Vertical integration in telecommunications and foreclosure: The role of quality and the long run

César Mattos

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 foreclose 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 users. Aiming to avoid these problems and introduce competition at least in the long distance segment, the telecom reform in Brazil reduced the previous verticalization of the state-owned company TELEBRAS before privatization. We introduce a model that shows the incentive of the incumbent to reduce the quality of the call provided by the entrant through interconnection in a linear city model of the Hotelling type. The incentive to reduce quality, however, is not absolute and there is an incentive to leave the entrant operating in a given portion of the market. On the other hand, when we introduce long run considerations, the incentive to reduce quality can become absolute in the sense of not allowing entry anyway. The crucial hypothesis is that the entry in the long distance segment in the short run provides the basis for that, through a learning process, the entrant enters also in the local service in the long run. This shows the requirement of a strong monitoring by the regulator over interconnection quality.

1 Ministry of Finances Deputy Secretary for Foreign Affairs, PhD in Economics, Professor at the Catholic University of Brasilia and at the University of Brasilia - UnB/DF's Master's Program on Regulation.

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Resumo

É conhecido na literatura de economia da regulação os incentivos que uma empresa verticalmente integrada no setor de telecomunicações, proprietária das redes local e de longa distância, possui de fechar este último mercado para concorrentes demandantes de interconexão. Isso ocorreu no mercado de telecomunicações americano, dada a dependência dos novos concorrentes na longa distância (MCI e Sprint) nas redes de acesso locais da AT&T que possibilitariam conexão com usuários finais. Objetivando evitar estes problemas e introduzir concorrência pelo menos no segmento de longa distância, a reforma das telecomunicações no Brasil reduziu a verticalização prévia da estatal TELEBRAS antes da privatização. Neste artigo, focamos mais diretamente a questão do incumbente monopolista verticalmente integrado decidindo preços de acesso cobrados ao rival entrante no segmento de longa distância. Apresentamos um modelo demonstrando o incentivo do incumbente em reduzir a qualidade da ligação do entrante através da interconexão em um modelo de cidade linear de Hotelling. O incentivo redução de qualidade, no entanto, não é absoluto e há um incentivo a deixar o entrante operando em uma parcela do mercado. Por outro lado, quando se introduzem considerações de longo prazo, o incentivo de redução de qualidade pode passar a ser absoluto no sentido de não permitir a entrada do entrante. O ponto fundamental é que supõe-se que a entrada no segmento de longa distância no curto prazo fornece a base para que, através de um processo de aprendizagem, o entrante entre também no serviço local em um prazo mais longo. Isso demonstra a necessidade de um forte monitoramento do regulador sobre a qualidade da interconexão tal como seguido no Brasil.

Key Words: competition, vertical foreclosure, telecommunications, access pricing.

JEL Code: L12, L22, L42.

1. Introduction.

The incentive that a vertically integrated company owning a local and a long distance network in telecommunications has to foreclose interconnecting competitors from the long distance market in its local loop bottleneck is a familiar phenomenon in telecommunications. This has occurred in the U.S. telecommunications market, given the dependence of the new long distance competitors (MCI and
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Sprint) on the AT&T local networks to connect with end users. In the U.S. antitrust trial that resulted in the vertical break-up of AT&T in 1984, the company was charged with using its market power to reduce downstream competition, raising rival costs by refusing to deal, by imposing high local interconnection charges and by decreasing the quality of access. In the UK, those problems also appeared after the privatization of British Telecom (BT), which is attributed to the absence of a policy of vertical break-up, as implemented in the antitrust suit in the U.S., and to the lack of appropriate action by the British regulator, the Office of Telecommunications (OFTEL). The telecom reform in Brazil followed closely the U.S. antitrust experience in the AT&T divestiture of 1984, reducing the previous verticalization of the state-owned company, TELEBRAS.

The theoretical rationale behind this behaviour rests on the economics of vertical foreclosure. A vertically integrated incumbent owning the local service bottleneck and the long distance service will use its ownership of the essential facility represented by the local service to get rid of its competitors in the long distance. While intuitive and frequently referred to in the antitrust literature, this simple idea was under severe attack from the theoretical point of view and has received relevant transformations with the passing of time.

The market foreclosure idea is the most important rationale for antitrust intervention on vertical mergers and potentially anticompetitive practices. Rey and Tirole (1997,p.1) state the fundamentals of the “market foreclosure” reasoning in the antitrust literature and jurisprudence. Foreclosure would refer to any dominant firm’s practice that denies proper access to the essential input it produces, extending monopoly power from the bottleneck segment (in the case

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2 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.


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of telecommunications, the local loop) to a potentially competitive segment (in the case of telecommunications, the long distance service). Essentiality refers to the fact that the dominant firm’s product cannot be duplicated cheaply. This doctrine was first discussed in the United States in Terminal Railroad Association v. U.S. (1912), when some railroads, that were partners in the ownership of a bridge across the Mississippi river and in the approaches and terminal in Saint Louis, 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 in the writings of Bork (1978) and Posner (1976) that argued the lack of economic rationality for firms to undertake a vertical merger strategy to raise their profits by foreclosing the market. According to Rey and Tirole (1997, p.7) there is only one final product market and thus only one monopoly power to be exploited, the claim’s being meaningless that the monopoly power has to be extended throughout the productive chain.

Given the lack of rationality for exclusionary behaviour in the conventional foreclosure approach, the above-mentioned authors defended the intrinsic efficiency aspects of the vertical mergers. The emergence of those 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, escaping from the naïve leverage version of the theory that was used by the U.S. courts until the seventies. Tirole (1988, p.193/198) provides a survey of those 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 by means of a myriad of generic strategies aiming at raising rival costs, including exclusionary vertical long term contracts, 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 intermediate goods market instead of foreclosing. The two exceptions were published afterwards in the papers of Salinger (1988) and Ordover, Saloner and Salop (1990).

