effect of antitrust induces the CA to exert more effort in monitoring (second term of equation 3.10 disappears) and, by the property of complementarity, induces also the regulator to reduce further the access charge.

Legitimate doubts may be raised about whether such contingent enforcement policy should be applied. First, there is an extra cost of monitoring since implementation of this policy requires more information; besides knowing the incumbent downstream costs, the CA needs also to learn the entrant costs. Second, if the CA learns both firms downstream costs and all other relevant parameters are known, then it might as well regulate final prices. The agency, having all the information, could fix the price at the level that ensures competition and at the same time extracts all the rents from the firms. However, all the problems related with regulation will emerge. For example, reducing entrant rents by intensifying the monitoring activity, decreases the incentives of prospective firms to develop more efficient technologies that allow them to compete against the incumbent[24]. Thus, the classic trade-off between rent extraction and incentives will also appear, but in the form of a trade-off between rent extraction and entry. If the main concern of authorities is about encouraging entry and competition in the downstream market, then applying this contingent monitoring policy might be not advisable.

6 Active Entrant

In our setting, the monitoring of downstream costs is triggered by the optimal policy that the CA has committed to execute. The entrant plays no active role in disclosing predation. Although in practice the CA can start a predation suit without a complaint from the victim, the latter always plays

that the reason why Mercury, the rival of British Telecom (BT) in U.K., found impossible to gain a larger market share was probably due to the high-powered incentives schemes of the pricing system applied to BT.

[24]This dynamic issue is not captured in our model since θ is exogenous. However, if we make the cost advantage of the entrant endogenous, then it is clear that the incentive for increase θ is reduced.

a role in this type of investigation. Furthermore, in the present model, the entrant has perfect information about relevant market variables (θ, γ) and antitrust policy as well as access charge is public knowledge, so the entrant knows exactly when predation takes place. The crucial question is whether the entrant is able to credibly transmit information to the CA, and how the CA should modify its monitoring policy upon the message received from that firm. Unfortunately, it is not possible for the CA to identify messages coming from entrants which have genuinely been preyed upon, because in any case -whether preyed upon or not - that firm has incentives to claim that is a victim of predation. When predation occurs $(\theta \leq \theta^*)$, it is obvious that the entrant will ask for monitoring. In the opposite case $(\theta \geq \theta^*)$, the entrant will also demand antitrust action because although he is not quitting, the monitoring induces the incumbent to price less aggressively which increases entrant profits. The CA wants to act in the first case, but not in the second. Yet, the agency cannot distinguish, from a message sent by the entrant, in which case they are. In conclusion, there is no improvement of information from an entrant claim when the communication is in a cheap talk way.

7 Conclusion

The efforts of the regulator to reduce upstream rents through setting lower access charges induces the incumbent to get rents downstream by pricing more aggressively and thus deterring efficient entry of financially weak firms. The impossibility of the authorities to freely observe downstream costs makes the predatory strategy profitable for incumbent for some states of the nature and allows the incumbent to obtain rents in the downstream market. In order to optimally set the policy variables of both agencies, each of them must know how its strategy or policy affect the policy of the other. What we found is a complementarity between antitrust and regulatory efforts, which implies that a weak regulation about the access to the essential input will induce a softer antitrust response aimed to deter predation. This result has important policy implications that are relevant at the moment of designing the institutions in charge of the well functioning of the markets in the network industries. Endowing a regulatory agency with more resources to reduce the informational gap with the regulated firm will trigger more antitrust action in the unregulated segment of the market. In other words, deterring predation is more valuable, in term of social benefit, when the regulatory agency is more reliable in capturing the upstream rents from the incumbent. A related message is that a stronger antitrust agency is not the appropriate solution to the problems derived form a lax regulation

We also provides a rationale for using an imputation test that is based in both incumbent and entrant downstream costs. This contingent predation test avoids to punish prices that are below the Nash-static level but do not lead to the exit of competitors. By applying such a test we eliminate the harmful effect of market monitoring, which in turn induces the agencies to increase their respective efforts.

