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HORIZONTAL MERGERS IN INTERNET

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Abstract

Our work concerns the Internet network. We propose to modify the traditional analysis of the theoretical economic literature which emphasizes on the vertical integration among backbones and ISPs, and his difficulties because IBPs have a strong market power. We propose to build a sequential game in two stages. We consider on the downstream market a competition between ISP horizontally differentiated, while on the upstream market, the IBP compete à la Cournot. In absence of regulation on the upstream, we find that, a merger among ISPs can under certain conditions decrease the access charge, by valorizing of the positive externalities in installed bases. Such a result can justify a softer anti-trust authorities' judgment.

1 Introduction

The telecommunication's sector articulates today around the multimedia convergence. The phenomenon is illustrated by a technologic convergence about final services and infrastructures. This one has not succeed yet. We can see at least two reasons at this difficult beginning. The first one is naturally, the severe financial crisis that this industry crosses since some years. The second one, for its part, results from the industrial organization and the capacity of this universal market to build itself. This slow starting up is one of the concerns of regulators, antitrust authorities and operators which compete on this platform. The organization of this industry is complex. For simplicity, we can distinguish different layers of players : Internet Backbone Providers (IBP)S, Internet Service Providers (ISPs) and end users. End users communicate with each other using ISPs or IBPs when they are vertically integrated (by selling access directly to end users). ISPs are generaly connected to others ISPs through IBPs. Communications between end users requires an essential input, the local loop, which is generaly strongly regulated. In other words, the Internet access service is similar to the traditional long-distance service. Indeed, some firms offer service through facilities that they own or lease, other resell service from such facilities-based providers and other provide service through a combination of their owned or leased facilities and resold services. Similarly many ISPs provide Internet access using their own backbone networks, facilities-based Internet Service Providers (or IBPs). Other ISPs offer service entirely by purchasing Internet access service at wholesale and reselling it at detail. Actually, antitrust authorities have questioned whether larger backbone providers are able to maintain and exploit market power through connectivity with service providers. Recently, the backbone consolidation during the MCI/WorldCom merger proceeding illustrated this concern as well and emphasize the horizontal concentration. It is worth to remark that if the ISPs market is widely competitive, it is not the case of the upstream market (IBPs) which is strongly concentrated. According to Kende [2000] it exists, five top-tier backbones, Americans (UUNET Technologies, Internet MCI, Genuity, AT&T, Sprint), whose the activity represents 80 % of Internet traffic. Backbone's vertical integration could also lead to market power. Indeed, backbones like WorldCom and Sprint could engage in anti-competitive actions in the downstream market from directly refusing to provide upstream interconnection or raising rival's costs manipulating access prices.

In this paper, we focus on transit arrangement between backbones and service providers: ISP pays backbones for interconnection, and therefore becomes a wholesale customer of them We examine how the downstream market competition affects access prices on the Internet access market. More precisely, this paper discusses relationships between ISPs market concentration and Internet backbones market power. The literature on Internet competition refers generally to two problems. On the one hand, analysis focused on the interconnection problem and its quality, more exactly on compatibility or globally the research of ubiquitous connectivity. Cremer Rey & Tirole [2000] analyze the trade off between a demand expansion effect and the quality differentiation effect. They show that any IBP who possesses an advantage in installed bases, has an incentive to degrade the quality of the connectivity especially when is advantage in installed bases is strong. Dogan [2001] focuses on the vertical relations among backbones and ISP. This paper presents a model based on horizontal differentiation between ISPs and shows the risks bound to the vertical integration between a backbone and a provider. The result shows that the larger backbones has a incentive to the vertical integration when differences in installed bases are rather small. On the other hand, literature was interested in pricing strategies (access charge) for the "bottleneck" which is offered by IBPs on the intermediate market. This concern puts in particular the problem of the IBP's market power due to the fact that the market structure is relatively concentrated. In Europe, this problem grows up because European authorities can't act directly on the top-tier backbones because of their nationality. Foros, Kind & Sorgard [2002] put the problems of foreclosure and quality of access service supplied. They consider a hierarchical structure: at the top of the network the upstream IBP, at the intermediate level the LAP (Local Access Providers) who supply the essential input at the local loop level to the downstream the ISPs, in order that they reach subscribers. They show how local regulation on LAP can answer to the inefficiency generated from the concentrated upstream market. In this case, the access charge regulation allows to reduce the IBP's power market.

Our contribution extend the framework of recent papers that have also studied networks competition with asymmetric firms. Dessein (2004) assumes customers' heterogeneity in demand and shows that under some conditions, the 'profit neutrality' still holds.

Carter and Wright (2003) introduce asymmetric market shares coming from exogenous brand loyalty. They show that this type of asymmetry induces the larger network to prefer the access charge to be set at the marginal cost of termination. We believe this asymmetry to be an interesting question that has not yet been addressed by the literature on Internet competition to justify market concentration and mergers between ISPs.

We propose a model of vertical relations in which we grant a particular interest to the antitrust policy. Indeed, we suggest in our work to use another tool allowing to analyze the inefficiency caused by the strong IBP's market power. For this purpose, we build a model which refers both to the economy of networks (Katz-Shapiro [1985, 1994]), and of the literature of the mergers analysis. (Farell-Shapiro [1990]). We consider a vertical industrial structure in which two firms on the upstream market (IBPs) compete *à la Cournot* and three firms downstream (ISPs) compete in two part tariffs. Furthermore, the ISPs offer installed base to consumers and are differentiated. We analyze a two stages game where IBPs first choose their quantity, then ISP's competition takes place. Our results show how merger on the downstream market affects prices both final market and access. In fact two effects occur: a *market power effect* and a *network effect*. The first effect, *market power effect*, is traditional, it results simply from the variation of prices which follows up an increase of market power. In fact, there are two price effects because there is a pricing in two-part. First, we observe that the marginal price tends to decrease. More precisely, this effect is different for insiders and outsiders. Second, the fee tends to increase because the downstream firms search to pick up more consumers' surplus, since naturally the competitive pressure decreases. The second effect, *network effect,* expresses the fact that merger leads to an increase of the merged firm installed base. The merger thus internalizes the indirect externality and then has an effect on prices. We examine then the trade off between both opposite effects. The key insight of the paper is that the *network effect* can dominate the *market power effect* and then reduces the risk of too much raised access price. The intuition of this result is straightforward. The merger reduces the off-net traffic because the merged firm has more on-net traffic given its important installed bases. This conducts to limit the demand for the connectivity and then reduces demand for IBPs. Backbones have then an incentive to decrease their access price. This result puts in perspective the traditional antitrust laws sights and besides, allows to justify the consolidation's wave. Being softer on horizontal mergers decisions between small Internet backbones (here ISPs), local antitrust authorities allow a more efficient market, reducing IBPs rents.