Hart and Tirole (1990) also build a rich and complex set of hypotheses under which foreclosure could emerge. There are a variety of possible outcomes in this paper which derive mainly from the incorporation in the model of two potential gains from mergers, i.e. i) avoidance of wasteful facility duplication (investment costs) by the remaining firms and ii) mere efficiency gains, which include the elimination of an eventual hold-up problem on the merged firm investment.

The model of Rey and Tirole (1997) relates the market foreclosure idea to the well-known Coase model of the “durable good” monopolist. Rey and Tirole (p.10/17) show that the bottleneck facility owner facing oligopolists in the complementary market may

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4See 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 its own inputs more efficiently and buys more expensive inputs in the market aiming at raising the rival costs. In this case, the vertical integration is not the source of foreclosing behavior. See also Salop and Kratenmark (1983).

5The most well-known model of exclusive dealing arrangement that forecloses the market inefficiently comes from Aghion and Bolton (2000), also summarised by Tirole (1988 p.196/198). The model replies formally to the criticisms by Bork (1978) and Posner (1976), who criticized the decision of the courts in the exclusionary contracts of the case United Shoe Machinery Corporation of 1922, on the basis of inexistent incentive for the buyers to feed a monopoly on the other side of the market, signing contracts that exclude competitors.
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not be able to credibly commit that the said owner will maintain the monopoly result in the contracts with each of those players. 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 will not accept the contracts that ensue from the monopoly result for the upstream bottleneck. This represents a decrease in the bottleneck monopolist’s profit. There are two main ways of dealing with this problem: an exclusive dealing arrangement with one of the oligopolists or a merger. In both cases, the bottleneck monopolist refuses to deal with the others, foreclosing the market, which results in the elimination of the temptation for opportunistic behaviour. The monopolist bottleneck is able to extract all monopolist rents from the complementary market. The result is a departure from the conventional wisdom, since foreclosure does not aim at extending market power from one market to another, but rather at reestablishing the market power.

In the case of the relationship between long distance carriers and the local loop bottleneck in telecommunications, that problem is not so sharp. This happens because, when the monopolist is at interface with the consumer, it is more inclined to internalise negative externalities between oligopolists. Therefore, as in the case of the local loop, the monopolist is directly responsible for the connection with the end-user, and the incentives to foreclose are reduced.

More recently, Kuhn and Vives (1999), extending and formalizing a conjecture raised by Perry (1989), linked the foreclosure caused by vertical integration and the “excess entry” result in 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 with the social optimum. Thus, vertical integration can increase efficiency and social welfare by increasing foreclosure and
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hurting competitors\(^6\).

The purpose of this article is to assess vertical market foreclosure by means of interconnecting quality and/or costs and the role of the long run effect in that behaviour. Laffont and Tirole (2000) show that the incumbent will foreclose by quality deterioration when the regulated access price is settled below its profit maximizing level. So, the incumbent derives more profits by operating through its own subsidiary rather than by supplying the entrant. In the next section, we develop a different model using a Hottelling linear city setting to show that quality foreclosure can emerge regardless of access price regulation. In the third section, we present a model in which the fear of having its local market taken over in the long run provides an extra incentive to foreclose entrants. Section IV concludes.

2. Foreclosure By Interconnection and/or Costs of Interconnection.

We assume that the choice of networks can be described by way of the linear city model of Hotelling\(^7\). There is a linear city of size \(k\), the consumers being uniformly distributed throughout, facing two firms, an incumbent (network 1) and an entrant (network 2), one in each extreme of the linear city. The closer the consumer is to network 1, the more he prefers 1 relatively to 2. \(k\) is the maximum horizontal differentiation existent and it can be related, as stated by Laffont,\(^8\)

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\(^6\) The "excess entry result" was also addressed by Vickers (1995).

\(^7\) We assume that all local markets in a given region have exactly the same demand and cost parameters. Then, the results of this paper are valid for the competition between the local incumbent and entrant in every location inside this region.

\(^8\) The linear city model proposed here follows closely the steps of Tirole (1988, p. 97/98), and it was already used in the study of network interconnection by Laffont, Rey and Tirole (1998) and Armstrong (1998).
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Rey and Tirole (1998, p. 2), to different functions offered by each network that appeal differently to different consumers.

The inverse of the marginal substitution rate between the two networks for any consumer is given by \( t \). In the traditional linear city model, where variables are explained in terms of geographical distances\(^9\), 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. 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 among consumers, the second concept represents the element of differentiation common to all consumers\(^10\). \( U_1 \) and \( U_2 \) are taken as the "gross utilities" of the networks 1 and 2 customers, respectively. These gross utilities are defined as the total utility (before deducting the price) obtained by the agent who derives the greatest satisfaction 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 differ-

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\(^9\)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".

\(^10\)For more detail on vertical differentiation, see Tirole (1988, p. 96-99).
entiation: horizontal along the linear city and vertical measured by $U_1 - U_2$ along the vertical axes. This latter kind of differentiation can include real quality variables such as the degree of noise, number of drops in the calls and the likelihood of completing a call, that are considered important characteristics by every end-user in the linear city. 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 average call charge\textsuperscript{11}. The surplus of the consumer located at $x$ will be given by the gross utility, the price and the transportation cost:

\begin{align*}
U_1 - p_1 - tx & \quad \text{if he buys at network1,} \\
U_2 - p_2 - t(k - x) & \quad \text{if he buys at network2,} \\
& \quad \text{and} \quad 0 \quad \text{if he does not buy at all.}
\end{align*}

If the difference between the prices charged by the two networks does not exceed the transportation cost plus the vertical differentiation\textsuperscript{12}, there is a consumer $x_1$ located between 0 and $k$ who is just indifferent to the two networks. Standard computations for the equilibrium profits result in the following equilibrium profits when the companies are not "local monopolists":

\textsuperscript{11} For the sake of avoiding non-linear prices, we assume that line installation and maintenance charges are zero. Alternatively, we could also assume that, as is standard in this type of model, each consumer will just buy one unit of the service.