8 Appendix

A.1 If W_1 and W_2 are both linear in a and e, we can rewrite the first order condition for a and e as :

$$f(\theta^*)[W_1(\theta^*, a, e) + W_2(\theta^*, a) + (\frac{\partial W_1}{\partial a} + \frac{\partial W_2}{\partial a})h(\theta^*)] = 0$$

$$f(\theta^*)[F(W_1(\theta^*, a, e) + W_2(\theta^*, a)) + \frac{\partial W_1}{\partial e} h(\theta^*)] + c'(e) = 0$$

Where $h(\theta) = \frac{[1-F(\theta^*)]}{f(\theta^*)}$ is the hazard rate.

Given that $\frac{\partial \theta^*}{\partial a} = -1$,computing second order conditions for a at the optimum yields to :

$$\frac{\partial^2 U}{\partial a^2} = f(\theta^*)[(\frac{\partial W_1}{\partial a} + \frac{\partial W_2}{\partial a})(1 - h'()) - (\frac{\partial W_1}{\partial \theta} + \frac{\partial W_2}{\partial \theta})]$$

The first term in the right hand side is negative since $\frac{\partial W_i()}{\partial \theta} \geq 0$ and $\frac{\partial W_i()}{\partial a} \leq 0$ for $i = 1, 2$ and $\frac{\partial \theta^*}{\partial a} \leq 0$. The second term is negative if the hazard rate is decreasing. Therefore, $h'() \leq 0$ is the sufficient condition for having an interior solution for a.

We need to calculate the Hessian in order to verify the condition for having a local maximum.

For the effort e of competition agency we have that second order conditions in the optimum are:

$$\frac{\partial^2 U}{\partial e^2} = f(\theta^*)[\frac{\partial W_1}{\partial e} F(1 - h'()) - F^2(\frac{\partial W_1}{\partial \theta} + \frac{\partial W_2}{\partial \theta})] - \frac{f'()}{f(\theta^*)} F c'(e) - c''(e)$$

The cross derivative at the optimum leads to:

$$\frac{\partial^2 U}{\partial a \partial e} = f(\theta^*)[-(\frac{\partial W_1}{\partial a} + \frac{\partial W_2}{\partial a})h'()F - (\frac{\partial W_1}{\partial \theta} + \frac{\partial W_2}{\partial \theta})F + \frac{\partial W_1}{\partial e}]$$

If the welfare function is linear, with zero weight in firms profits, then, $W_1 = 2(S-a) - eF$ and $W_2 = (S-a)$.

Then, the Hessian: $\frac{\partial^2 U}{\partial a^2}\frac{\partial^2 U}{\partial e^2} - \left[\frac{\partial^2 U}{\partial a \partial e}\right]^2$ is equal to:$3f(1-h_1)\left[f(F - F^2 h_1) + f\acute{}()\frac{F}{f}c\acute{}() + c\acute{}()\right] - f^2F^2(1-3h_1)^2$.

Under the sufficient conditions of:

(i) Strong convexity of the monitoring cost function: $f\acute{}()\frac{F}{f}c\acute{}() + c\acute{}() \geq 0$.

(ii) Fine has a upper bound threshold given by: $F_{Max} = \frac{3(1-h\acute{}())}{(1-3h\acute{}())}$

The sign of the Hessian is positive, and we are in presence of a local maximum.

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A.2 We obtain results for the particular case of uniform distribution function in θ, no weight on firms profits and a explicit monitoring cost function: $c(e) = \frac{\alpha}{2}e^2$.

For a normal distribution in the interval $\left[0, \bar{\theta}\right]$, we have that $f(\theta) = \frac{1}{\bar{\theta}}$ and $F() = \frac{\theta}{\bar{\theta}}$. The objective function is equal to the expected consumer surplus gains minus the cost of monitoring: $U = \int_{\theta^*}^{\bar{\theta}} (W_1(\theta, a, e) + W_2(\theta, a)) - c(e)$

In the first period if entry occurs, the gain for consumers is equal to the difference in price, which is: $(S + \gamma) - \widehat{p} = S + \gamma - (2a + \gamma - S + eF) = 2(S - a) - e\digamma$. In the second period there is no predation, thus if entry took place at the beginning, then the price in T=2 is equal to $p = a + \gamma$. Compared with the no entry situation, consumers gains are equivalent to: $(S + \gamma) - (a + \gamma) = S - a$. Hence, we obtain: $W_1(a, e) = 2(S - a) - e\digamma$ and $W_2(a) = S - a$. The binding constraint is the predatory, then $\theta^* = S + K - A - a - e\digamma$.

