LACEA 2001
MONTEVIDEO URUGUAY

LACEA 2001
MONTEVIDEO URUGUAY

César Mattos

Vertical Foreclosure in Telecommunications Thorugh Access Prices and Interconnection Quality

Vertical Foreclosure in Telecommunications Through Access Prices and Interconnection Quality

César Mattos[1]

JEL: L12, L22, L42

Abstract

It is known in regulatory economics the incentive that a vertically integrated company in the telecommunications sector, owning a local and a long distance network, has to deny (or charge a very high price for) interconnecting competitors in the long distance market in its local loop bottleneck or even supply a poor interconnection quality. This occurred in the US telecommunications market, given the dependence of the new long distance competitors (MCI and Sprint) on the AT&T local networks to connect with end users. Aiming to avoid these problems and introduce competition at least in the long distance segment, the telecom reform in Brazil followed closely the US antitrust experience in the AT&T divestiture of 1984, reducing the previous verticalization of the state-owned company TELEBRAS before privatization. There is an extensive economic literature on the idea of vertical foreclosure. Most of this literature concentrate on the idea of a vertical merger between firms in the downstream and upstream markets generating foreclosure. We aim to focus more directly in the issue of a vertically integrated incumbent deciding access prices and interconnection quality to the entrant rival in the long distance segment. We present two models that refer to vertical foreclosure in telecommunications through the optimal access price and through the change on interconnection quality (or cost) to the entrant. In the first case, we use a simple linear demand setting to show that the optimal access price settled by the vertically integrated incumbent is not higher than the optimal access price that would be settled by a single upstream monopolist, owner of the local loop. This means that, under these hypothesis, there will not be vertical foreclosure in telecom. In the second case, we use the linear city model of Hotteling to show that the vertically integrated access provider always has an incentive to reduce interconnection quality when the regulator is not able to observe this variable. These models show that the regulation of the cost and quality of the interconnection can be more important than the regulation of the access price to avoid vertical foreclosure and harm to competition. In Brazil, this justifies not only the vertical break-up of TELEBRAS, but also the strong provisions towards the maintenance of quality and a low cost of interconnection.

I) Introduction

It is known the incentive that the vertically integrated company in telecommunications, owning a local and a long distance network, has to deny interconnecting competitors in the long distance market in its local loop bottleneck. This occurred in the US telecommunications market, given the dependence of the new long distance competitors (MCI and Sprint) on the AT&T local networks to connect with end

[1] Department of Economics at Universidade de Brasília – UNB - Brazil.

users. AT&T was charged of using its market power to reduce downstream competition, raising rival costs through refusal to deal, high local interconnection charges[2] or even reduction of the quality of the access to competitors. Viscusi, Vernon and Harrington (VVH-1995, p. 504/505) summarize the history of AT&T negotiations with MCI about the requests for local network interconnection:

"The initial response of AT&T to entry in 1969 by MCI was simply to refuse to interconnect with them. In the FCC decision in 1971, the FCC said AT&T should interconnect with their competitors, but the terms were left open to AT&T. This did not improve the situation, because AT&T placed considerable restrictions on the specialized common carriers. Only on 1974 did the FCC order interconnection in its Bell System Tariff Offering decision. When MCI expanded entry into message toll service, the same problem arose. Their entry was approved by the US court of appeals in 1975, but not until 1978 was AT&T forced to interconnect with MCI's Execunet service.

Only in 1978 were firms like MCI allowed to interconnect with the local operating company as long lines. Even after achieving this right, the competitors to AT&T in the Intercity Telecommunication Market were still not treated equally. It is generally believed that AT&T's competitors were given poorer quality connections by Bell operating companies. Customers had to dial twenty digits to make a long distance call with MCI, but only eleven with AT&T. The result was that consumers saw AT&T as offering a higher-quality product, which forced its competitors to offer a discount to compete. It was this type of behaviour that led to the original antitrust suit against AT&T"[3][4].

In the UK, these problems also appeared after the privatization of BT, given the absence of a policy of vertical break-up as implemented in the antitrust suit in the US[5] and the lack of appropriate action by OFTEL[6].

Aiming to avoid these problems, the telecom reform in Brazil followed closely the US antitrust experience in the AT&T divestiture of 1984[7], reducing the previous verticalization of the state-owned company TELEBRAS before privatization. On the other

---

[2] If the interconnection charge is high enough, it will drive competitors out of the market and the effect is equivalent to a refusal to deal.

[3] For a brief history of the AT&T in the US, including the first agreement of the company with the US Department of Justice in 1913 (the Kingsbury Commitment) due to anticompetitive practices, see Noll and Owen (1995, p. 329/333). One of the main duties imposed on the company was interconnection with competitors.

[4] Noll and Owen (1995, p. 342) describe in more detail other means of reducing the quality of the rival calls through interconnection.

[5] The lack of vertical break-up is also found in the Canadian experience as shown by Crandall and Waverman (1995,p. 67/68).

[6] According to Armstrong, Cowan and Vickers (1994, p. 239) "*Mercury should be protected against anticompetitive behavior by BT, and it is unfortunate that resolution of the question of interconnection was held up for as long as it was...*".

[7] This was considered the largest antitrust settlement of all history and started in November, 1974 lasting almost 10 years until implementation.

hand, in the UK, the government did not proceed to any restructuring of the state-owned company before privatization[8].

There are some important differences between the Brazilian reform and the US antitrust law suit, however. First, the Brazilian government imposed line of business restrictions on the long distance companies to operate in the local services, which did not occur in the AT&T break-up. In this regard, the BMTR was more stringent than the US antitrust intervention[9].

Second, there were seven regional companies divested from AT&T (called Regional Bell Operating Companies or RBOCS) that could only provide long distance service in a very limited area. The Modified Final Judgment in the US, which resulted in the break-up of the AT&T, divided the country into 160 Local Access and Transport Areas (LATAS)[10]. Each RBOC, despite owning local networks in several LATAS, was only permitted to provide long distance service inside each LATA. In Brazil, the regional companies can provide long distance service in all its territory. Therefore, in this regard, the US instituted a more radical vertical break-up compared to the BMTR. The following table summarises the differences among Brazil, US and UK regarding vertical separation of the incumbent company in telecommunications.

Table 1-International Comparison of Vertical Separation in the Telecommunication Sector

Country	Brazil	US	UK
Vertical Separation of Long and Local Distance Networks of the Incumbent	Yes	Yes	No
Scope of Provision of the Long distance Service	The three regional companies are allowed to make long distance calls inside their whole respective areas, but not between areas	The seven RBOCS are only allowed to make long distance calls inside each one of the 160 LATAS in which the country was divided, but not between areas.	None
Temporary Line of Business Constraints	Yes, from the local companies to the long distance and vice-versa.	Yes, but at the federal level. only from the local companies to the long distance service.	No

In the next section, we provide a brief survey of the literature on vertical foreclosure that is behind the concerns on these kinds of procedures on telecom reform in Brazil and the US.

II) Brief Survey of the Literature on Vertical Foreclosure

[8] Vickers and Yarrow (1988, p. 237) criticised the UK model in this respect:
"*There are several ways in which BT could have been split in order to promote effective competition and regulation before privatisation (or indeed in the future). The operation of local and long distance networks could be separated, perhaps with several local or regional network operators as in the United States. ....*
Restructuring of this kind can enhance the effectiveness of competition and regulation by altering incentives and information conditions in such a way that private motives are directed more to social ends".

[9] This occurred more in practice until the promulgation of the competition Act in 1996, since several State regulators restricted entry in the local service or even long distance service in small areas.

[10] See Noll and Owen (1995, p. 151).