The paper is organized as follows. In section 2, we examine the basic model in which we consider price competition between downstream firms and competition *à la Cournot* on upstream market. Section 3 analyses effects of mergers in ISP market. Section 4 offers some conclusive remarks.

2 The analysis framework

The model that we propose builds on the framework of Laffont, Rey and Tirole (1998a) (hereafter LRT). We consider a vertically organized industry. On the downstream market, three ISPs differentiated in variety compete in price. We denote these firms by i, with $i = A,\ B, C$. We assume a competitive upstream market between two IBPs,noted j with $j = 1,\ 2$. There is an horizontal relationship between backbones, which allows to exchange all the traffic, called the connectivity or network's ubiquity. For example, a consumer will be able send mails to an user interconnected to another ISP, only if an horizontal connection exists in the upstream market. Finally, for simplification we postulate that backbones peer each other, and no purchase transit for their own horizontal interconnection. Moreover, the connectivity level is set at the maximum of the minimum required level. This allows an acceptable connection level for a normal working of the network. So the connectivity parameter $\theta = 0$[1]. Actually, we consider a circular model in which independent downstream firms are symmetrically localized, and the consumers are uniformly distributed along this unit circle. Each ISP offers installed base β_i to consumers. We assume that $\beta_i = \beta, \forall i$. Firms use the same technology with a constant marginal cost c, which is for convenience set to 0. They offer a non linear pricing

$$T(q_i) = F_i + p_i q_i \tag{1}$$

where F_i is the fixed fee supported by consumers to join a network, and p_i is the marginal price relative to the network use. We can express the net surplus for one consumer as the

[1] For a formal discussion on this particular point see Marcus, Laffont Rey & Tirole : Connectivity in Internet" [2001]

following one

$$w_i = v(p_i) - F_i \tag{2}$$

Connecting a customer involves a fixed cost $f \geq 0$. We assume with LRT that the consumption utility is :

$$u(q_i) = \frac{q_i^{1-\frac{1}{\eta}}}{1-\frac{1}{\eta}}$$

where q_i represents the demand of each consumer and η is the constant elasticity Then the demand function is given by :

$$q_i = p_i^{-\eta}$$

and the indirect utility is

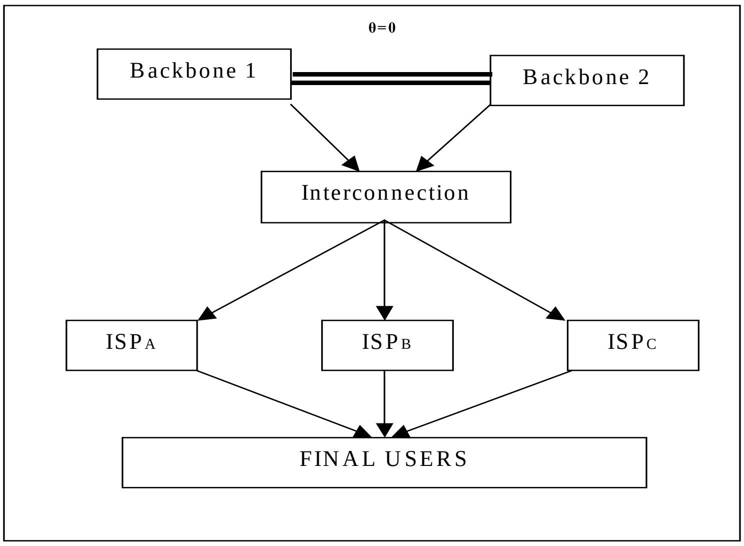
$$v(p_i) = \frac{p_i^{-(\eta-1)}}{\eta - 1} \tag{3}$$

Naturally we assume only the case where the elasticity η is superior to 1. A consumer localized at x who chooses ISP i has a net utility :

$$v_0 + v(p_i) - F_i - t(x - x_i) + \delta(\beta_i + n_i)$$

where t the unit transport cost, x_i the localization of ISPi and δ an externality parameter. Note that we suppose that the utility depends on the anticipated number of consumers of network i. Following Katz-Shapiro [1985], here it is worth to remark, that consumers set their rational anticipations only about one network, and not about the total installed bases on the downstream market. This involves that the final users are myopic relatively to the global industrial structure, in particular with the upstream market. Obviously, the backbones choose the compatibility or connectivity level, θ, and consumers consider only that they can exchange traffic with anyone else connected. In the paper we stand out

IBPs and ISPs. In order to specify the features of upstream and downstream networks we can assert that an IBP is an international ISP. The only difference between the networks is the geographical coverage. Thus, we consider that there is two types of traffic. On the one hand, an on-net traffic, which concerns traffic between end users who are connected at the same ISP. On the other hand, an off-net traffic when end users belong to different regional ISPs. The latter one seems as the isotropic traffic, this conduct to consider that the proportion of calls originating on a network that terminates on the other network is proportional to the latter network's market share. However, we assume no discrimination between on-net and off-net calls. So, we adopt the balanced calling pattern assumption[2]. The structure of the model is then depicted in the following picture:



Market structure in Internet

On the downstream market, the marginal consumer who is localized in x is indifferent between two ISPs, for instance A and B if and only if

$$v(p_A) - F_A - tx + \delta(\beta_A + n_A) = v(p_B) - F_B - t(\frac{1}{3} - x) + \delta(\beta_B + n_B)$$