We can re-write the objective function as: $U = [3(S - a) - e\digamma][1 - F(\theta^*)] - c(e) = [3(S - a) - e\digamma]\left[1 - \frac{\theta^*}{\bar{\theta}}\right] - \frac{\alpha}{2}e^2$.

The agencies solve the following problem: $\text{Max}_{\{a,e\}} : U(a, e) = \frac{1}{\bar{\theta}}[3(S - a) - e\digamma]\left[\bar{\theta} - \theta^*(a,\right.$ $\frac{\alpha}{2}e^2$.

The first order condition for a, e gives us:

$\frac{\partial U}{\partial a} = \frac{1}{\bar{\theta}}\left[-3\left(\bar{\theta} - \theta^*\right) + 3(S - a) - e\digamma\right] = 0$

$\frac{\partial U}{\partial e} = -\frac{\digamma}{\bar{\theta}}\left[\left(\bar{\theta} - \theta^*\right) + 3(S - a) - e\digamma\right] - \alpha e = 0$

Second order conditions:

$\frac{\partial^2 U}{\partial a^2} = -\frac{6}{\bar{\theta}} \leq 0$

$\frac{\partial^2 U}{\partial e^2} = -\frac{2}{\bar{\theta}}\digamma^2 - \alpha \leq 0$

$\frac{\partial^2 U}{\partial e \partial a} = -\frac{4\digamma}{\bar{\theta}}$

Calculating the Hessian, the condition for having a maximum is given by: $\alpha \geq \frac{2}{3}\frac{\digamma^2}{\bar{\theta}}$. This condition imposes a lower bound in the parameter α which represents the convexity of the monitoring cost function. This requirement says that monitoring the market has to increase highly enough in order to have an interior solution. On the contrary, if monitoring is rather costless, the agencies will always prefer to count on monitoring to dissuade predation because it produces less distortion in prices than using access charge. In this latter case, the optimum will be an interior solution with $a^* = a\min = 0$.

The reaction function of the agencies are the following:

$a^*(e) = S - \frac{1}{2}\left(\bar{\theta} - K + A\right) - \frac{2}{3}e\digamma$.

$e^*(a) = \frac{\digamma}{2\digamma^2 + \alpha\bar{\theta}}\left(4S + K - A - \bar{\theta} - 4a\right)$

Form the above equation we can observe that both reaction functions are decreasing in the other parameter i.e. $a'(e) \leq 0$ and $e'(a) \leq 0$. Thus if S.O.C. are satisfied, then the access charge a and the monitoring effort e are strategic substitutes.

In equilibrium we obtain the following level of access charge and monitoring effort:

$a^* = S - \frac{1}{2}\frac{3\alpha\bar{\theta}+2F^2}{3\alpha\bar{\theta}-2F^2}\left(\bar{\theta} - K + A\right)$

$e^* = \frac{3F}{3\alpha\bar{\theta}-2F^2}\left(\bar{\theta} - K + A\right)$

In order to check that predation constraint is binding, we need to satisfy the condition of $a_p^* \leq \hat{a}$. The threshold $\hat{a}$ is obtained from the intersection of both constraints entry and predation and corresponds to the value of access charge that makes both constraint equivalent. Thus, from equations 8 and 9 we have: $\hat{a} = S - 2A$. Then, $a_p^* \leq \hat{a} \Longleftrightarrow S - \frac{1}{2}\frac{3\alpha\bar{\theta}+2F^2}{3\alpha\bar{\theta}-2F^2}\left(\bar{\theta} - K + A\right) \leq S - 2A$. $\Leftrightarrow A \leq \left(\bar{\theta} - K\right)\frac{\Phi}{4-\Phi} \equiv A_p$, where $\Phi = \frac{3\alpha\bar{\theta}+2F^2}{3\alpha\bar{\theta}-2F^2}$. Therefore, A has to be below a threshold value A_p in order to have the predation constraint being active. This condition has the interpretation that the entrant is severely cash constrained. In other words, the condition for A goes beyond to require $A \leq K$.