There are two main theories behind any antitrust intervention in vertical integrations in the US: i) the entry barriers theory[11] and ii) the "market foreclosure" or "essential-facility" doctrine. The latter one is by far the most important and we concentrate on it. Rey and Tirole (1997,p.1) state the fundamentals of the "market foreclosure" reasoning in the antitrust literature and jurisprudence:

"*According to the received definition, foreclosure refers to any dominant firm's practice that denies proper access to an essential input it produces to some users of this input, with the intent of extending monopoly power from one segment of the market (the bottleneck segment) to the other (the potentially competitive segment). The excluded firms on the competitive segment are than said to be "squeezed" or to be suffering a secondary line injury. Essentiality means that the dominant firm's product cannot cheaply be duplicated by users who are denied access to it. Examples of essential facilities or bottlenecks to which competition law has been applied include a stadium, a railroad bridge or station, a harbor, a power transmission or a local telecommunications network, and a computer reservation system. The foreclosure or essential facility doctrine states that the owner of an essential facility may have an incentive to monopolize complementary or downstream segments as well. This doctrine was first discussed in the United States in Terminal Railroad Association v. U.S. (1912), in which a set of railroads formed a joint venture owning a key bridge across the Mississipi river and the approaches and terminal in Saint Louis and excluded non-member competitors".*

In the case of AT&T, the local loop was considered an essential facility given the difficulty of duplication by competitors, mainly because of its natural monopoly characteristics.

The foreclosure theory was severely criticised by the Chicago school, mainly through the writings of Bork (1978) and Posner (1976)[12] that argued the lack of economic rationality for firms to reckon with a vertical merger strategy to raise their profits, by foreclosing the market. For these authors, the single explanation for vertical integration would be the generation of efficiencies. Rey and Tirole (1997, p. 7) summarises the Chicago criticism:

"*The thrust of the Chicago School critique of this doctrine is that there is only one final product market and therefore only one monopoly power to be exploited, and that it is not obvious how the monopolist could further extend its monopoly power*".

---

[11] The entry barrier theory is based on the fact that vertical integration may increase the capital requirements for another firm to enter the market. According to Perry (1989, p. 197), this theory was originally conceived with the first body of theoretical work related to the concept of barriers to entry of Bain in 1956: "*Bain argued that vertical integration creates a capital barrier to entry by forcing potential competitors to contemplate entry at two stages of production rather than just one. In addition, he pointed out that vertical merger also eliminates one of the most natural potential entrants into each stage*". See Posner (1979) as quoted by VVH (1995, p. 160), for the most impacting critique against this theory.

[12] See Comanor (1969) for a full critique of the foreclosure idea as well. The main point for this author was that the degree of market power would not be "*additive at successive stages*" which will become the core of the Chicago critique.

Given the lack of rationality to exclusionary behaviour in the foreclosure approach, these authors defended the intrinsic efficiency aspects of the vertical mergers. The force of this criticism resulted in a change of the antitrust policy toward vertical mergers in the US, with a less interventionist approach.

Indeed, there are many critiques of the foreclosure theory. Surveyed by Ordover, Saloner and Salop (1990, p. 128/129), one of these critiques can be applied to the essential facility case of an integrated company owning a bottleneck like the telecom local network case[13]. According to these authors, this critique relates to the fact that "*..lost upstream profits*" due to downstream competitor foreclosure "*may exceed the increased downstream profits*" of the integrated firm and thus there would be no reason to foreclose.

The emergence of these critiques was mainly due to the lack of a rigorous analysis of the economic rationality of vertical foreclosure. Several authors started to provide more rigorous economic rationales, improving the understanding of the possible economic reasoning behind foreclosure[14], escaping from the naive leverage version of the theory that was used by the US courts until the seventies.

Tirole (1988, p.193/198) provides a survey of these efforts from the end of the seventies up to the publication of his textbook. One important aspect that emerged is that socially inefficient market foreclosure could be obtained through a myriad of generic strategies aiming to raise rival costs[15] including exclusionary vertical long term contracts[16] rather than only vertical mergers. Concerning the issue of market foreclosure by vertical integration, Tirole (p. 195) states that, with few exceptions, the main failure of the economic literature was not explaining why integrated firms do not sell or buy on the

[13] The other criticisms are i) "*The supply of inputs available to rivals is not necessarily reduced.... because the integrated firm also reduces its demand for inputs produced by unintegrated suppliers.... it merely will necessitate a rearrangement in supply relationships*"; ii) "*...remaining suppliers may not have the incentive to raise their input prices*",and , then, the denial of supply by one supplier will not raise rival costs; iii) the likelihood of foreclosed competitors integrate vertically with remaining suppliers; iv) even if input prices increases, the supplier that integrated would have to be compensated by the forgone potential extra profits obtained by their rivals. This compensation can decrease the profitability of the merger "*possibly to the point that no merger occur*"; v) "*Since the firm that is foreclosed is placed at a disadvantage, it ought itself to participate in the bidding for the scarce upstream resource*". This last criticism can be used to the case of a single natural monopoly supplier as in the case of telecommunications. The difference with the AT&T case is that the integration happened before the entry of MCI and Sprint in the market.

[14] According to Rey and Tirole (1997,p. 4): "*The Chicago school view has had the beneficial effect of forcing industrial economists to reconsider the foreclosure argument and to put it, we believe, on firmer ground*".

[15] See Salop and Scheffman (1983). Salop and Scheffman (1987) extend the basic model of 1983 to other situations, including the one where a dominant integrated firm prefers not to produce their own inputs more efficiently and buy more expensive inputs in the market aiming to raise the rival costs. Anyway, in this case, the vertical integration is not the source of foreclosing behavior. See also Salop and Kratenmark (1993).

[16] The most known model of exclusive dealing arrangement that forecloses inefficiently the market comes from Aghion and Bolton (1987), also summarised by Tirole (1988 p.196/198). The model replies formally the criticisms from Bork (1978) and Posner (1976) that criticized the decision of the courts in the exclusionary contracts of the case United Shoe Machinery Corporation of 1922 on the basis that there was not any incentive for the buyers to feed a monopoly on the other side of the market, signing contracts that exclude competitors. In their model, the capacity to impose fines high enough for the breach of the contract coupled with some degree of uncertainty regarding the entrant efficiency results in long term contracts that ensues a degree of foreclosure greater than the social optimum.

intermediate goods market instead of foreclosing. The two exceptions were published afterwards on the papers of Salinger (1988) and Ordover, Saloner and Salop (1990).

Salinger (1988) shows with three simple assumptions that the vertically integrated firm after the merger does not participate in the upstream input market but only supply its downstream associated company, foreclosing the access of other downstream firms. The author defines as an economically meaningful definition of market foreclosure of downstream firms, an increase in the price of the input, which, as we will see, is closer to the first model we are presenting here. Ordover, Saloner and Salop (1990) structure a model where vertical foreclosure can emerge as an equilibrium in a successive duopoly setting. The model is a four-stage game where the final equilibrium is obtained through backward induction. The main importance of the paper is that it replies the six main criticisms against the foreclosure doctrine[17]. The main result of their model is that the vertical merger hurts both downstream companies. At the same time, both upstream firms are benefited and the consumer is unambiguously hurt, since final price always increases. The full structure of the game results in the two downstream firms facing a prisoner dilemma regarding who will be the first to integrate[18].

Hart and Tirole (1990) build a very rich and complex set of hypotheses under which foreclosure can emerge and antitrust intervention can be welfare enhancing. One of the important features of their model is that they do not restrict their framework to any particular contractual arrangement, which enlarges considerably the application of their model to real world cases. Three variants of the basic model are constructed: a) *ex post monopolization* is the single variant that results in output contraction; b) *scarce needs* where the downstream firms face capacity constraints and the main reasoning for vertical integration is the need of one of the upstream firms to ensure that the downstream firm purchases its supplies and not from the rival's; c) *scarce supplies* where the upstream firms face capacity constraints and the main reasoning for the vertical merger is the need of one of the downstream firm to ensure that the upstream firm channels its scarce supplies to it instead to the other downstream firms. In the last two cases, foreclosure can emerge as a by-product and not as the main motivation for the merger.