\textsuperscript{12} $p_2 - p_1 < t(k + U_1 - U_2)$. Otherwise, there is the case of "local monopolies also found in the basic reference of Tirole (1988).
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\[ \Pi_1^* = \left( \frac{tk + \frac{U_1 - U_2 + c_2 - c_1}{3}}{2} + \frac{U_1 - U_2 + c_2 - c_1}{6t} \right) \]

\[ \Pi_2^* = \left( \frac{tk + \frac{U_2 - U_1 + c_1 - c_2}{3}}{2} + \frac{U_2 - U_1 + c_1 - c_2}{6t} \right) \]  

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 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. When the companies are local monopolists, their profit functions are:

\[ \Pi_{1m} = \frac{(U_1 - c_1)^2}{4t} \]

\[ \Pi_{2m} = \frac{(U_2 - c_2)^2}{4t} \]  

We concentrate on the problem of a long distance entrant entering 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 with the local bottleneck.

The rule of the regulated access price is very simple with the regulator setting a fixed mark-up \(\delta\) on the marginal access cost \(c\). We also assume that the regulator is not able to monitor or does not care about the regulation of the quality and/or the cost of in-
terconnection\textsuperscript{13}. At the same time, we assume that the vertically integrated firm provides access to itself and to the rival at the same access cost $c$, regardless of the interconnection quality. The maximum interconnection quality level that can be provided to both long distance companies is $U_{1M}$ and $U_{2M}$.

We assume that the incumbent can reduce (but not increase), costlessly, the interconnection quality with its own long distance network and of its downstream rival to less than $U_{1M}$ and $U_{2M}$, decreasing $U_i$ down to any non-negative value. Moreover, the incumbent can provide interconnection to the rival in such a way that 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 $c_{2m}$ and $c_{1m}$ as the minimum levels of long distance marginal costs that can be achieved by, respectively, the entrant and the incumbent without any interference of the incumbent. In sum, the vertically integrated incumbent is able to reduce the quality and/or 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’s?

Next, we have to define vertical foreclosure through quality properly. The definition has to account for every difference in the incentives of the vertically integrated incumbent compared with an independent access provider. This aims at isolating the effect of ownership of the downstream segment by the upstream access provider, avoiding any effect stemming from the monopolistic position of the local loop. So, the purpose of the definition is to capture a systematic bias, if any, of the vertically integrated incumbent in terms of

\textsuperscript{13}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 straightforward.
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reducing interconnection quality or increasing interconnection cost. Note that the source of the bias could also stem from an efficiency differential and not from vertical integration. Hence, we have to restrict the comparison to the case of equal efficiency (equal marginal cost) between the incumbent and the entrant. Furthermore, it is possible that the bias will come from the fact that it is more costly for the incumbent to interconnect to the long distance network of the entrant than to its own long distance network. So, we assume that the marginal cost of access does not differ. Finally, it is required that the independent supplier face the same number of downstream firms in the comparison, to avoid potential differences associated to a different number of downstream firms not directly related to the incentives for vertical foreclosure.

Vertical foreclosure through quality will be defined as follows:

Definition 1 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 (1), when, having both players i) the same maximum gross quality $U_{iM}$; ii) the same minimum long distance costs $c_{im}$; iii) the same marginal access cost to the local network of the incumbent and; iv) access prices regulated by adding a fixed mark-up of $\delta$ to the marginal cost of access, the incumbent has an incentive to reduce the quality of the entrant in the downstream segment while the two lines cross in figure (1) and an independent access provider would not have this incentive.

The total marginal cost of the incumbent to provide the long distance service that we call $c_{1l}$ can be disentangled into two components, the long distance marginal cost, $c_1$ and the marginal 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 $\delta$. Then,

$$c_{1l} = c + c_1$$
$$c_{2l} = a + c_2 = c + \delta + c_2$$

The incumbent’s and the entrant’s profit functions in the long distance service are given, respectively, by:

$$\Pi_1 = \frac{(p_2 - p_1 + tk + U_{1M} - U_{2M})}{2t} \times (p_1 - c - c_{1m})$$
$$+ \frac{(p_1 - p_2 + tk + U_{2M} - U_{1M})}{2t} \times (c + \delta - c)$$
$$\Pi_2 = \frac{(p_1 - p_2 + tk + U_{2M} - U_{1M})}{2t} \times (p_2 - c - c_{2m} - \delta)$$

The second term in the first equation of (5) accounts for the profit derived from the incumbent’s access business to the entrant. Given the definition of vertical foreclosure provided above, we have to check whether the vertically integrated incumbent will have an incentive to reduce the quality of the entrant from $U_{2M}$ and/or to increase the cost of the entrant from $c_{2m}$. So, we solve the incumbent’s problem, first calculating the equilibrium prices at $U_{1M}$, $U_{2M}$, $c_{1m}$ and $c_{2m}$, and then checking for its incentives to change these variables in the direction pointed in definition 1. Differentiating the profit functions in (5), in respect to prices at $U_{1M}$, $U_{2M}$, $c_{1m}$ and $c_{2m}$, we find the equilibrium prices of the two companies and compute for the new profit functions of the players:
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\[ \Pi_1 = \left( tk + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \]

\[ \times \left( \frac{K}{2} + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{6t} \right) + k\delta \]

\[ \Pi_2 = \left( tk + \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{3} \right) \]

\[ \times \left( \frac{K}{2} + \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{6t} \right) + k\delta \]  