If only entry constraint is binding, we have: $\theta^* = \frac{1}{2}(S-a) + K - eF$. First order conditions change to:

$\frac{\partial U}{\partial a} = \frac{1}{\bar{\theta}}\left[-3\left(\bar{\theta} - \theta^*\right) + \frac{1}{2}(3S - 3a - eF)\right] = 0$

$\frac{\partial U}{\partial e} = -\frac{F}{\bar{\theta}}\left[\left(\bar{\theta} - \theta^*\right) + 3(S-a) - eF\right] - \alpha e = 0$

Second order conditions

$\frac{\partial^2 U}{\partial a^2} = -\frac{3}{\bar{\theta}} \leq 0$

$\frac{\partial^2 U}{\partial e^2} = -\frac{2}{\bar{\theta}}F^2 - \alpha \leq 0$

$\frac{\partial^2 U}{\partial e \partial a} = -\frac{7F}{2\bar{\theta}}$

In order to have a maximum, the Hessian imposes the following condition: $\alpha \geq \frac{25}{12}\frac{F^2}{\bar{\theta}}$, which has the same interpretation as in the case where the predation constraint is binding, although, the requirement in terms of the convexity of the cost function is now bigger.

The reaction function are the following:

$a^*(e) = S - \bar{\theta} + K - \frac{7}{6}eF$.

$e^*(a) = \frac{F}{2F^2+\alpha\bar{\theta}}\left[\frac{7}{2}(S-a) + K - \bar{\theta}\right]$

The optimum values are:

$a^* = S - \frac{12\alpha\bar{\theta}+10F^2}{12\alpha\bar{\theta}-25F^2}\left(\bar{\theta} - K\right)$

$e^* = \frac{30F}{12\alpha\bar{\theta}-25F^2}\left(\bar{\theta} - K\right)$

To satisfy the condition that the entry constraint is binding, we need: $a_e^* \geq \hat{a} = S - 2A$. This is true if and only if: $A \geq \frac{1}{2}\left(\bar{\theta} - K\right)\frac{12\alpha\bar{\theta}+10F^2}{12\alpha\bar{\theta}-25F^2} \equiv A_e$.

The possibility of having two candidates for an optimum corresponds to the case when both conditions are satisfied, i.e. if $a_p^* \leq \hat{a}$ and $a_e^* \geq \hat{a}$. This is equivalent to have: $A_e \leq A \leq A_p$. These conditions are feasible if and only if:

$A_e \leq A_p \Leftrightarrow \frac{1}{2}\left(\bar{\theta} - K\right)\frac{12\alpha\bar{\theta}+10F^2}{12\alpha\bar{\theta}-25F^2} \leq \left(\bar{\theta} - K\right)\frac{\Phi}{4-\Phi} \Leftrightarrow \frac{6\alpha\bar{\theta}+5F^2}{12\alpha\bar{\theta}-25F^2} \leq \frac{3\alpha\bar{\theta}+2F^2}{9\alpha\bar{\theta}-6F^2}$

$\Leftrightarrow 9(\alpha\theta)^2 + 30\alpha\theta F^2 + 10F^4 \leq 0$

Since the parameters α, θ are positive, it is impossible that the above inequality be satisfied. Therefore, we have that always $A_e \geq A_p$. This relationship between the thresholds A_e, A_p implies that it is not feasible to have both critical access charges a_e^*, a_p^* as possible alternative values for a maximum. In the case of $A_p \leq A \leq A_e$, neither the predatory constraint nor the entry constraint only by themselves guarantee the existence of a maximum. Since the case of no binding constraint is ruled out because it has no economic sense, then the only interpretation for the intermediate values of A is having both constraint binding simultaneously. Then, if $A_p \leq A \leq A_e$, $a^* = \hat{a} = S - 2A$. The optimal monitoring effort is obtained from the first order condition (equation 12), from where we get:

$e^* = \frac{F}{2F^2+2\alpha\bar{\theta}} \left(7A - K - \bar{\theta}\right)$

Summarizing, the optimal values of a and e in function of the liquidity A of the entrant are the following:

If $A \leq A_p \Rightarrow \quad a^* = S - \frac{1}{2}\frac{3\alpha\bar{\theta}+2F^2}{3\alpha\bar{\theta}-2F^2} \left(\bar{\theta} - K + A\right)$ and $e^* = \frac{3F}{3\alpha\bar{\theta}-2F^2} \left(\bar{\theta} - K + A\right)$

If $A_p \leq A \leq A_e \Rightarrow a^* = \hat{a} = S - 2A$ and $e^* = \frac{F}{2F^2+2\alpha\bar{\theta}} \left(7A - K - \bar{\theta}\right)$

If $A \leq A_e, \Rightarrow a^* = S - \frac{12\alpha\bar{\theta}+10F^2}{12\alpha\bar{\theta}-25F^2} \left(\bar{\theta} - K\right)$ and $e^* = \frac{30F}{12\alpha\bar{\theta}-25F^2} \left(\bar{\theta} - K\right)$

About the relationship of substitution between a and e, we can see that for any value of A, $e(a)$ is always a decreasing function. In the case of the access charge, $a(e)$ is strictly decreasing when only one of the constraints is binding, however if both are active, the optimal access charge is independent of the monitoring effort e.

References

[1] Biglaiser, G and P. de Graba (2001) "Downstream integration by a bottleneck input supplier whose regulated wholesale prices are above costs". *Rand Journal of Economics*. 32: 302 - 15.

[2] Besanko, D and D Spulber (1989). "Antitrust enforcement under asymmetric information" *The Economic Journal*. 99: 408-25.

[3] Bolton, P and D. Scharfstein (1990). "A theory of predation based in agency problems in financial contracting". *American Economic Review* 80: 94 - 106.

[4] Brennan, T (1987). "Why regulated firms should be kept out of unregulated markets: understanding the divestiture in United Sataes v. ATT", *The Antitrust Bulletin*, Fall 741-793.

[5] Cabral, L and M. Riordan (1997). "The learning curve, predation, antitrust and welfare", *The Journal of Industrial Economics*, XLV, 2: 155-69.

[6] Faure-Grimaud, A. (1997) "The regulation of predatory firms", *Journal of Economics & Management Strategy*, Vol 6, 849 -76.

[7] Holmstron B and J Tirole (1997). "Financial intermediation, loanable funds and the real sector", *Quarterly Journal of Economics,* 112: 663-92

[8] Baron, D and R. Myerson (1982). "Regulating a monopolist with unknown costs", *Econometrica* 50: 911 -30

[9] Laffont, J.J. and Tirole, J. (1986). "Using cost observation to regulate firms", *Journal of Political Economy* 94

[10] Lee, S and J. Hamilton (1999) "Using market structure to regulate a vertically integrated monopolist" *Journal of Regulatory Economics*, 15: 223-248

[11] Mandy, D (2000). "Killing the goose that may have laid the golden egg: Only the data know whether sabotage pays" *Journal of Regulatory Economics*, 17.2 157 -172

[12] Milgrom P and J. Roberts (1982). "Limit pricing and entry under incomplete information: An equilibrium analysis", *Econometrica* 50: 443 -59

[13] Scharfstein, D (1984). "A policy to prevent rational test-market predation" *Rand Journal of Economics*, 15: 229-43

[14] Sibley D. and D.Weisman (1998). "Raising rivals costs: The entry of an upstream monopolist into downstream markets", *Information Economics and Policy*. 10: 451-70

[15] Vickers, J (1995). "Competition and regulation in vertically related markets", *Review of Economics Studies* 62: 1 -17