The model of Rey and Tirole (1997) provides a rationale for the foreclosure theory relating this idea to the known Coase model of the "durable good" monopolist[19]. Rey and Tirole (p.10/17) show that the bottleneck facility owner facing oligopolists in the

---

[17] The first stage of the game happens when both downstream firms bid to acquire one of the upstream suppliers. In the second stage, input prices are determined. As one of the bidding downstream companies acquire one upstream firm, the other downstream firm bids to acquire the remaining supplier in the third stage. Finally, downstream prices are chosen in the fourth stage.

[18] The authors summarize this intuition stating that "*the fear of being foreclosed drives each firm to attempt to foreclose the other. As a result, all the rents from foreclosure are dissipated through the bidding and all the profits accrue to the upstream firm(s)*".

[19] Coase (1972) showed that when the durable good monopolist cannot commit to future prices, the buyers delay purchases in order to benefit from expected lower future prices. This happens because the monopolist himself will be tempted to reduce prices after some level of sales have been achieved, behaving opportunistically with the former buyers. In this regard, the monopolist faces intertemporal competition from himself. Thus, the durable good monopolist is not able to enjoy all his monopoly power that he/she would achieve when he can commit ex-ante to not lowering future prices.

complementary market may not be able to credibly commit that he will maintain the monopoly result in the contracts with each of these players. This result can be obtained with the bottleneck monopolist offering to each of the oligopolists a "take it or leave it" contract that specifies the quantity supplied and total remuneration. The upstream firm always has an *ex-post* incentive to open secret renegotiations, acting opportunistically against the downstream contractors. Anticipating this result, each downstream oligopolist does not accept the contracts that ensues the monopoly result for the upstream bottleneck. This represents a decrease on the bottleneck monopolist's profit. There are two main ways to deal with this problem: an exclusive dealing arrangement with one of the oligopolists or a merge. In both cases, the bottleneck monopolist refuses to deal with the others, foreclosing the market to them. In this case, the temptation for opportunistic behaviour is eliminated. The monopolist bottleneck is able to extract all monopolist rents from the complementary market and the chosen downstream firm will not fear about opportunistic behaviour. In this regard, the result is a departure from the conventional wisdom since foreclosure does not aim to extend market power from one market to another, but rather to reestablish the market power from a situation where the oligopolists in the complementary market fear the opportunistic behaviour from the bottleneck monopolist.

More recently, Kuhn and Vives (1999), extending and formalizing a conjecture raised by Perry (1989), link the foreclosure caused by vertical integration and the "excess entry" result from Mankiw and Whinston (1986) arising from the "business stealing effect". In their model, foreclosure brings down the number of players in the market more in line to the social optimum. Thus, vertical integration by increasing foreclosure and hurting competitors can increase efficiency and social welfare. The "excess entry result" was also addressed by Vickers (1995) in the context of the linkages between a natural monopoly market with a potentially competitive one. The novelty of his analysis is the introduction of price regulation at the monopolistic level, mainly access regulated prices, considering the information asymmetry of the regulator. This is a crucial departure from the previous literature on foreclosure and applies more closely to the situation of the regulated sectors, including telecommunications[20].

The models described above represent the core of the current literature on foreclosure. However, almost all of them (with the exception of Vickers' model) are quite focused on the effects of vertical mergers and not on the more simple idea that an already integrated firm owning an essential facility will often have an incentive to foreclose supply to downstream competitors.

III) Vertical Foreclosure Through Access Pricing

First, we have to define vertical foreclosure in a broader sense, since full foreclosure is a particular and extreme case of a general case of discrimination of a vertically integrated

---

[20] The basic trade-off of the cost and benefits of keeping vertical integration is stressed by the author (p. 4): "*Vertical integration has the disadvantage that the regulator's task is made harder insofar as the monopolist has incentives to raise rivals' costs, but it may have the advantage of offsetting excess entry and hence allowing a more efficient production structure in the competitive industry*".

incumbent against an entrant. We provide two definitions based on the tools used by the access provider to foreclose: the access price and the interconnection quality and cost.

The first candidate rule to obtain a proper definition would be the access price differential with marginal access cost. However, since the provision of access is also a business, we can expect that even an independent non-integrated bottleneck supplier will charge access prices greater than the marginal access cost. So, the access price/marginal cost differential does not only capture the incentive of a vertically integrated incumbent to protect its own downstream business, but also its incentive to make positive profits in the access business. Thus, we have to pick a definition that eliminates this "access business profit-seeking" effect that will occur regardless of vertical integration. This is made through the following definition:

Definition 1- There is <u>partial vertical foreclosure through access pricing</u> from the upstream bottleneck segment to a downstream potentially duopolistic segment, when both downstream competitors have the same efficiency, but there is a positive access price differential between the situation where the upstream access provider is a vertically integrated firm and the situation where the access provider is an independent non-integrated access supplier that is able to price discriminate in his access business and faces the same number of downstream firms from the first situation.

Since the access price of the independent access provider will contain an access business profit-seeking effect, differently from the marginal access cost, the differential between the access price of the vertically integrated firm and the independent provider will isolate for the effect of the ownership of the upstream access provider in the access price rule, capturing for the vertical foreclosure incentive. Note that the source of the bias could also stem from an efficiency differential and not from vertical integration. That is why, we restrict the comparison to the case of equal efficiency (equal marginal cost).

Furthermore, it is important to allow for the independent access provider to price discriminate whenever he wishes. We will come back for the motivation behind this hypothesis ahead. The requirement of the independent supplier facing the same number of downstream firms avoids potential differences associated to a different number of downstream firms, not directly related to the incentives for vertical foreclosure.

Suppose a vertically integrated monopolist incumbent facing an entrant in the downstream market. Assume that the entrant is not able to enter the local service (upstream) if he did not enter the long distance service yet[21][22]. The inverse demand function and the profit functions of the upstream (*1u*) and downstream (*1d*) segments of the incumbent firm and the entrant firm (*2d*) in the long distance business are given, respectively, by:

[21] We can suppose that the marginal cost of the entrant, given that he does not operate in the long distance, is infinity. The role of this assumption is to force the dependence of the entrant in the long distance to the incumbent local network in the short run.

[22] For the sake of simplicity, we also restrict to the case of two downstream companies and not "n".

$$P(q_1+q_2)=1-q_1-q_2 \quad (1)$$
$$\prod_{1u}(q_1,q_2)=(a-c)(q_1+q_2) \quad (2)$$
$$\prod_{1d}(q_1,q_2)=q_1(1-q_1-q_2)-C_1(q_1) \quad (3)$$
$$\prod_{2d}(q_1,q_2)=q_2(1-q_1-q_2)-C_2(q_2) \quad (4)$$