The same trade-off exist between a consumer localized between A and C. So Finally we can write that the market share which addresses to ISP_A is given by

$$2x = \frac{1}{3} + \frac{2v(p_A) - 2F_A - v(p_B) + F_B - v(p_C) + F_C + \delta(2\beta_A - \beta_B - \beta_C)}{(t-\delta)}$$

that is

$$\alpha_A = \alpha_A(w_A, w_B, w_C) = \frac{1}{3} + \sigma\left[2w_a - w_b - w_c\right] \quad (4)$$

with $\sigma = \frac{1}{2(t-\delta)}$, where we assume $t > \delta$. The parameter σ represents an index of substituability between networks, its function is to regulate the intensity of price competition. We assume away market cornering in the downstream market. For this, we suppose as Dogan [2001] there is not possible to have large asymmetries in installed bases and we put $\beta < \frac{(t-\delta)}{\delta}$. For the moment we assume, in this competitve downstream market that there are symmetric installed bases. In fact α_i represents only the number of consumers connected at the ISP_i. The real demand has to take into account quantities of traffic

[2] As similar assumption see LRT (1998).

asked by every consumers having been connected. Symmetry requires the market shares for ISP_B and ISP_C We can then express this demand as $D(p_i) = \alpha_i q_i$. with $i = A, B, C$. This is the total demand for the traffic splits up between the on-net and the off net traffic. First, the off-net demand traffic is given by the following expression $\alpha_i(1 - \alpha_i)q_i$ for each ISP i. And the on-net traffic is given by $(\alpha_i - \alpha_i(1 - \alpha_i))q_i$. That is $\alpha_i^2 q_i$ for each ISP i.Moreover we assume that each unity of access is asked by unity of off-net traffic.

3 The basic model

In this section we provide a simple framework for the hierarchical organization of Internet market. We focus on the horizontal relationships between the ISPs, but we take into account the vertical ones. Then we consider, a competitive industry in downstream, and an upstream duopoly. In the downstream market ISPs offer a two-part tariff. In the upstream market two IBPs compete *à la Cournot,* and provide connectivity at the overall industry. We consider the same framework that we have depicted in the section 2 and we study the following sequential game. At the first stage, in the upstream market, firms compete *à la Cournot* and provide a homogeneous product (network access) at the price a. At the second stage the downstream firms, ISPs, compete with each other in a two-part pricing and provide Internet services to end users. In the two following subsections, we present the pre-merger competition.

3.1 Downstream competition

We consider three ISPs competing in a two-part tariff, given by (1). Each unit of off-net call requires a unit of access. We suppose that there is no price discrimination for end users between on-net and off-net calls. The profit of ISP is then given by:

$$\pi_i = \alpha_i \left(p_i q(p_i) + v(p_i) - w_i - f \right) - \alpha_i (1 - \alpha_i) a q(p_i) = A, B, C \tag{5}$$

which can be decomposed in two terms. The first, represents the profit from subscription while the second term is the access cost. We assume a unit access price which captures the difference between two unit prices of access between IBPs and ISPs. So in the model, the ISPs have no access revenue from backbones. There is a net positive payment from

ISPs to IBPs noted a. This is the *off-net cost pricing principle*, pointed out by Laffont, Marcus, Rey and Tirole [2002]. The ISPs then maximize their own profit. And the first order conditions expresse:

$$\frac{\partial \pi_i}{\partial p_i} = \alpha_i q(p_i) + q_i'[p_i - (1-\alpha_i)\, a]\alpha_i - q(p_i)\alpha_i = 0 \tag{6}$$

and

$$\frac{\partial \pi_i}{\partial w_i} = 2\sigma\left[(p_i - (1-\alpha_i)a)\, q(p_i) + v(p_i) - w_i - f + aq(p_i)\alpha_i\right] - \alpha_i = 0 \tag{7}$$

>From (6), the marginal price for ISP i is given by:

$$p_i^*(a) = (1-\alpha_i^*)\, a \tag{8}$$

>From (7), and after some manipulations, we can assert that the fixed fee of tariff takes the following form:

$$F_i^* = f + \alpha_i^*(\frac{1}{2\sigma} - aq(p_i)) \tag{9}$$

With LRT, we argue there exists an unique and symetric equilibrium characterized by the following lemma.

Lemma 1 *: With a non linear pricing and in presence of downstream competitive market, the marginal price is not exactly the marginal cost of the industry but especially the marginal cost faced by the ISP i, so* $\alpha_i^* = \frac{1}{3}$ *and* $p_i^*(a) = \frac{2}{3}a$

As underlined by LRT, this price reflects the real marginal cost, the firm faces. We observe that the marginal price is increasing with the rival's market shares and with the access price. Unlike, the fixed fee F_i^*, increases with the own market share of the network i. So the higher is market power, the higher is fixed fee for joining the network. This effect is a classic one. Higher is the market share, higher is the market power more the firm is able to extract consumer's surplus. At contrast, F_i^* is decreasing with the substitutability between networks, σ. Naturally, more competition is strengthened more the IBPs' market power tends to decrease. Last, the fixed fee increases with the access price. In the following, we determine the pricing level of the access without regulation. That means we consider, there is a competition on the upstreamm market, and the backbones themselves set the price of the 'bottleneck', while there is always a Bertrand competition on the downstream market as above.

3.2 Competition between backbones

We now study the upstream market competition between the two IBPs. This market is assumed to be a symmetric duopoly. According to assumptions, demand for the IBPs takes into account only the off-net traffic. So, the total demand of off-net flows is given by $3\alpha_i^*(1-\alpha_i^*)q(p_i)$. Nevertheless, at equilibrium we know that $\alpha_i^* = \frac{1}{3}$, and by assumption $q(p_i) = p_i^{-\eta}$. We note respectively y_j with $j = 1, 2$ the quantity of the essential input for IBP_1 and IBP_2, and $Y(a) = y_1 + y_2$ such as:

$$Y(a) = y_1 + y_2 = \frac{2}{3}q(p_i) = \frac{2}{3}\left(\frac{2}{3}a\right)^{-\eta} \tag{10}$$

Finally the demand has the following form:

$$a(Y) = \left(\frac{3}{2}\right)^{\frac{\eta-1}{\eta}} Y^{\left(-\frac{1}{\eta}\right)} - \frac{3}{2}c$$

The profit of IBP i is given by:

$$\pi_{IBPj}(Y) = (a(Y) - k)y_j \tag{11}$$

where k is the unit cost for access. The first order condition for backbones profit maximization is:

$$\frac{\partial \pi_{IBP_j}}{\partial y_j} = \frac{da}{dY}\frac{Y}{2} + a - k = 0$$

It then occurs :

$$\left(\frac{a-k}{a}\right) = \frac{1}{2\left(-\frac{dY}{dp}\frac{p}{Y}\right)\left(\frac{dp}{da}\frac{a}{p}\right)} \tag{12}$$

At equilibrium, we find the traditional pricing rule: the Lerner index is related to the demand elasticity and to the elasticity of end price with access charge. After some manipulations (12) becomes:

$$\left(\frac{a^* - k}{a^*}\right) = \frac{1}{2\eta}$$

Proposition 1 *: In the pre-merger situation, the access charge pricing is given by the traditional Lerner pricing rule.*

In fact, in this market configuration, the level of "marginal price" has no effect on the upstream market. As the same way, the level of ISP's market share has no effect on the access charge, and the IBP's Lerner is a classic one.