(6)

Now, we can address the conditions under which the vertically integrated 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 quality or cost of interconnection. Taking the derivative of the incumbent's profit function in respect to the quality of the call from the entrant, we have:

\[ \frac{\delta \Pi_1}{\delta U_2} = -\frac{1}{3} \times \left( \frac{k}{2} + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{6t} \right) \]

\[ - \frac{1}{6t} \left( tk + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \]  

(7)

Given definition 1, we know that assuming equal efficiency from the sides of the gross utility and also costs, i.e., \( U_{1M} = U_{2M} \) and \( c_{2m} = c_{1m} \), (7) is always non-positive. In other words, the incumbent has incentives to reduce the entrant's interconnection quality if the regulator does not monitor or does not care about the quality of interconnection from \( U_{2M} \) downwards, regardless of the access price mark-up \( \delta \) settled by the regulator. Moreover, note that the lower \( U_2 \), the more negative will (7) be. This means that the incentive to reduce \( U_2 \) further is even stronger for some range where \( U_2 < U_{2M} \). Furthermore, we have
As (8) is just (7) with the opposite sign, the same result holds. In other words, the incumbent has incentive to increase the entrant’s cost \( c_2 \) if the regulator is not able to monitor interconnection costs and/or does not care about that.

And then, independent of the access business profitability granted by the regulator through \( \delta \), the negative impact of \( U_2 \) on \( \Pi_1 \) remains. As a result, 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 for 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 terms on the access price mark up \( \delta \) cancel out in the derivative of the incumbent profit regarding \( U_2 \). This happens because the incumbent adds this whole value to its own price and, then, one unit of the incumbent’s quantity is always more valuable than one unit of the entrant’s quantity in the access business for the sake of the incumbent’s profit maximization.

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 (7) is valid only while the players are not “local monopolists”. After some threshold values of \( x \), the entrant becomes a “local monopolist” and the incumbent’s preference is to supply access to the entrant in the local monopoly of this player, obtaining
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some profit from it. The incumbent will be willing to leave the following market for the entrant:

\[ x_{2ml} = k - \left( \frac{U_{1M} - c_{1m}}{2t} \right) \]  

(9)

Since the entrant will also become a local monopolist, its optimal quantity will be:

\[ x_{2m}^* = \frac{U_2^* - c_{2m}}{2t} \]  

(10)

being \( U_2^* \) the equilibrium quality of the entrant after the incumbent has dropped it down to the threshold value where the entrant becomes a "local monopolist". In the equilibrium of the vertically integrated incumbent that is able to change costlessly \( U_{2M} \) downwards, equations (9) and (10) must match. So, we are able to define the entrant’s quality level \( U_2^* \) down to which the incumbent has an incentive to reduce the entrant’s quality:

\[ \frac{U_2^* - c_{2m}}{2t} = k + \frac{c_{1m} - U_{1M}}{2t} \]  

(11)

\[ U_2^* = 2kt + c_{1m} + c_{2m} - U_{1M} \]

All terms in (11) respond to the basic intuition. The greater the level of demand \( k \), the more space in the market there is and the lesser the need to foreclose through decreasing the rival quality. A large inverse marginal rate of substitution \( t \) means that both networks are not so interchangeable and, thus, the lower will the requirement to foreclose the rival be. The higher the costs \( c_{1m} \) and \( c_{2m} \), the higher the prices will be and the more concentrated in their respective regions the networks will be. This also reduces the requirement for foreclosure. The opposite holds with \( U_{1M} \). The greater \( U_{1M} \), the
larger the space of the linear city that the incumbent can occupy. In
the limit, when the $U_{1M} - p_1 - tx$ curve does not cross the horizontal
axis of the linear city, then there is an incentive of the incumbent
to drop the entrant’s quality until it leaves the market. We assume
that $k$ is high enough such that:

$$U_2^* = 2kt + c_{1m} + c_{2m} - U_{1M} > 0$$  \hspace{1cm} (12)

Using (12), the profits of the incumbent and entrant after quality
adjustments are, respectively:

$$\Pi_{1m} = \frac{(U_{1M} - c - c_{1m})^2}{4t} + \delta \frac{(2kt + c_{1m} - U_{1M})}{2t}$$

$$\Pi_{2m} = \frac{(2kt + c_{1m} - c - \delta - U_{1M})^2}{4t}$$  \hspace{1cm} (13)

Next, we check what the incentives are of an independent access
provider regarding the quality of both companies. Its profit would
be:

$$\Pi_{ind} = \delta k$$  \hspace{1cm} (14)

So, from (14), we have that $\frac{\delta \Pi_{ind}}{\delta U_1} = \frac{\delta \Pi_{ind}}{\delta U_2} = 0$ and there is
no incentive to reduce the quality of any player, contrary to the
vertically integrated access provider incumbent. Now, we can derive
the main proposition of this section

**Proposition 1** Considering the linear city model depicted in fig­
ure 1 represents a duopoly telecom long distance competition. Then,
assuming that $k$ is high enough so that (2), (10) and (12) are al­
ways non-negative for all relevant values of $U_{1M}$, $U_{2M}$, $c_{1m}$ and $c_{2m}$,
the vertically integrated incumbent will always have an incentive to
partially foreclose the downstream entrant for quality, according to definition 1. The greater the incentives, the larger k.

Proof: By definition 1, we make $c_{1m} = c_{2m}$ and $U_{2M} = U_{1M}$. Clearly, the sign of (7) is always negative. We check that the independent access provider does not have any incentive to foreclose since $\frac{\delta \Pi_{\text{ind}}}{\delta U_1} = \frac{\delta \Pi_{\text{ind}}}{\delta U_2} = 0$. So, given definition (1), the existence of an incentive for partial foreclosure is proved. Furthermore, under the conditions above, $\delta \Pi_1 / \delta U_2 = -k/3$, meaning that as "k" increases the greater the incentive for partial foreclosure will be.