Variable q_i is the quantity traded by the downstream firm i ($i=1d,2d$). $C_1(q_1)$ and $C_2(q_2)$ are the total costs, respectively, of the incumbent and entrant downstream firms. a is the access price charged by the upstream incumbent, *1u* for both downstream firms *1d* and *2d*. We suppose that one unit of access results in one unit of long distance service provided and there are no fixed costs at all. The parameter c is the marginal cost of the upstream firm providing any input (access) quantity q_i to the downstream firms. The expressions for the total costs of the downstream firms are:

$$C_1(q_1)=aq_1+c_1q_1 \quad (5)$$
$$C_2(q_2)=aq_2+c_2q_2 \quad (6)$$

The parameters c_1 and c_2 are the constant marginal costs of each downstream firm. As the upstream firm is integrated with the downstream *1d*, their profits must be aggregated. Notice that when we derive the aggregate profit function of the vertically integrated incumbent, the terms including the access price a cancel out in the sum. This is a revenue to the upstream firm but an expense to the downstream firm. The profit equation of the vertically integrated and entrant firms are, respectively

$$\prod_1=q_1(1-q_1-q_2)+aq_2-c(q_1+q_2)-c_1q_1 \quad (7)$$

$$\prod_2=q_2(1-q_1-q_2)-(a+c_2)q_2 \quad (8)$$

The oligopolists play a Cournot-Nash game in the downstream market. Given the parameters of this game, the vertically integrated incumbent chooses the optimal value of the access price a that he charges the entrant. We assume that the parameters are such that there are only interior solutions. The reaction functions of both companies in the downstream market are given by:

$$\frac{\partial\prod_1}{\partial q_1}=1-2q_1-q_2-c-c_1=0$$

$$q_1=\frac{1-c-c_1-q_2}{2} \quad (9)$$

and

$$\frac{\partial\prod_2}{\partial q_2}=1-2q_2-q_1-c-c_2=0$$

$$q_2 = \frac{1 - a - c_2 - q_1}{2} \tag{10}$$

Solving for q_1 and q_2, we get:

$$q_1{*} = \frac{1 + a - 2c_1 - 2c + c_2}{3}$$
$$q_2{*} = \frac{1 + c - 2c_2 - 2a + c_1}{3} \tag{11}$$

The profit of the vertically integrated incumbent replacing (11) in (7) and (8) will be given by :

$$\Pi_1 = \frac{(1 + a - 2c_1 - 2c + c_2)}{3}[1 - \frac{(1 + a - 2c_1 - 2c + c_2)}{3} - \frac{(1 + c - 2c_2 - 2a + c_1)}{3} - c_1 - c]$$
$$+ (a - c)\frac{(1 + c - 2c_2 - 2a + c_1)}{3}$$

$$\frac{\partial \Pi_1}{\partial a} = \frac{2}{3}\frac{(1 + a - 2c_1 - 2c + c_2)}{3} + \frac{(1 + c - 2c_2 - 2a + c_1)}{3} - \frac{2(a - c)}{3} = 0$$
$$\frac{5}{9} - \frac{10a}{9} - \frac{c_1}{9} + \frac{5c}{9} - \frac{4c_2}{9}$$
$$a{*} = \frac{1}{2} - \frac{c_1}{10} + \frac{c}{2} - \frac{2c_2}{5} \tag{12}$$

Next, we have to compare the optimal access price of the vertically integrated firm given in (12) with that from an independent access supplier. There are two possibilities. First, the independent access provider cannot price discriminate and settles the same access price a to both downstream companies. Second, the independent access provider is able to price discriminate and settles different access prices to each of the two downstream firms. Note, however, that the vertically integrated firm is implicitly supposed to price discriminate between the access price settled to the entrant (given in (12)) and the access price settled to himself (c by definition). If we do not allow price discrimination for the independent access provider, the comparison of the access price he settles and the access price of the vertically integrated firm given in (12) can be reflecting this asymmetry. In other words, besides foreclosure, there would be also the effect of the ability to price discriminate of the vertically integrated firm not possessed by the independent provider. That is why we made explicit the possibility of price discrimination in the definition of foreclosure above. So, a_1 is the access price settled by the upstream firm to the downstream firm 1 and a_2 the access price settled to the downstream firm 2.

Next, we restate (2), (7) and (8) for the case of an independent access supplier in the upstream with two companies in the downstream segment of the market:

$$\prod_{1u} = (a_1 - c)q_1 + (a_2 - c)q_2 \qquad (2')$$
$$\prod_1 = q_1(1 - q_1 - q_2) - a_1 q_1 - c_1 q_1 \qquad (7')$$
$$\prod_2 = q_2(1 - q_1 - q_2) - a_2 q_2 - c_2 q_2 \qquad (8')$$

Differentiating (7´) and (8´), respectively, to q_1 and q_2, and solving the system, we get:

$$q_1 = \frac{1 + a_2 + c_2 - 2a_1 - 2c_1}{3}$$
$$q_2 = \frac{1 + a_1 + c_1 - 2a_2 - 2c_2}{3} \qquad (11')$$

The independent access supplier incorporates (11´) in his problem (2´) and chooses optimally a_1 and a_2:

$$\prod_{1U} = (a_1 - c)[\frac{1 + a_2 + c_2 - 2a_1 - 2c_1}{3}] + (a_2 - c)[\frac{1 + a_1 + c_1 - 2a_2 - 2c_2}{3}]$$

$$\frac{\partial \prod_{1U}}{\partial a_1} = \frac{1 + a_2 + c_2 - 2a_1 - 2c_1}{3} - \frac{2}{3}(a_1 - c) + \frac{1}{3}(a_2 - c) = 0$$

$$a_1 = \frac{1 + 2a_2 + c_2 - 2c_1 + c}{4}$$

Given the symmetry of the problem:

$$a_2 = \frac{1 + 2a_1 + c_1 - 2c_2 + c}{4}$$

Solving for a_1 and a_2, we get:

$$a_1{*} = \frac{1 - c_1 + c}{2}$$
$$a_2{*} = \frac{1 - c_2 + c}{2} \qquad (12')$$

The difference between (12) and (12´) (only a_2*) is:

$$\frac{1}{2} + \frac{c}{2} - \frac{c_1}{10} - \frac{2c_2}{5} - \frac{1}{2} + \frac{c_2}{2} - \frac{c}{2} = \frac{c_2 - c_1}{10} \qquad (13)$$

So, the vertically integrated firm settles an access price that is greater than the access price picked by an independent provider if and only if he is more efficient than the entrant. Equation (13) results in Proposition 1.

Proposition 1: Given a downstream duopoly playing a Cournot game with the linear demand function (4.1) and variable linear cost functions in the downstream ($(a_1+c_1)q_1$ and $(a_2+c_2)q_2$) and upstream segments ($c(q_1+q_2)$), there will be <u>no</u> incentive for vertical foreclosure by the incumbent against an entrant through access pricing as defined in Definition 1 resulting from a vertical integration of one of the downstream firms and the upstream firm.

Proof: Given the result obtained in (13), it is direct that if $c_2=c_1$, there is no access price differential between the vertically integrated incumbent and the independent access provider. Since definition (1) requires equal costs to check for foreclosure, we conclude that there is no vertical foreclosure through access price.

This matches the Chicago intuition, but with further insights. What (13) is saying is that when the incumbent is less efficient than the entrant, the former tends to charge a lower access price compared to what would an independent access provider charge. This occurs because when the vertically integrated incumbent is less efficient, he loses twice if he discriminates against the entrant: First, he does not extract a higher amount of profits from the most efficient player and, second, he derives a lower amount of profits through his own (less efficient) downstream subsidiary. On the other hand, the independent access provider loses just once if he discriminates against the most efficient entrant, by not extracting a higher amount of profits from the most efficient player. By the same token, the vertically integrated incumbent earns twice when his downstream subsidiary is more efficient. So, the vertically integrated incumbent is more sensitive to the cost differential than the independent access provider. But this is not a vertical foreclosure strategy as defined in Def 1. Discrimination occurs when the reduction in the upstream profits by discriminating against the entrant is lower than the gains in the downstream market and this just happen when the entrant is less efficient than the downstream subsidiary of the incumbent.