4 Merger on downstream market

4.1 Equilibrium on ISP market

In this section we study the exogenous merger effect on the ISP's market, on the industry. We assume that the merger (between A and B) realizes no cost synergy, then the new entity (M) has the same constant marginal cost than the outsider C, which is again for convenience set to 0. Moreover, there is no switching cost and the marginal consumer x indifferent between M and C is given by:

$$v(p_M) - F_M - tx + \delta(\beta_M + n_M) = v(p_C) - F_C - t(1-x) + \delta(\beta_C + n_C)$$

With a two-part pricing, the market shares are determined respectively for M and C by the net surplus as follows:

$$\alpha_M(w_M, w_C) = \alpha_M = \frac{1}{2} + \sigma\left[w_M - w_C + \delta\beta\right] \tag{13}$$

$$\alpha_C(w_C, w_M) = \alpha_C = \frac{1}{2} + \sigma[w_C - w_M - \delta\beta] \tag{14}$$

With $\delta\beta = \delta\left(\beta_M - \beta_C\right) > 0$, stands out the difference in installed bases. As above, that the equations (13) and (14), are the number of consumers for the two ISPs, in which the rational expectations *à la* Katz-Shapiro play a very important role, since α_M and α_C differ in installed bases. In this situation, market shares depend on installed bases. More exactly, the competitive presure is reinforced by network externalities coming from installed bases. If the substituability between networks is weak, the asymmetry created by installed bases strengthened competition, this is not the case in the pre-merger situation. The profits respectively for merged firm and the outsider take the following form

$$\begin{aligned}\pi_i(p_i) &= \alpha_i(w_i, w_j)[p_i q(pi) - (1 - \alpha i(w_i, wj))aq(pi)] \\ &\quad + \alpha_i(w_i, w_j)(v(pi) - w_i - f)\end{aligned} \tag{15}$$

And the first order conditions for the merged firm and for the insider give the usage price:

$$p_i = \alpha_j a \tag{16}$$

and the fixed fee:

$$F_i = f + \alpha_i \left(\frac{1}{\sigma} - aq(p_i)\right) \tag{17}$$

Lemma 2 *In the merger situation, the unit price for the outsider, p_C increases with $\delta\beta$. In contrast p_M^* decreases with $\delta\beta$.*

This lemma requires some explanations. The existence of an asymmetric equilibrium is directly relied to the number of consumers connected to the merged firm. In fact α_M^* increase with the installed bases differentiation, in contrast to α_C^*. The rational expectations play fully their role in the decision process of consumers by creating an asymmetry between networks. Remember that the unit price is increasing with the rival's market share (Lemma 1), then consequently the merged firm which has the highest market share, has the lowest usage price. Moreover, the higher is the asymmetry in installed bases and the lower is the merged firm usage price. Before taking into account the merger effect on the upstream market (with a given access price), we can suggest that industry consolidation is welfare-enhancing. Indeed, it must take into account the merger effect on the upstream market, and especially the backbone reactions to the downstream merger. The potential effect of a merger which increases the merged market share is link to the ISPs off net traffic decreasing. In this contexte, what is the consequence of this merger on the access charge fixed by IBPs? Is then the access price higher or lower than in the pre-merger competition?

4.2 Upstream competition

The post merger equilibrium on the upstream market is naturally different since the installed bases are no longer symmetric. Two countervailing effects appear. The first one coming from the merger's on-net traffic which is larger (since $\alpha_M^2 q_M > \alpha_C^2 q_C$). The second in contrast, is due to the off-net traffic for the outsider which is higher. So the installed bases asymmetry implies a modification in the demand adresses to the upstream market. Actually, the proportions of off-net traffic are modified and so the demand on the upstream market too. Indeed the total traffic flow on the upstream duopoly corresponds at the sum of the off-net traffic for each ISP, and takes the following form:

$$Y(a) = \alpha_M \alpha_C \left[q_M + q_C \right] \tag{18}$$

with $q_M^* = (\alpha_C^* a)^{-\eta}$ and $q_C^* = (\alpha_M^* a)^{-\eta}$. An ambiguous effect appears since α_M^* is increased with $\delta\beta$, and α_C^* varies in the opposite sense with $\delta\beta$. We have ever seen that the merged on-net traffic increases. However the consumers of the outsider (firm C) have an incentive to send more off net flows. The question is then to know which effect dominates. The IBPs' profit writes:

$$\pi_j = (a(Y) - k)y_j$$

The first order conditions conduct to the following Lerner index which defines implicitly the equilibrium access price:

$$\left(\frac{a^M - k}{a^M}\right) = \frac{1}{2\left(-\frac{dY}{da}\frac{a^M}{Y}\right)} \tag{19}$$

Nevertheless, the mark-up depends no longer on an unique price, but simultaneously on p_C^* and p_M^*, and finally on $\alpha_M^* = 1 - \alpha_C^*$. Note that $\frac{dY}{da}\frac{a}{Y}$ can be decomposed as $\left(\frac{dY}{d\alpha_M}\frac{d\alpha_M}{da} + \frac{dY}{da}\right)\frac{a}{Y}$ and then the Lerner index rewrites:

$$\left(\frac{a^M - k}{a^M}\right) = \frac{1}{2\eta + 2\sigma\left[(1-2\alpha)\left(q_M + q_C\right) - \eta[(1-\alpha)\, q_C - \alpha q_M]\right]^2 \frac{a^M}{Y}} \tag{20}$$