Although the incentive to foreclose partially increases with k, it does not imply that the incumbent wishes to drop the quality of the entrant further. On the contrary, we can check by (12) that $U_2^*$ increases with k. This happens because a larger market also increases the segment of the linear city that the incumbent will not serve the long distance service and the entrant is a potential "local monopolist". If it shrinks the participation of the entrant in this segment, it will be losing access revenues.

This model indicates the need to regulate the conditions of interconnection to promote competition in the long distance telephone market.

3. Foreclosure and Long Run Concerns: Incomplete Information about the Future Type of the Entrant.

We introduce the long run in the previous model by assuming two periods. The former period characterizes the "short run" and the latter period, "the long run". For the sake of simplicity, we suppose that the discount rate is zero, i.e. the future is as valuable as the present and both agents are risk-neutral. We keep the other hypothesis made in the last section. In particular, we continue assuming that the size of the long distance market given by k is large.
enough such that (6) and (12) are always positive for all relevant values of gross qualities and marginal costs. Once more, we assume that the regulator is neither able to monitor or not concerned about interconnection quality and costs.

For the sake of introducing long-run concerns on the issue of foreclosure, we have to make further assumptions. First, we suppose that the incumbent does not know in the first period what the efficiency (or the type) of the entrant in the second period, in the local service, will be after it has entered in the first period. There are two possible types: efficient (ef) and non-efficient (nef). Second, the entry in the long distance service in the first period works like a “ticket” for the entrant through a “learn by doing” process, enabling it to enter the local service in the second period. To simplify the analysis, we assume that any positive quantity supplied by the entrant in the long distance will provide it with this “ticket”. Therefore, if the incumbent allows access in the first period, it runs the risk of having the entrant entering its local service monopoly in the second period.

We also suppose that if the entrant enters the local service, it has to build a complete local infrastructure that will enable it to provide local service and access to every household, for the long distance service, in the second period. This is a hypothesis that seems to fit well in the second period, that represents the “long run” in this model. Furthermore, there is no extra cost to connect any additional household to its network once its infrastructure is already installed and there is no extra cost for the customer to be connected. Therefore, in the second period, if the entrant builds its own local infrastructure, competition will take place for calls and not for connections.

The question here is whether, by introducing long run concerns, the incumbent has an incentive to reduce quality even further to
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prevent any entry at all.

There is no need to specify in detail the components of the local service profit functions. The general expressions for the local service profit functions will be $\Pi_{ls1}(c_i, c_j)$. This can be read as the local service profit function of player $i$, when its marginal cost is $c_i$ and its rival’s is $c_j$. In the case of the entrant, this profit function will also account for the fixed cost of building a local infrastructure and entering the local service in the second period. Since the incumbent will have already sunk its fixed cost before the game starts, this does not influence its behavior during the game, and we simply neglect it in the pay-offs below.

Given the assumption that the entrant is not able to enter the local service before entering the long distance service, we can assume that its local service marginal cost or, alternatively, its fixed cost of entry in the first period is infinite. We assume the first hypothesis. Thus, the local service profit of the incumbent in the first period is $\Pi_{ls1}(c_h, \infty)$. This formulation implicitly assumes that the maximization problem of the local service market is solved completely independent of the long distance market variables. This means that the incumbent will not supply more, or less, service in the local market because it is more, or less, efficient in the long distance service.

The most important fear of the incumbent is that the entrant will enter the local service in the second period, stealing part of its market after the incumbent has allowed it entry by providing access in the short run (first period), in the long distance. We also assume that the two players cannot write a contract that will forbid the entrant to enter the local service in the future, since it would be challenged by the antitrust legislation.

This is a four-stage game, as depicted in the extensive form below.
In the first stage of the game, nature “plays” at the beginning and defines whether the entrant is efficient (ef) or non-efficient (nef) with probabilities of, respectively, $\rho$ and $1 - \rho$. This is private information for the entrant that decides, in the second stage of the game, whether to require access to the incumbent (RA) or not to require access (NRA). If the entrant does not require access, the game is over in “A”, if it is of the nef type, or in “B”, if it is of the ef type. We assume for simplicity that there is no fixed cost of entry in the long distance service. Given this assumption, we can disregard the possibility that the entrant will not require access and, hence, we can drop terminal points A and B from the substantive analysis. In other words, the entrant will always requests access in the long distance service in the second stage of the game.
If the entrant requests access, the incumbent decides whether to partially foreclose (playing PF), according to the rationale of the last section, or to go beyond that. Note that given the results of the last section, the incumbent will always foreclose at some degree. So, the question is whether to foreclose partially (playing PF) or simply drop $U_2$ until the entrant leaves the market, which we will designate as "playing FF". If the incumbent plays FF, it will leave the area of the linear city unattended, which it will never reach by itself and where it could make some profit by providing access to the entrant. It would be willing to play FF and give up the profits coming from the access business because it might be afraid of the entrant's threat in the local segment in the second period. Indeed, it may not be a good idea to "feed" a potential rival for the local service in the future in exchange for short run extra-profits in the access business, depending on the relative magnitude of the balance of expected losses and gains.

Since the type of the entrant is private information, the incumbent does not know whether the entrant is ef or nef and, hence, the incumbent's information set in the third phase of the game contains two nodes as depicted above. When the incumbent plays PF, it drops the quality of the entrant only down to the value given in (12). When the incumbent plays FF, it drops the quality of the entrant until the latter leaves the market\textsuperscript{14}.