The Chicago's view is right by stating that the incumbent earn more in some circumstances by providing access than by foreclosing and thus it is not so obvious that the latter conduct should always be expected. Note, however, that this statement cannot be taken as universal since the model here developed is restricted to specific linear demand and cost functions. Checking how general is this finding is an interesting topic for further research.

Finally, as we saw in the US experience, regulated prices are not the only single variable to be looked after by the regulator to guarantee that a foreclosing behavior will not harm competition in telecommunications. The quality or the cost of the interconnection to the entrant also matters and can be an alternative channel to a foreclosure behavior. To improve the understanding of this idea, we introduce in the next section a linear city model.

IV) Foreclosure Through Quality

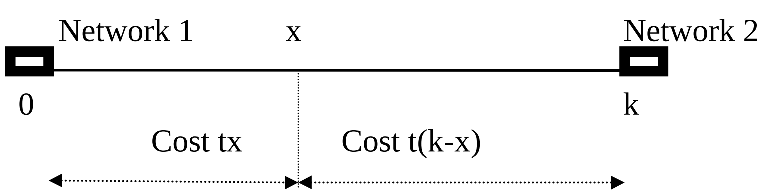
We assume that the choice of networks can be described through the linear city model of Hotelling[23][24]. We first construct a general model that will be used in this section and afterwards. Next, we study the specific case of foreclosure through the quality of connection.

A Basic Framework of the Linear City Model

There is a linear city of size *k*, the consumers being uniformly distributed along it facing two firms, an incumbent (network 1) and an entrant (network 2), one in each extreme as depicted in Figure below. The closer the consumer is to network 1, the more he prefers 1 relatively to 2. *k* is the maximum horizontal differentiation existent and can be related, as stated by Laffont, Rey and Tirole (1998, p. 2), to different functions offered by each network that appeal differently to different consumers.

The marginal substitution rate between the two networks for any consumer is given by *t*. In the traditional linear city model, where the variables are explained in terms of geographical distances[25], this variable is the transportation cost of the consumers per unit of distance. The consumer located at *x* will have a "transportation cost" (or a utility discount compared to the consumer located at 0), *tx*, to move from *x* to network *1* and buy the good (or service). The same consumer will have a transportation cost of *t(k-x)* to go to network *2*.

Figure 1 – Linear City with Two Networks



An important aspect is the distinction between horizontal and vertical differentiation that is not considered in the standard linear city model as presented by Tirole. While the first concept relates to preference differences between consumers, the second concept represents the element of differentiation common to all consumers[26].

---

[23] We assume that all local markets in a given region have exactly the same demand and cost parameters. Then, the results below are valid for the competition between the local incumbent and entrant in every location inside this region.

[24] The linear city model proposed here follows closely the steps of Tirole (1988,p. 97/98).

[25] Though the explanation is often made in terms of geographical distances, one of the main purposes of Hotelling in the linear city model was to address the issue of product differentiation. The compatibility of the two kinds of analysis (product differentiation and geographical distances) is stressed by Basu (1993): "*there is a certain analogy between the economics of location and the economics of product brands. This was evident to Hotelling (1929) who observed that the problem of two firms selling a homogeneous good at two different locations on a line could, alternatively, be thought of as two firms choosing to sell cider of two different degrees of sourness from within a continuum of possibilities*".

[26] For more detail on vertical differentiation, see Tirole (1988, p. 96-99).

U_1 and U_2 are taken as the "gross utilities" of the customers of networks *1* and *2* respectively. These gross utilities are defined as the total utility (before deducting the price) obtained by the agent who derives the highest satisfaction than anyone else from consuming in a given network. In the case of networks *1* and *2*, these consumers are located exactly at *0* and *k*, respectively. Note that when we allow for $U_1 \neq U_2$, we are introducing an element that captures vertical differentiation. Thus, the model incorporates both sources of differentiation: horizontal along the linear city and vertical measured by U_1-U_2 in the vertical axes. This variable can include real quality variables as the degree of noise, number of falls in the calls the likelihood of completing a call, for example. Furthermore, this general variable called "quality" will include brand loyalty and the set of value-added services offered by each local network.

P_1 and P_2 are the prices charged by each local network for the line installation plus the fixed maintenance charge plus the average call charge. The surplus of the consumer located at *x* will be given by the gross utility, the price and the transportation cost:

$$U_1 - p_1 - tx$$

if he buys at network 1

(14)

$$U_2 - p_2 - t(k - x)$$

if he buys at network 2

and

0 if he does not buy at all.

If the difference between the prices charged by the two networks does not exceed the transportation cost plus the vertical differentiation[27], there is a consumer x_1 located between *0* and *k* who is just indifferent between the two networks. x_1 is given by:

$$U_1 - p_1 - tx_1 = U_2 - p_2 - t(k - x_1)$$

$$x_1(p_1, p_2) = \frac{(p_2 - p_1 + tk + U_1 - U_2)}{2t} \qquad (15)$$

$$k - x_1(p_1, p_2) = x_2(p_1, p_2) = \frac{(p_1 - p_2 + tk + U_2 - U_1)}{2t} \qquad (16)$$

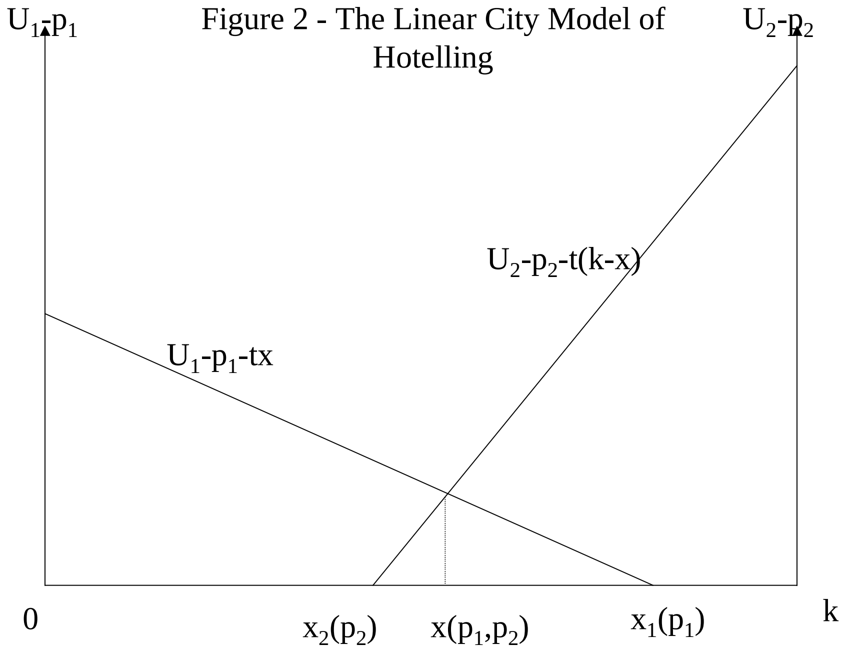
It will be useful ahead to take the quantity when firm 1 is a monopolist.