Proposition 2 *Without access charge regulation, a downstream merger between ISPs allows to limit upstream market powers.*

We just give here an intuition of this result comparing the Lerner index between the pre-merger and the post-merger competition. The only difference is the following term $\left(\frac{dY}{d\alpha_M}\frac{d\alpha_M}{da}\right)$ which measures the effect of the access charge on the backbones quantity. However, this effect transits by the market share α_M. The total effect is naturally negative. More particularly we can observe two effects. The first one is the effect of the market share on backbones quantity. The second one is the effect of a change in a^M, on the market share. We prove in *appendix 2* that $\frac{dY}{d\alpha_M} > 0$ and $\frac{d\alpha_M}{da} = -\sigma\left(\frac{dY}{d\alpha_M}\right) < 0$. So these effects play in opposite sense. The former is the direct effect of the merger on the upstream market. Indeed, since we proved that $\alpha_M > \frac{1}{2}$ the calls for M are higher than the outsider calls. More interesting is to compare the total off-net traffic. In case of a dowstream merger, the off-net calls are lower than in the pre-merger competition. Indeed the probability for a consumer to send a call to a consumer connected to the rival network is given by $2\alpha_M(1-\alpha_M)$ in the merger situation whereas is $\frac{2}{3}$ in the competitive situation. It is easy to see that $2\alpha_M(1-\alpha_M) < \frac{2}{3}$ for $\alpha_M > \frac{1}{2}$; this induced by the network effect. The second effect is induced by the first one: since the traffic flows for $IBPs$ is lower, they have an incentive to decrease their access price. So a lower access charge stimulating traffic on the downstrean market because this implies a lower unit price for consumers. By decreasing access charge backbones stimulate the total traffic flows and then the demand on the upstream market. Moreover, it's worth noting that lower is a^M and higher is the market share for the merged entity. This effect can appear surprising. Nevertheless this effect takes into account that the number of consumers connected is a function of the net surplus w_i.Indeed, recall, $\frac{d\alpha_M}{da} = \sigma \left(\frac{dw_M}{da} - \frac{dw_C}{da} \right)$. At the asymmetric equilibrium with $\alpha_M > \alpha_C$ the fixed fee is higher for the consumers belonging to the bigger network. As there is no discrimination on the access pricing along the downstream network, and as α_M is a function of the net surplus difference, $\frac{d\alpha_M}{da}$ only stands for the fact that the decrease of w_M and w_C is the same, so we have always the fixed fee higher for the bigger network.

5 Welfare analysis

In this section we compare the welfare in the pre-merger competition with the post-merger welfare .The welfare is defined as the sum of the consumers net surplus, the downstream profits (ISP), and upstream profits (IBP), that is

$$W = SC + \sum_i \pi_i + \sum_j \pi_j$$

The overall welfare of the industry when the downstream market is competitive is then given by

$$\begin{aligned} W^S &= 3\alpha_i \left[v(p_i) - F_i \right] - T \\ &\quad +3\alpha_i \left[(p_i - (1-\alpha_i)a^s)q(p_i) + (v(p_i) - w_i - f) \right] \\ &\quad +(a^s - k)Y^s \end{aligned}$$

At the equilibrium we have $\alpha_i = \frac{1}{3}$ and the profit for each ISP$_i$ is given by $\alpha_i \left[v(p_i) - w_i - f \right]$ since $p_i^* = (1 - \alpha_i)a$. And finally the transportation cost is given by the following expression

$$T = 6 \int_0^{\frac{1}{6}} (tx)dx = \frac{1}{12}t$$

So the pre-merger competition provides the following welfare

$$W^S = v(p_i) + (a^s - k)Y^s - \frac{t}{12} \tag{21}$$

In the merger situation the welfare is

$$\begin{aligned}W^M &= \alpha_M \left[v(p_M) - F_M\right] + \alpha_C \left[v(p_C) - F_C\right] \\ &+\alpha_M \left[(p_M - (1-\alpha_M)a^M)q(p_M) + (v(p_M) - w_M - f)\right] \\ &+\alpha_C \left[(p_C - (1-\alpha_C)a^M)q(p_C) + (v(p_C) - w_C - f)\right] \\ &+(a^M - k)Y^M - \frac{t}{4}\end{aligned}$$

where $T = 2\int_0^{\frac{\alpha_M}{2}} (tx)dx + 2\int_{\frac{\alpha_M}{2}}^{1} (tx)dx = \frac{t}{4}$. After some computations the welfare can rewrite

$$W^M = \alpha_M v(p_M) + \alpha_C v(p_C) + (a^M - k)Y^M - \frac{t}{4} \tag{22}$$

The merger effect on welfare is measured by ΔW which is defined by

$$\begin{aligned}\Delta W &= W^M - W^S \\ \Delta W &= \alpha_M v(p_M) + \alpha_C v(p_C) + (a^M - k)Y^M - \frac{t}{4} - \left(v(p_i) + (a^s - k)Y^s - \frac{t}{12}\right)\end{aligned}$$

where $v(p_i) = \frac{p_i^{-\eta+1}}{\eta-1}$. The backbones' supplies are respectively

$$\begin{aligned}Y^S &= \frac{2}{3}q_i^* \\ Y^M &= \alpha_M \alpha_C (q_M^* + q_C^*)\end{aligned}$$

The consumers surplus can rewrite $v(p_i^*) = \frac{1}{\eta-1}a^S Y^S$ in the pre-merger situation and $\alpha_M v(p_M) + \alpha_C v(p_C) = \frac{1}{\eta-1}a^M Y^M$ in the post-merger competiion. And ΔW becomes

$$\Delta W = \frac{\eta}{\eta - 1}\left[a^M Y^M - a^S Y^S\right] + k\left(Y^M - Y^s\right) - \frac{t}{3} \tag{23}$$

Proposition 3 *For α_M higher and close to $\frac{1}{2}$ and if dowstream competition is soften, the merger improve welfare.*

Proof. If the market share of merged firm is $\alpha_M = \frac{1}{2} + \varepsilon$ we can prove that $\frac{a^M Y^M}{\eta-1} = \alpha_M v(p_M^*) + \alpha_C v(p_C^*) > \frac{a^s Y^S}{\eta-1} = v(p_i^*)$. Moreover the access charge pricing is lower in the merger case than in a more competitive market. So the unique solution to have $a^M Y^M > a^s Y^S$ is that $Y^M > Y^S$. We can note finally that $a^S > a^M > k$. Then the result appears. ■