When the incumbent chooses FF, the game is over in terminal node "C", if the entrant is of the nef type, or in "D", if the entrant is of the ef type. When the incumbent chooses PF, the entrant is able to enter the local service market in the second period, because it gets the "ticket" of entry in the long distance in the first period. And then, we reach the fourth stage of the game. The entrant decides whether to enter (ELS) the local service, building a new infrastructure to

\textsuperscript{14} Consistent with the last section, the incumbent can also raise the costs of the entrant.
provide local service and bypassing the incumbent in the local loop or not to enter (DNLS) the local service. If it (does not) enters, it reaches terminal nodes "E" ("F"), if it is of the nef type or "G" ("H"), if it is of the ef type.

We assume that an efficient (inefficient) entrant type will be more (less) efficient in the local service. If the entrant is ef (nef), its parameter will be $c_e(c_{ne})$ for the local service marginal cost, which is also equal to the marginal access cost to the long distance network. So,

$$c_e < c_{ne} \quad (13)$$

Moreover, if the entrant is ef, the local service profit functions of the incumbent and the entrant will be, respectively $\Pi_{ls1}(c, c_e)$ and $\Pi_{ls2}(c_e, c)$, in the second period. Analogously, if the entrant is of the nef type, then the local service profit functions are given by $\Pi_{ls1}(c, c_{ne})$ for the incumbent and $\Pi_{ls2}(c_{ne}, c)$ for the entrant. We assume that the profit functions are not increasing in their own costs and not decreasing in the rival's costs. So,

$$\Pi_{ls1}(c, \infty) \geq \Pi_{ls1}(c, c_{ne}) \geq \Pi_{ls1}(c, c_e) \quad (14)$$

$$\Pi_{ls2}(c_{ne}, c) \leq \Pi_{ls2}(c_e, c) \quad (15)$$

We assume that the local service profit functions $\Pi_{ls1}(c, c_e)$ and $\Pi_{ls1}(c, c_{ne})$ are non-negative and then the incumbent remains in the local service market in the second period\textsuperscript{15}. Next, we check the pay-offs of the companies in each terminal node. The pay-offs of the companies in each terminal node. The pay-offs of the companies in each terminal node.

\textsuperscript{15}If the local service profit equations were lower than zero, we should replace $\Pi_{ls1}(c, c_e)$ or $\Pi_{ls1}(c, c_{ne})$ by zero when either were negative in the pay-offs sketched below, implying unnecessary proliferation of equations.
incumbent and of the entrant, in terminal points C and D of this game, are the same and given by

\[ \Pi_{1CD} = 2\Pi_{ls1} (c, \infty) + \frac{(U_{1M} - c - c_{1m})^2}{t} \]  \hspace{1cm} (16)

\[ \Pi_{2CD} = 0 \]  \hspace{1cm} (17)

When the incumbent plays FF, reaching terminal points C or D, the incumbent obtains the vertically integrated monopolist result in both markets in the two periods and the entrant obtains zero.

Now, we look at the other terminal points. Suppose that the incumbent, without knowing the real type of the entrant, plays PF, opening the possibility for the entrant to get able to enter the local service in the long run. Then, we go to the fourth stage of the game, and the entrant decides whether to enter or not the local service. If the entrant is nef, the incumbent and the entrant will gain, respectively

\[ \Pi_{1e} = \Pi_{ls1} (c, \infty) + \frac{\delta (2kt + c_{1m} - U_{1M})}{2t} \]

\[ + \frac{(U_{1M} - c - c_{1m})^2}{2t} + \Pi_{ls1} (c, c_{ne}) \]

\[ + \left( tk + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \]

\[ + \left( \frac{k}{2} + \frac{U_{1m} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \]  \hspace{1cm} (18)
The first three terms of (18) and the first term of (19) are the first period profits of, respectively, the incumbent and the entrant at terminal point “E”. As the entrant enters the local service in the second period, the incumbent profit is no longer equal to the first period expression. The fourth and the fifth terms of (18) are, respectively, the second period local service and long distance profits of the incumbent, when the entrant plays ELS, being nef. Now, the incumbent loses his access business profits in the second period, since the entrant has built his own local loop alternative, bypassing the incumbent’s network. Furthermore, the entrant does not suffer from partial foreclosure anymore and is able to enter part of the area attended by the incumbent in the first period.

The entrant obtains, in the first period, only the first term of (19) that shows the profits from the part of the long distance market left by the incumbent after a decrease in the entrant’s quality. The second and the third terms account, respectively, for the second period local service and long distance profits of the entrant after it enters the local service. Notice that the entrant is not foreclosed (even partially) anymore, since it has built its own local loop infrastructure to bypass the incumbent.

Now, we turn to terminal point (F), where the entrant does not enter the local service in the second period, being of a nef type. The profits of the incumbent and the entrant at (F) are, respectively

\[
\Pi_{2e} = \frac{(2kt + c_{1m} - c - \delta - U_{1M})^2}{4t} + \Pi_{ls2} (c_{ne}, c) \\
+ \left( tk + \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{3} \right) \\
\left( \frac{k}{2} + \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{3} \right)
\]
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\[ \Pi_{1f} = 2\Pi_{ls1}(c, \infty) + \frac{\delta (2kt + c_{1m} - U_{1M})}{t} + \frac{(U_{1M} - c - c_{1m})^2}{t} \quad (20) \]

\[ \Pi_{2f} = \frac{(2kt + c_{1m} - c - \delta - U_{1M})^2}{2t} \quad (21) \]

When the entrant does not enter the local service, the profits of both players are just two times the first period profits. Notice that, in both expressions, there is no reference to the parameter of the \textit{nef} type entrant, \( c_{ne} \), since it will just appear when this player enters the local service. This is also the case when the entrant is of the \textit{ef} type but does not enter. So, the profit expressions of terminal point (F) also hold for terminal point (H).