[27] *p2 - p1 < tk + U1 - U2*. Otherwise, there is the case of local monopolies also found in the basic reference of Tirole (1988).

$$U_1 - p_1 - tx_{1m} = 0$$
$$x_{1m} = \frac{U_1 - p_1}{t} \qquad (15')$$

Figure 2 shows the equilibrium given in (16):

Figure 2 - The Linear City Model of Hotelling



Assume that networks 1 and 2 have, respectively, marginal costs c_1 and c_2. The profit expression for networks 1 and 2 are, respectively:

$$\Pi_1 = \frac{(p_2 - p_1 + tk + U_1 - U_2)}{2t} * (p_1 - c_1)$$
$$\Pi_2 = \frac{(p_1 - p_2 + tk + U_2 - U_1)}{2t} * (p_2 - c_2) \qquad (17)$$

Differentiating Π_1 and Π_2 with respect, respectively to p_1 *and* p_2, we find the optimal prices for networks *1* and *2*, given the price of network *2(1)*, $p_2(p_1)$.

$$p_1 = \frac{p_2 + tk + U_1 - U_2 + c_1}{2}$$
$$p_2 = \frac{p_1 + tk + U_2 - U_1 + c_{2l}}{2} \qquad (18)$$

From (18), we reach the final expressions for prices:

$$p_1{*} = tk + \frac{U_1 - U_2}{3} + \frac{2c_1 + c_2}{3}$$

$$p_2{*} = tk + \frac{U_2 - U_1}{3} + \frac{2c_2 + c_1}{3} \qquad (19)$$

Replacing (19) in (16), we get:

$$x_1{*} = \frac{k}{2} + \frac{U_1 - U_2}{6t} + \frac{c_2 - c_1}{6t}$$
$$x_2{*} = \frac{k}{2} + \frac{U_2 - U_1}{6t} + \frac{c_1 - c_2}{6t} \qquad (20)^{28}$$

The same rationale applies to the case of firm 1 and 2 being local monopolists[29]:

$$p_{1m} = \frac{U_1 + c_1}{2}$$
$$p_{2m} = \frac{U_2 + c_2}{2}$$

(19')

We derive expressions for profits, using the equilibrium prices and quantities given in (19) and (20):

$$\prod_1{*} = (tk + \frac{U_1 - U_2 + c_2 - c_1}{3})(\frac{k}{2} + \frac{U_1 - U_2 + c_1 - c_2}{6t})$$
$$\prod_2{*} = (tk + \frac{U_2 - U_1 + c_1 - c_2}{3})(\frac{k}{2} + \frac{U_2 - U_1 + c_2 - c_1}{6t}) \qquad (21)$$

Observe that all variables have the expected signs. The higher the vertical differentiation (U_1-U_2 larger), the higher the profits of network *1* and the lower the profits

---

[28] Networks 1 and 2 market shares, s_1 and s_2 are

$$s_1 = \frac{x_1}{x_1 + x_2} = \frac{1}{2} + \frac{U_1 - U_2 + c_2 - c_1}{6tk}$$
$$s_2 = \frac{x_2}{x_1 + x_2} = \frac{1}{2} + \frac{U_2 - U_1 + c_1 - c_2}{6tk}$$

Notice that for the special case where $U_1=U_2$ and $c_1 = c_2$, $s_1=s_2=1/2$. However, we have assumed before that $U_1-U_2 \geq 0$, given the brand loyalty enjoyed by network *1* which is an exogenous first mover advantage. We also assume a second potential source of first mover advantage coming from a marginal cost differential derived from the low experience of the entrant, $c_{1l} \leq c_{2l}$. In this case, we have that $s1 \geq s2$.

[29] See Appendix 4.2.

of network *2*. The marginal costs of each firm enter negatively in the firm's own profits and positively in the other. t and k effects are ambiguous and depend on the marginal cost differential and vertical differentiation.

Following the same rationale, the profit function of the monopolist derived from (16') and (19') is:

$$\Pi_{1m} = \frac{(U_1 - c_1)^2}{4t}$$
$$\Pi_{2m} = \frac{(U_2 - c_2)^2}{4t} \tag{22}$$

Quality and Costs of Interconnection and Foreclosure

Next, we concentrate in the problem where a long distance entrant enters a market dominated by a vertically integrated incumbent that owns the local bottleneck and a long distance company. Assume in the model depicted above that network 1 is the long distance network of this vertically integrated incumbent. Also, assume that network 2 is the long distance network owned by an entrant not integrated in the local bottleneck.

Here, we assume that the access price is regulated on an *ad-hoc* basis. The rule is very simple with the regulator setting a fixed mark-up δ on the marginal access cost c. On the other hand, we also assume that the regulator is not able to monitor or does not care about the regulation of the quality of interconnection and/or the cost of interconnection[30]. At the same time, we assume that the vertically integrated supplier of access provides access to himself and to the rival at the same access cost c, regardless of the quality of the interconnection y. We assume that the maximum level of interconnection quality that can be provided to both long distance companies is y_{max}. The quality provided by each long distance network to their customers, respectively, U_1 and U_2 also depend on y and we assume that:

$$U_{1\max} = U_1(y_{\max})$$
$$U_{2\max} = U_2(y_{\max})$$

The relevant issue is that the incumbent can reduce costlessly (not increase) the interconnection quality of himself and of his downstream rival to less than y_{max}, decreasing U_i until any non-negative value. Moreover, the incumbent can provide interconnection to the rival in a way such that the the cost of the latter increases. So, we suppose that the vertically integrated incumbent can costlessly increase (but not decrease) the long distance cost of the entrant from c_2. So, we define c_{2min} and c_{1min} as the minimum levels of long distance cost that can be achieved by, respectively, the entrant and the incumbent without any interference of the incumbent.

[30] Most of the time, we will work on interconnection quality. It will be clear ahead, however, that the assessment of the cost of interconnection is basically the same and thus all conclusions can be extended.

In sum, the vertically integrated incumbent is able to reduce the quality and increase the long distance cost of the entrant costlessly through their interconnection relationships. The question in this section is to assess what would be the incentives behind this potential predatory behaviour of the incumbent?

Here we provide a different definition for partial vertical foreclosure compared to the definition based on access pricing. This occurs because foreclosure in terms of quality

Def 2 There will be partial vertical foreclosure through quality made by a vertically integrated incumbent against a downstream entrant in a linear city model like that described in figure 2, when, having both the same efficiency and access prices are regulated as in (23) below, the former has an incentive to reduce the quality of the latter in the dowsntream potentially duopolistic segment while the curves $U_1 - p_1 - tx$ ***and*** $U_2 - p_2 - t(k - x)$ ***are crossing above the horizontal line and an independent access provider would not have this incentive.***

The total marginal cost of the incumbent to provide long distance service, that we call c_{1l}, can be disentangled into two components, the long distance marginal cost, c_1 and the cost of access c. The total marginal cost of the entrant, called c_{2l}, also has two components, the long distance marginal cost, c_2 and the access price a. The regulator sets the access price a summing the marginal cost of access c to a fixed mark-up δ. Then,

$$\begin{aligned} c_{1l} &= c + c_1 \\ c_{2l} &= c + \delta + c_2 \end{aligned} \tag{23}$$

Changing (17) appropriately, the profit functions of the incumbent and the entrant in the long distance service are given, respectively, by:

$$\begin{aligned} \Pi_1 &= \frac{(p_2 - p_1 + tk + U_{1\max} - U_{2\max})}{2t} * (p_1 - c - c_{1\min}) + \frac{(p_1 - p_2 + tk + U_{2\max} - U_{1\max})}{2t} * (c + \delta - c) \\ \Pi_2 &= \frac{(p_1 - p_2 + tk + U_{2\max} - U_{1\max})}{2t} * (p_2 - c - c_{2\min} - \delta) \end{aligned} \tag{24}$$

The second term in the first equation of (24) accounts for the profit derived from the access business of the incumbent to the entrant. We suppose that the vertically integrated incumbent first decides if he reduces the quality of the entrant and/or increases the cost of the entrant through c_{2min} and then chooses simultaneously with the entrant the optimal prices to be charged. So, the incumbent first solves for the equilibrium prices and just then chooses if he reduces the quality or increases the cost of the entrant. Differentiating the profit functions in (24) in respect to prices at U_{1max}, U_{2max}, c_{1min} and c_{2min}, we find the equilibrium prices of the two companies:

$$p_1* = tk + \frac{U_{1\max} - U_{2\max} + 2c_{1\min} + c_{2\min}}{3} + c + \delta$$
$$p_2* = tk + \frac{U_{2\max} - U_{1\max} + 2c_{2\min} + c_{1\min}}{3} + c + \delta$$
(25)