When competition is soften, the merger involves two countervailing effects. The first is an increasing of the market power on the downstream market, and the second effect is the positive network effect. The later dominates the former for σ given and not too high. Note that here, for a given $\delta\beta$ the merger creates an asymmetry on the downstream market, between the merged firm and the outsider. This asymmetry strengthens the valorization of the externality, in other words, α_M increases with $\delta\beta$, so $\alpha \gg \frac{1}{2}$ since $\alpha = \frac{1}{2} + \sigma [\Delta w + \delta\beta]$. So the condition (23) always holds with soften competition (a small σ). We can interpret this effect as the fact that firms can act as local monopolies. Moreover, less the goods are differenciated and naturally more the network externality produce by the merger is internalized, and dominates the market power effect. This results seems to be reasonable since dowstream differenciation is not too high. Note that ΔW decrease with the elasticity of the demand ($\frac{\eta}{\eta-1}$ is decreasing with η). This result is very important because it means that the more elasticity is low and the more welfare is improving. This resultes from a trade-off between IBPs' behavior and the sensibility of demand on the dowstream market. The intuition of this effect could be easly understand. Indeed, we shown that the merger increase the ISP bargaining power since the merger reduces the off-net taffic flows. Then the IBPs have an incentive to decrease the access price in order to stimulate the demand for the off-net traffic. This demand effect means that higher is the price sensibility and less the IBPs should induce an effort on the access charge pricing. In fact, there are two countervailing effects coming from a decreasing of demand elasticity. On the one hand, when the demand elasticity decreases, the unit prices increase. On the other hand, a decreasing in demand elasticity leads IBPs to reduce strongly access charge to stimulate traffic. As access charge modifies the mark-up distorsion though double marginalization effect, the former effect dominates the latter effect and the welfare increasing. unit prices are more sensible to access price than elasticity. So the post-merger welfare will be higher as the elastictiy is lower. To resume, the merger entails asymmetric market shares. This asymmetry reduces the price of the access because the off-net traffic flows are less important. On the other hand, the merger leads to a market power, but the consumers have a higher disposition to pay, because they valorize the network effect. This trade-off conducts to improve welfare because here the network effect (through installed bases) dominates the market power effect.

6 Conclusive remarks

Antitrust guidelines that place undue emphasis on market concentration in network industries, can lead policymakers to block mergers that have the potential to enhance economic welfare. These findings may serve to influence the type of information that antitrust authorities rely upon in evaluating the merits of a proposed merger. The Internet development has allowed to few international operators to exercise a market power. This is the case of the IBPs. No surprise, the regulation on this particular upstream market is not possible, since their activities are not national. Nevertheless, they offer an essential input, for market development. We have tried to answer at the following question. Since it seems very difficult to regulate these actors, are there strategic behaviors on the downstream market, independent of the national regulation, able to restrain the IBPs' market power? We can observe two effects which play in opposite sense. The first is classical, this is the price effect. It's worth noting, that the ISPs compete with non linear pricing. In the post-merger competition it turns out that the usage price is lower as long as the number of the new entity's consumers. Moreover the usage price, at the same time, for the outsider and the merged firm are lower. The second effect is the installed bases effect, which allows to restrain the market power on the upstream market. We prove that in presence of a merger on the downstream market tends to decrease the market power. This effect is directly relied to the impact of asymmetric installed bases on downstream market. Hence in the case of a bigger network the quantity of on net traffic is higher than the one of competitive situation. Moreover the total off-net traffic is lower and the backbones have an incentive to decrease the price of the connectivity. This result shows in which circumstances, an soften control of concentrations, can limit the backbones' market power. Moreover we have shown that for merger which is not too big, the decreasing of the access price stimulates the off-net traffic.

Appendix 1

- Proof of lemma 2:

At the equilibrium we have p_M^*, p_C^*, F_M^*, F_C^*. At first, we demonstrate that it is impossible to have a equality between $\alpha_M^* = \alpha_C^*$. So $\alpha_M^* = \alpha^* = \frac{1}{2}$ is always wrong. Indeed at the equilibrium the following relations must be verified

$$\alpha = \frac{1}{2} + \sigma\left[w_M - w_C + \delta\beta\right]$$

Let us put the function $\Psi(\alpha^*) = w_M^* - w_C^*$ such as

$$\Psi(\alpha^*) = v(p_M^*) - F_M^* - v(p_C^*) + F_C^*$$

Consider two cases

Case 1 *If* $\alpha^* = \frac{1}{2}$:

It means then $p_M^* = p_C^*$, $F_M^* = F_C^*$. and consequently $\psi(\alpha = \frac{1}{2}) = 0$, is equivalent to $w_M - w_C = 0$. In the other hand we have $\psi'_{|\alpha=\frac{1}{2}} = -\frac{2}{\sigma} + 4aq + a^2\eta\frac{q}{p} < 0$ with $v(p_i) = \frac{p^{-\eta+1}}{\eta-1}$ et $F_i = f + \alpha_i\left(\frac{1}{\sigma} - aq(p_i)\right)$, $\forall i = C, M$ and for σ close to zero. Finally when $\alpha = \frac{1}{2}$ the relation (13), allows us to affirm $\alpha = \frac{1}{2} + \sigma\delta\beta > \frac{1}{2}$.A contradiction

Case 2 *If* $\alpha^* < \frac{1}{2}$, *such as* $\overline{\alpha} = \frac{1}{2} - \varepsilon$

According to $\psi'(\alpha) < 0$ and $\psi(\alpha = \frac{1}{2}) = 0$, then $\psi(\overline{\alpha}) > 0$.Therefore $w_M^* - w_C^* > 0$ and (13) is not verified since $\alpha = \frac{1}{2} + \sigma\left[w_M - w_C + \delta\beta\right] < \frac{1}{2}$ is impossible. A second contradiction We can argue α is always superior to $\frac{1}{2}$, and so far $p_M^* < p_C^*$.