Then, we can check for the last terminal point, (G).

\[ \Pi_{1g} = \Pi_{ls1}(c, \infty) + \frac{\delta (2kt + c_{1m} - U_{1M})}{2t} \]

\[ + \frac{(U_{1M} - c - c_{1m})^2}{2t} + \Pi_{ls1}(c, c_e) \]

\[ + \left( tk + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \]

\[ \left( \frac{k}{2} + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \quad (22) \]

\[ \Pi_{2g} = \frac{(2kt + c_{1m} - c - \delta - U_{1M})^2}{4t} + \Pi_{ls2}(c_e, c) \]

\[ + \left( tk + \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{3} \right) \]

\[ \left( \frac{k}{2} + \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{3} \right) \quad (23) \]
These profit expressions are almost equal to those from terminal point (E) in (18) and (19), just switching the non-efficient type subscript \( (nef) \) for the efficient type subscript \( (ef) \). Given the hypotheses presented above, we will always have \( \Pi_{1e} > \Pi_{1g} \) and \( \Pi_{2e} < \Pi_{2g} \).

We look for the equilibrium of this game solving it by backward induction. This will always depend on the magnitude of the parameters. There are three relevant cases.

First, suppose that the entrant is of the \( nef \) type. There are low enough values of \( c_{ne}, c_{2m} \) and \( U_{1m} \) and high enough \( U_{2M} \) and \( c_{1m} \) so that the entrant prefers (E) to (F) at the fourth stage of the game. Given the hypothesis above, when this happens, the entrant will also prefer (G) to (H). In other words, when the \( nef \) entrant type prefers to enter the local service in the second period, the \( ef \) type will also prefer this action. Thus, the incumbent can anticipate with certainty that the entrant will always enter its local service market and play PF or FF, aware of the next action of the entrant. Moreover, when the incumbent plays FF, it is also sure about its payoff, which is independent of the entrant’s type. This does not occur if the incumbent plays PF. In this case, the incumbent has to deal with the uncertainty between an \( ef \) type and a \( nef \) type. The profit will be lower in the first case, since by the hypothesis presented above, (18) is always greater than (22). At the third stage of the game, the incumbent weights these expressions by \( \delta \) and \( 1 - \delta \), respectively, and compares them to its pay-off at C and D (that are equal, given by (16)). The (risk-neutral) incumbent plays “FF” when the following inequality holds:
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\[ \Pi_{ls1}(c, \infty) + \frac{(U_{1M} - c - c_{1m})^2}{2t} \]

\[ - \rho \left[ \Pi_{ls1}(c, c_{ne}) + \left( tk + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \right] \]

\[ \left( \frac{k}{2} + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \]

\[ - (1 - \rho) \left[ \Pi_{ls1}(c, c_{ne}) + \left( tk + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \right] \]

\[ \left( \frac{k}{2} + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \]

\[ > \frac{\delta (2kt + c_{1m} - U_{1M})}{2t} \]

The inequality can be interpreted as follows. The left-hand side accounts for the opportunity cost of the incumbent from losing its market power in the local and long distance services in the second period. The first two terms of (24) are the forgone profits of the incumbent in the second period after the entrant has entered the local service. These two terms have to be discounted, by the expected profits that the incumbent obtains, after the entrant has played ELS to obtain the expected opportunity cost of the incumbent in granting access to the entrant, those being the third and the fourth terms in the first period. The single term on the right-hand side of (24) accounts for the incumbent’s opportunity cost, when the incumbent plays FF and forgoes the access business profits in the first period. The balance of both opportunity costs will define what is the incumbent’s best action in this case.
A crucial consideration is the opportunity cost of the forgone profits, in the local service, in the second period, after the entry of the entrant in the second period. When the distance between $\Pi_{ls1}(c, \infty)$ and $\Pi_{ls1}(c, c_{ne})$ and/or $\Pi_{ls1}(c, c_{e})$ is great, the opportunity cost of allowing entry in the first period is also great, pushing for the incumbent to play FF. The opportunity cost of the long distance service is also relevant and depends on how much the entrant is expected to steal away from the incumbent in the second period, since the former is not partially foreclosed, as it happened in the first period. It is also important to remark the role of the opportunity cost of the access business that appears on the right hand side of inequality (24). The greater the regulated access mark-up $\delta$, the greater the opportunity cost of playing FF, which shows that the temptation of the regulator to reduce the costs of the entrants by using artificially low access prices increases the incentives to play FF. This is in line with Laffont and Tirole (2000, p.175/176). The higher the probability of a nef type, $\rho$, the less likely inequality (24) will hold.

Now, we turn to the second case. Suppose that the entrant is of the ef type. We have the opposite result. There are several high enough combinations of $c_{e}$, $c_{2m}$ and low enough $U_{1M}$ and $U_{2M}$ and $c_{1m}$, so that the entrant prefers (H) to (G) at the fourth stage of the game, Given the hypothesis above, when this happens, the entrant would also prefer (F) to (E). In this case, the entrant never enters the local service in the fourth stage of the game. It is worth keeping in mind that we assumed that the size of the market, $k$, is large enough so that, for all relevant values of the gross qualities and marginal costs, the profits in the long distance market are always positive. Then, these combinations refer to the case where the local service profits, $\Pi_{ls2}(c_{e}, c)$ and $\Pi_{ls2}(c_{ne}, c)$ are negative enough, perhaps because of the presence of relevant fixed costs to enter the
local service, compensating the positive profits in the long distance market. In this case, the incumbent compares (20) (the profit by playing PF) to (16) (the profit by playing FF). Clearly, the incumbent always chooses PF, since (20) is always greater than (16), by the term that represents the access business revenues. There is no fear of facing the competition of the entrant in the local service in the second period, while, by playing PF, the incumbent obtains the access revenues.