The reader can check that replacing (25) in (16) we find the same value for x_1* and x_2* from (20). Next, we present the incumbent and entrant profit functions after accounting for these changes. We find

$$\prod_1 = (tk + \frac{U_{1\max} - U_{2\max} + c_{2\min} - c_{1\min}}{3} + \delta) * (\frac{k}{2} + \frac{U_{1\max} - U_{2\max} + c_{2\min} - c_{1\min}}{6t})$$
$$+ \delta * (\frac{k}{2} + \frac{U_{2\max} - U_{1\max} + c_{2\min} - c_{1\min})}{6t}) =$$
$$(tk + \frac{U_{1\max} - U_{2\max} + c_{2\min} - c_{1\min}}{3}) * (\frac{k}{2} + \frac{U_{1\max} - U_{2\max} + c_{2\min} - c_{1\min}}{6t}) + k\delta$$
$$\prod_2 = (tk + \frac{U_{2\max} - U_{1\max} + c_{1\min} - c_{2\min}}{3}) * (\frac{k}{2} + \frac{U_{2\max} - U_{1\max} + c_{1\min} - c_{2\min}}{6t})$$
(26)

Now, we can address the conditions under which the incumbent would wish to reduce the quality of the entrant in the downstream market, since we assumed that the regulator is not able to monitor or does not care about the quality and the cost of the interconnection. Taking the derivative of the incumbent profit function in respect to the quality of the call from the entrant, we have:

$$\frac{\partial \prod_1}{\partial U_2} = -\frac{1}{3} * (\frac{k}{2} + \frac{U_{1\max} - U_{2\max} + c_2 - c_1}{6t}) - \frac{1}{6t}(tk + \frac{U_{1\max} - U_{2\max} + c_{2\min} - c_{1\min}}{3} + \delta) + \frac{\delta}{6t} =$$
$$-\frac{1}{3} * (\frac{k}{2} + \frac{U_{1\max} - U_{2\max} + c_{2\min} - c_{1\min}}{6t}) - \frac{1}{6t}(tk + \frac{U_{1\max} - U_{2\max} + c_{2\min} - c_{1\min}}{3})$$
(27)

Given definition 2, we know that at $U_{1max}=U_{2max}$ and $c_{2min}=c_{1min}$, (27) is always non-positive. In other words, the incumbent has incentives to reduce the entrant interconnection quality if the regulator does not monitor or does not care about the quality of interconnection from U_{2max} downwards. Moreover, note that the lower U_2, the more negative will be (27). This means that the incentive to reduce U_2 further is even stronger for some range where $U_2 < U_{2max}$. Furthermore, we have

$$\frac{\partial \prod_1}{\partial c_2} = -\frac{\partial \prod_1}{\partial U_2} = \frac{1}{3} * (\frac{k}{2} + \frac{U_{1\max} - U_{2\max} + c_{2\min} - c_{1\min}}{6t}) + \frac{1}{6t}(tk + \frac{U_{1\max} - U_{2\max} + c_{2\min} - c_{1\min}}{3})$$
(28)

As (28) is just (27) with the opposite signal, the same result holds. In other words, the incumbent has incentives to increase the entrant cost c_2 if the regulator is not able to monitor interconnection quality and costs and/or does not care about it.

And then, independent from the profitability of the access business granted by the regulator through δ, the negative impact of U_2 on Π_1 remains So, in this model, the decrease in the downstream profits of the vertically integrated incumbent generated by a strategy of non-vertical foreclosure more than compensates the increase in the upstream profits stemming from an increase in the access profits derived from an increase in the competitor's quality. This occurs because the incentive to foreclose does not depend on the regulated access price $c+\delta$. The term on the access price mark up δ cancel out in the derivative of the incumbent profit regarding U_2. Formally,

$$\frac{\partial^2 \Pi_1}{\partial U_2 \partial \delta} = \frac{\partial^2 \Pi_1}{\partial c_2 \partial \delta} = 0$$

This happens because the incumbent adds this whole value in its own price as shown in (25) and, then, one unit of the incumbent quantity is always more valuable rather than one unit of the entrant quantity in the access business of the incumbent.

Furthermore, observe that there is not an incentive to drop the quality of the entrant down to zero. This occurs because the profit function given in (26) above holds only while the two curves in figure 2 cross each other. After $x_1(p_1)$, the incumbent and the entrant become local monopolists and the preference of the former is to supply access to the entrant in the local monopoly of this player, obtaining some profit from it. Given (16'), the incumbent will be willing to leave the following market for the entrant:

$$x_{2ml} = k - \left(\frac{U_{1\max} - c_{1\min}}{2t}\right) \tag{29}$$

Since the entrant will also become a local monopolist after $x_1(p_1)$, from (16'), his optimal quantity will be:

$$x_{2m}* = \frac{U_2 * - c_{2\min}}{2t} \tag{30}$$

In the equilibrium of the vertically integrated incumbent that is able to change costlessly U_{2max} downwards, equations (29) and (30) must match. So, we are able to define the entrant's quality level until which the incumbent has an incentive to reduce the entrant's quality:

$$\frac{U_2 * - c_{2\min}}{2t} = k + \frac{c_{1\min} - U_{1\max}}{2t}$$
$$U_2 * = 2kt + c_{1\min} + c_{2\min} - U_{1\max} \tag{31}$$

All the terms of (31) respond to the basic intuition. The greater the level of demand *k*, there is more space in the market and the need to foreclose through decreasing the rival quality is minor. A large marginal rate of substitution *t* means that both networks are not so interchangeable and thus, the lower will be the requirement to foreclose the rival. The higher the costs, the larger the prices will be and more concentrated in their respective regions the networks will be. This also reduces the requirement for foreclosure. The opposite holds with U_{1max}. The greater U_{1max}, the larger the space of the linear city that the incumbent can occupy. In the limit, when the $U_{1\max} - p_1 - tx$ curve does not cross the horizontal axis of the linear city, then we say that there is an incentive for full foreclosure of the entrant, reducing the quality of the entrant until zero. Anyway, we assume that k is high enough such that:

$$U_2 * = 2kt + c_{1\min} + c_{2\min} - U_{1\max} > 0 \tag{32}$$

Using (32), the final profits of the incumbent and entrant after quality adjustments are:

$$\prod_{1m} = \frac{(U_{1\max} - c - c_{1\min})^2}{4t} + (c + \delta - c) * \frac{(2kt + c_{1\min} + c_{2\min} - U_{1\max} - c_{2\min})}{2t} =$$
$$\frac{(U_{1\max} - c - c_{1\min})^2}{4t} + \delta \frac{(2kt + c_{1\min} - U_{1\max})}{2t}$$

$$\prod_{2m} = \frac{(2kt + c_{1\min} + c_{2\min} - U_{1\max} - c_{2\min} - c - \delta)^2}{4t} =$$
$$\prod_{2m} = \frac{(2kt + c_{1\min} - c - \delta - U_{1\max})^2}{4t} \tag{33}$$

To simplify analysis, we assume that it is always better to be the incumbent providing access rather than the entrant with the following hypothesis:

$$\frac{(U_{i\max} - c - c_{i\min})^2}{4t} + \delta \frac{(2kt + c_{i\min} - U_{i\max})}{2t} \geq \frac{(2kt + c_{i\min} - c - \delta - U_{i\max})^2}{4t} \tag{33'}$$

Next, we check what are the incentives of an independent access provider regarding the quality of both companies. The access provider considers the equilibrium quantities as in (20). His profit would be:

$$\prod_{ind} = (c+\delta-c)(\frac{k}{2}+\frac{k}{2}+\frac{U_{1\max}-U_{2\max}+U_{2\max}-U_{1\max}+c_{2\min}-c_{1\min}+c_{1\min}-c_{2\min}}{6tk}) = \delta k$$

(34)

So, from (33), we have that $\frac{\partial \prod_{ind}}{\partial U_1} = \frac{\partial \prod_{ind}}{\partial U_2} = 0$ and there is no incentive to reduce the quality of any player, contrarily to the vertically integrated access provider incumbent. Now, we can derive the main proposition of this section

Proposition 2 Assume that the linear city model depicted in figure 2 represents a duopoly telecom long distance competition. Then, the vertically integrated incumbent will always have an incentive to foreclose partially the downstream entrant through quality, according to definition 2. These incentives are larger, the lower k, t, c_{1min} and c_{2min} and the larger U_{1max}.