Appendix 2

- **Proof of the proposition 2:**

The mark-up on the upstream market is given by

$$\left(\frac{a-k}{a}\right)^{M} = \frac{1}{\left(-2\frac{dY}{d\alpha_M}\frac{d\alpha_M}{da}+\frac{dY}{da}\right)\frac{a}{Y}}$$

With

$$\frac{dY}{da}\frac{a}{Y} = \left[\left(\frac{dY}{dp_M}\frac{dp_M}{da}\right)+\left(\frac{dY}{dp_c}\frac{dp_c}{da}\right)\right]\frac{a^M}{Y^M} = -\eta$$

And we search, with $\alpha = \alpha_M$, the expression $\frac{dY}{d\alpha}$

$$\begin{aligned}\frac{dY}{d\alpha} &= (1-2\alpha)[(\alpha a)^{-\eta}+((1-\alpha)\,a)^{-\eta}] - \eta\alpha(1-\alpha)\left[\frac{(\alpha a)^{-\eta}}{\alpha}-\frac{((1-\alpha)\,a)^{-\eta}}{(1-\alpha)}\right] \\ &= (\alpha_C-\alpha_M)(q_C+q_M) - \eta\,(\alpha_C q_C - \alpha_M q_M)\end{aligned}$$

First let show that $(\alpha_C q_C - \alpha_M q_M) < 0$

$$(\alpha_C q_C - \alpha_M q_M) = (1-\alpha)(\alpha a)^{-\eta} - \alpha\,((1-\alpha)\,a)^{-\eta} < 0$$

since, where $\alpha > 1-\alpha$

$$\frac{(1-\alpha)}{\alpha} < \frac{(1-\alpha)^{-\eta}}{(\alpha)^{-\eta}}$$

Secondly we must find the sign of $\frac{dY}{d\alpha}$; We suppose $\frac{dY}{d\alpha} > 0$ so

$$\frac{(\alpha_C-\alpha_M)(q_C+q_M)}{(\alpha_C q_C - \alpha_M q_M)} < \eta$$

Then we have suppose that the elasticity is higher than 1 $\eta > 1$. Let write

$$\frac{(\alpha_C-\alpha_M)(q_C+q_M)}{(\alpha_C q_C - \alpha_M q_M)} < 1$$

which implies

$$\frac{(1-\alpha)}{\alpha} > \frac{(\alpha)^{-\eta}}{(1-\alpha)^{-\eta}}$$

That is always verified, with $\alpha > \frac{1}{2}$, so we can conclude that

$$\frac{dY}{d\alpha} > 0$$

So there is a necessary condition on $\frac{d\alpha}{da}$. Indeed if this last expression is negative then $\left(-\frac{dY}{d\alpha}\frac{d\alpha}{da}\right)$ is positive and the mark-up is lower than the one in competitive situation.

We note then $\frac{d\alpha}{da} = \left(\frac{d\alpha}{dw_M}\frac{dw_M}{da}\right) + \left(\frac{d\alpha}{dw_c}\frac{dw_C}{da}\right)$. It's easy to see that $\frac{d\alpha}{dw_M} = -\frac{d\alpha}{dw_c} = \sigma$. It follows that $\frac{d\alpha}{da} = \sigma\left(\frac{dw_M}{da} - \frac{dw_C}{da}\right)$. Furthermore the numbers of consumers connected to the merged firm M is given by the following expression $\alpha = \frac{1}{2} + \sigma\left[w_M - w_C + \delta\beta\right]$, and the expressions of the net surplus for each consumers respectively connected to the firm M and C are given by

$$\begin{aligned} w_M &= v(p_M) - F_M \\ w_C &= v(p_C) - F_C, \end{aligned}$$

With $\alpha_M = \alpha$, $\alpha_C = 1 - \alpha$, and it appears that's

$$\frac{d\alpha}{da} = \left(\frac{d\alpha}{dw_M}\frac{dw_M}{da}\right) + \left(\frac{d\alpha}{dw_c}\frac{dw_C}{da}\right)$$

with $\frac{d\alpha}{dw_M} = -\frac{d\alpha}{dw_c} = \sigma$, and

$$\begin{aligned} \frac{dw_M}{da} &= q_M\left(2\alpha - 1 - \eta\alpha\right) \\ \frac{dw_C}{da} &= q_C\left(1 - 2\alpha - \eta(1-\alpha)\right) \end{aligned}$$

$$\begin{aligned} \frac{d\alpha}{da} &= \left(\frac{d\alpha}{dw_M}\frac{dw_M}{da}\right) + \left(\frac{d\alpha}{dw_c}\frac{dw_C}{da}\right) \\ &= \sigma\left[q_M\left(2\alpha - 1 - \eta\alpha\right) - q_C\left(1 - 2\alpha - \eta(1-\alpha)\right)\right] \end{aligned}$$

with

$$\begin{aligned} q_M\left(2\alpha - 1 - \eta\alpha\right) - q_C\left(1 - 2\alpha - \eta(1-\alpha)\right) &< 0 \\ \frac{(2\alpha - 1 - \eta\alpha)}{(1 - 2\alpha - \eta(1-\alpha))} &> \frac{q_C}{q_M} \end{aligned}$$

We can transform this expression as follows

$$\eta > \frac{(2\alpha - 1)(q_M - q_C)}{\alpha q_M - (1-\alpha)q_C}$$

It means

$$\frac{q_M}{q_C} > \frac{3\alpha - 2}{\alpha - 1}$$

We know $\frac{q_M}{q_C} > 1$ and it's easy to see $\frac{3\alpha-2}{\alpha-1} < 1$. To summarize we have

$$\frac{dY}{da}\frac{a}{Y} = -\eta; \qquad \frac{dY}{d\alpha} > 0; \qquad \frac{d\alpha}{da} < 0$$

Then the denominator is always positive and higher than 2η. We can conclude

$$\left(\frac{a-k}{a}\right)_M < \left(\frac{a-k}{a}\right)_S$$

Appendix 3: Welfare analysis

We show that for transportation cost not too high the function $f(\alpha)$ is increasing and concave.

$$f(\alpha) = \frac{\eta}{\eta - 1}\left[a^M Y^M - a^S Y^S\right] - k(Y^M - Y^S) - \frac{t}{3}$$

The first derivative is given by

$$f'(\alpha) = \frac{dY^M}{d\alpha}(\frac{\eta}{\eta - 1}a^M - k) > 0$$

is always positive since $\frac{dY^M}{d\alpha} > 0$ with $\frac{dY^M}{d\alpha} = (1-2\alpha)(q_M + q_C) - \eta((1-\alpha)q_C - \alpha q_M)$ (in appendix 2) and $a^M - k > 0$. DBsides the second derivative is

$$f''(\alpha) = -2\alpha(q_M + q_C) + \eta(\alpha q_M - (1-\alpha)q_C) - \eta(1+\eta)(q_M - q_C) < 0$$

Appendix 4

Existence of the equilibrium with merger on the downstream market The equilibrium exists if and only if the profits are concaves. So if

$$\frac{\partial^2 \pi_i}{\partial p_i^2} < 0 \text{ and } \frac{\partial^2 \pi_i}{\partial w_i^2} < 0 \qquad\qquad i = F, C$$

The profit of the merger firm is given by

$$\pi_M = \alpha_M \left[(p_M - c - (1 - \alpha_M) a) q(p_M) + (v(p_M) - w_M - f) \right]$$

The second order conditions are as follows

$$\begin{aligned}
\frac{\partial^2 \pi_M}{\partial p_M^2} &= \alpha_M q'(p_M) + \alpha_M q''(p_M) \left[(p_M - c - (1 - \alpha_M) a) \right] + \alpha_M q'(p_M) - \alpha_M q'(p_M) \\
&= \alpha_M q'(p_M) + \alpha_M q''(p_M) \left[p_M - c - (1 - \alpha_M) a \right] < 0
\end{aligned}$$

With $p_M = c - (1 - \alpha_M) a$, the equilibrium exists if

$$\alpha_M q'(p_M) < 0$$

this is always verified since $q'(p_M) < 0$ and $\alpha_M > 0$. As a result the profits are concave in p_M. We must verify this second order condition for the profit in w_M We can write at the equilibrium, we have $(p_M, w_M = v((p_M) - F_M)$ and $(p_C, w_C = v((p_C) - F_C))$ and the best response of ISP_M is given by $p^*(w_M, w_C) \equiv c + (\frac{1}{2} + \sigma(w_C - w_M - \delta\beta) a$ and considering w_C like fixed. So we can express π_M as follows

$$\pi_M = \left(\frac{1}{2} + \sigma(w_M - w_C + \delta\beta) \right) \left[v \left(c + (\frac{1}{2} + \sigma(w_C - w_M - \delta\beta) a \right) - w_M - f \right]$$

It appears that

$$\begin{aligned}
\frac{\partial \pi_M}{\partial w_M} &= \left(\frac{1}{2} + \sigma(w_M - w_C + \delta\beta) \right) \left[(-\sigma a)\, v' \left(c + (\frac{1}{2} + \sigma(w_C - w_M - \delta\beta) a \right) - 1 \right] \\
&\quad + \sigma \left[v \left(c + (\frac{1}{2} + \sigma(w_C - w_M - \delta\beta) a \right) - w_M - f \right]
\end{aligned}$$

And the second partial derivative is given by

$$\begin{aligned}
\frac{\partial^2 \pi_M}{\partial w_M^2} &= \left(-\sigma^2 a \right) . v' \left(c + (\frac{1}{2} + \sigma(w_C - w_M - \delta\beta) a \right) - \sigma \\
&\quad + \sigma \left[v' \left(c + (\frac{1}{2} + \sigma(w_C - w_M - \delta\beta) a \right) (-\sigma a) - 1 \right] \\
&\quad + \left(\frac{1}{2} + \sigma(w_M - w_C + \delta\beta) \right) . \left(v'' \left(c + (\frac{1}{2} + \sigma(w_C - w_M - \delta\beta) a \right) \right) \left(\sigma^2 a^2 \right)
\end{aligned}$$

We obtain

$$\begin{aligned}\frac{\partial^2 \pi_M}{\partial w_M^2} &= 2\sigma\left[v'\left(c+(\frac{1}{2}+\sigma(w_C-w_M-\delta\beta)a\right)(-\sigma a)-1\right]\\&+\left(\frac{1}{2}+\sigma(w_M-w_C+\delta\beta)\right).\left(v''\left(c+(\frac{1}{2}+\sigma(w_C-w_M-\delta\beta)a\right)\right)\left[\sigma^2 a^2\right]\end{aligned}$$

We know $v'(p_M)=-q_M$, $v''(p_M)=-q'_M=\eta p_M^{-\eta-1}$.Finally,

$$\frac{\partial^2 \pi_M}{\partial w_M^2}=2\sigma\left[\sigma a q_M-1\right]+\alpha_M(\sigma^2a^2)\eta\frac{q_M}{p_M}$$

π_M is concave in w_M if and only if

$$\begin{aligned}\eta &< -\frac{2}{\sigma}\left(\frac{\sigma a q_M-1}{\alpha_M a^2 q_M}\right)p_M\\ \eta &< 2\alpha_C\left[-\frac{1}{\alpha_C}+\frac{1}{\sigma\alpha_M a q_M}\right]\end{aligned}$$

With LRT [1998] we can see that when $\sigma\to 0$, then $2\alpha_C\left[-\frac{1}{\alpha_C}+\frac{1}{\sigma\alpha_M a q_M}\right]\to\infty$. In the same way if $a\to 0$, then $2\alpha_C\left[-\frac{1}{\alpha_C}+\frac{1}{\sigma\alpha_M a q_M}\right]\to\infty$. We can conclude that this condition is always respected at the equilibrium.

$$0<\frac{(\alpha_M-\alpha_C)(q_C+q_M)}{(\alpha_M q_M-\alpha_C q_C)}<1<\eta<\infty.$$

As the same way we can write the cross partial derivatives as follows

$$\frac{\partial^2 \pi_i}{\partial w_i \partial w_j}=-2\sigma^2 a q_i+\sigma-\alpha_i\eta\sigma^2a^2\frac{q_i}{p_i}\qquad \textit{with } i\neq j$$

It's worth noting that if $\frac{\partial^2 w_i}{\partial w_i\partial w_j}>0$ then we are in presence of strategic complements. Moreover the sum of the cross derivative is given by : $-\Psi'(\alpha)$. So the only conditions for the existence and the unicity is given by $-\frac{2}{\sigma}<0$.

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