Proof: By definition 2, we make $c_{1min}=c_{2min}$ and $U_{2max}=U_{1max}$. Clearly, the signal of (28) is always negative. Adding expression (34) to the analysis, we check that the independent access provider does not have any incentive to foreclose since $\frac{\partial \prod_{ind}}{\partial U_1} = \frac{\partial \prod_{ind}}{\partial U_2} = 0$. So, given definition 2, the existence of an incentive for partial foreclosure is proved. The sign of the variables influencing quality foreclosure come directly from (32).

The incentives to reduce quality (but not to foreclose according to definition 2 will be even enhanced if there is a first-mover advantage in the sense that:

$$U_{1\max} \geq U_{2\max}$$
$$c_{1\min} \leq c_{2\min}$$

The first inequality can be caused, for instance, by any positive degree of brand loyalty of the customers to the incumbent. The second inequality can be caused by a higher degree of efficiency of the incumbent due to the longer time he is already supplying the service in the market.

V) Conclusions

We saw that regulation of the access price can be neither necessary nor sufficient to avoid foreclosure behavior by the incumbent over the entrant, justifying an emphasis on a heavy-hand regulation on interconnection quality.

That was the case of Brazil. The General Ruling Toward Interconnection issued by ANATEL provides in more detail the regulatory provisions of interconnection in Brazil. There are specific provisions against anticompetitive practices within the interconnection agreements, including inefficient operation and deliberate postponement of negotiations. Duties regarding direcxtly the issue of interconnection quality includes the choice of an adequate point in the network, common planning and supply of information about technical changes and eventual interruptions of the service among the interconnected providers, minimum technical requirements related to interfaces, alternative routes in case of failure of the interconnection points, minimum operational availability of the interconnection points about 99,8% of the time and, finally, targets regarding the construction of a minimum number of interconnection points until the end of 2000 to the regional privatized companies and EMBRATEL. Finally, access providers are obliged to make relevant information available. Based on the issues discussed theoretically in this text, we consider that the direction of this intervention conceived in the Brazilian Model of Telecommunications Reform based on the experience of other countries is very positive.

Thought the model of section 3 shows how foreclosure through access pricing may not occur as defended by Chicago critiques, it is not general enough to conclude that there would be no anticompetitive concern of a vertically integrated firm in this case. Other features like the fear of having the local market taken over after entry in the long distance market have also to be considered. Moreover, it does not mean that the regulation of access prices is meaningless. Indeed, even the independent access provider, given his monopolist position, has have his price regulated and so does the vertically integrated incumbent. We think that the main conclusion is that i) there are, indeed, like the Chicago critique, circumstances where there won't be any difference between the behaviour of the independent access provider and the vertically integrated incumbent. This occurs because the increase in the profit of the upstream subsidiary by providing access will compensate fully the fall in the profits of the dowsntream subsidiary and thus there will be no reason to discriminate an entrant; ii) interconnection quality regulation can be an issue even more important than access price regulation.

The two models above did not attempt to proceed to a welfare analysis of vertical foreclosure. Indeed, we restricted the analysis to the existence of incentives from a vertically integrated incumbent to foreclose, but not what would be the impact over social welfare. In this case, fixed costs would gain a prominent role in the models, but this is a topic for future research.

References

ANATEL: "Regulamento Geral de Interconexão". http://www.anatel.gov.br/index.asp?link=/biblioteca/regulamentos/1998/regulamento_geral_Interconexao.htm

Armstrong, M., Cowan,S and Vickers,J:"Regulatory Reform: Economic Analysis and British Experience". The MIT Press. 1994.

Basu,K: "Lectures in Industrial Organization Theory". Blackwell. 1993.

Bork,R.: "The Antitrust Paradox" (New York Basic Books). 1978

Bolton,P. and Whinston,M: "Incomplete Contracts, Vertical Integration and Supply Assurance". Review of Economic Studies, 60. (1993)

Comanor: "Vertical Foreclosure". American Economic Review. 1969.

Crandall,R. and Waverman,L: "Talk is Cheap: The Promise of Regulatory Reform in North American Telecommunications". The Brookings Institution/Washington D.C. 1995.

Grossman,S.J and Hart,O.D:"The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration". Journal of Political Economy, 94, 1986.

Hart,O. and Tirole,J.: "Vertical Integration and Market Foreclosure". Brookings Papers on Economic Activity: Microeconomics. 1990.

Klein, B.; Crawford.,R.A. and Alchian,A.A.: "Vertical Integration, Appropriable Rents and the Competitive Contracting Process". Journal of Law and Economics. 1978.

Krattenmaker,T and Salop, S. : "Anticompetitive Exclusion: Raising Rivals´Coststo Achieve Power Over Price". Yale Law Journal, 96.

Kuhn,K.U. and Vives,X.: "Excess Entry, Vertical Integration and Welfare". Rand Journal of Economics. 1999.

Laffont,J.J. and Tirole,J.: "A Theory of Incentives in Regulation and Procurement". Cambridge. MIT Press. 1993.

Laffont,J.J. and Tirole,J.:"Competition in Telecommunications". Munich Lectures in Economics. The MIT Press. 2000.

Mankiw,N.G and M.D. Whinston: "Free Entry and Social Inefficiency". Rand Journal of Economics, 17. 1986.

Noll,R. and Owen,B.: "The Anticompetitive Uses of Regulation: United States v. AT&T (1982)".The Antitrust Revolution. Edited by Kwoka,J.1995.

Ordover, J., Saloner,G and Salop,S.: "Equilibrium Vertical Foreclosure". American Economic Review. March 1990.

Perry, M.: "Vertical Integration: Determinants and Effects". Handbook of Industrial Organization. 1989.

Posner,R.:"Antitrust Law: An Economic Perspective". Chicago. University of Chicago Press. 1976.

Rey,P. and Tirole,J: “A Primer on Foreclosure”. Mimeo – IDEI -Tolouse 1997. Forthcoming in the Handbook of Industrial Organization. 2001.

Salinger, M.: “Vertical Mergers and Market Foreclosure”. Quarterly Journal of Economics, May 1988.

Salop,S. and Scheffman,D.: “Raising Rival Costs”. AEA Papers and Proceedings. May 1983.

Salop,S. and Scheffman,D.:”Cost-Raising Strategies”. The Journal of Industrial Economics. Vol. XXXVI N 1.September 1987.

Tirole, J.: “The Theory of Industrial Organization”. The MIT Press. 1988.

Vickers,J.: “Competition and Regulation in Vertically Related Markets”. Review of Economic Studies 62 (1995).

Vickers,J and Yarrow, G.:”Privatization: An Economic Analysis”. Cambridge,MA: MIT Press. 1988.

Viscusi.W., Vernon,J. and Harrington,J: “Economics of Regulation and Antitrust”. Second Edition. The MIT Press 1995.