Next, we address the third case when the difference of types matters more. Suppose that, if the entrant is ef, it chooses ELS, while, if it is nef, it chooses DELS. In this case, the following inequalities will hold:

\[
\Pi_{ls2}(c_e, c) + \left( tk + \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{3} \right) \\
\left( k \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{2} \right) > 0 > \Pi_{ls2}(c_{ne}, c) + \left( tk + \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{3} \right) \\
\left( k \frac{U_{2M} - U_{1M} + c_{1m} - c_{2m}}{2} \right)
\]

(25)

The entrant in the second period has negative profits if it is nef and positive profits if it is ef. Notice that for (25) to hold, \( \Pi_{ls2}(c_{ne}, c) \) has to be negative enough, perhaps because of a substantial fixed cost of entry in the local service that is supposed to be included in this profit function. Also notice that those two inequalities depend solely on the difference of efficiencies between the two types of entrant. The entrant enters the local service in the second period only if it is of the ef type. This makes the role of \( \rho \) more important than ever for the decision of the incumbent. The incumbent plays FF if
(1 − ρ) \left[ \Pi_{l_1} (c, ∞) − \Pi_{l_1} (c, c_e) + \frac{(U_{1M} - c - c_{1m})^2}{2t} \right. \\
\left. - \left( tk + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \left( \frac{k}{2} + \frac{U_{1M} - U_{2M} + c_{2m} - c_{1m}}{3} \right) \right] \\
> (1 − ρ) \frac{δ (2kt + c_{1m} - U_{1M})}{2t} \tag{26}

The left-hand side of the equation is the expected opportunity cost of the incumbent by having the entrant playing ELS and being of the ef type. The difference of the first two terms in brackets is the incumbent’s opportunity cost, in the local service, for granting access to the entrant, by playing PF in the first period. The difference of the other terms in brackets accounts for the incumbent’s opportunity cost, in the long distance service, for granting access to the entrant, by playing PF in the first period. The single term on the right-hand side is the expected opportunity cost of the access revenues, by playing FF in the first period.

Once more, the greater the regulated access mark-up δ, the less likely the incumbent will play FF, since the expected opportunity cost of losing the monopoly in the local service and in the long distance service, in the second period, by granting access to the entrant in the first period, decreases, and the opportunity cost of foregoing the access business increases.

Now, we have to provide a suitable definition for full foreclosure. An important remark in this section is that, to play FF in the game depicted in figure (2) does not mean that the incumbent is fully foreclosing according to a proper definition. As in definition 1, we also
have to purify the differences in long distance qualities and marginal costs:

**Definition 2:** There will be full foreclosure through quality made by a vertically integrated incumbent against a downstream entrant in the two-period game depicted in figure (2), based on the linear city model depicted in figure (1), when, having both players i) the same maximum gross quality \( U_{1M} \); ii) the same minimum long distance costs \( c_{im} \); iii) the same marginal access cost to the local network of the incumbent and; iv) access prices regulated by adding a fixed mark-up of \( \delta \) to \( c \), the incumbent has an incentive to reduce the quality of the entrant in the downstream segment until the entrant gives up entering the long distance service in the first period and an independent access provider would not have this incentive.

Now, we apply the conditions of definition 2 to (24) and (26):

\[
\Pi_{ls1}(c, \infty) + \left( \frac{U_{1M} - c - c_{1m}}{2t} \right)^2 - \rho \Pi_{ls1}(c, c_{ne}) - (1 - \rho) \Pi_{ls1}(c, c_e) > \frac{\delta (2kt + c_{1m} - U_{1M})}{2t}
\]

(24')

\[
(1 - \rho) \left[ \Pi_{ls1}(c, \infty) - \Pi_{ls1}(c, c_e) + \left( \frac{U_{1M} - c - c_{1m}}{2t} \right)^2 - \frac{tk^2}{2} \right] > (1 + \rho) \frac{\delta (2kt + c_{1m} - U_{1M})}{2t}
\]

(26')

\(^{16}\)Expression (25) will also become \( \Pi_{ls2}(c_e, c) + \frac{tk^2}{2} > 0 \)\( > \Pi_{ls2}(c_{ne}, c) + \frac{tk^2}{2} \). Notice that the third case happens only when the local service profit of the nef type is very negative to outweigh the term \( tk^2/2 \). Once more, this can occur, for instance, because \( \Pi_{ls2}(c_{ne}, c) \) involves a very high fixed cost of entry.
From (24') and (26'), we get the following proposition:

**Proposition 2:** Considering the two-period game of foreclosure with incomplete information from the incumbent about the entrant, depicted in figure 2, based on the linear city model depicted in figure 1, which represents a duopoly telecom long distance competition. Then, assuming that the second period is not discounted, that $k$ is high enough so that (2), (10) and (12) are always non-negative for all relevant values of $U_{1M}$, $U_{2M}$, $c_{1m}$ and $c_{2m}$ and that any positive supply of the entrant enables it to enter the local service in the second period, with a finite local service and access marginal cost of $c_e$ or $c_{ne}$, and a finite and constant fixed cost, and to be ready to provide calls for every citizen of the linear city with the same marginal cost, there are combinations of low (high) enough values of $\delta$, $k$, $c_{1m}$ and $c_{ne}$ or $c_e$ and high (low) enough values of $U_{1M}$, so that the incumbent (does not) fully forecloses the entrant according to definition 2 in the third stage of the game.

**Proof:** From (24') and (26'), the higher $\delta$, the greater the right-hand side of the expressions, making "play FF" less likely. Seemingly, the higher $k$, the right-hand side of both equations increases and the left-hand side of equation (26') decreases. When $c_{1m}(U_{1M})$ increases (decreases) the right-hand side of equations (24') and (26') increases and the left-hand side of both equations decreases, making "play FF" less likely altogether. When $c_e$ and $c_{ne}$ are greater, the left-hand side of equation (24') decreases. When $c_e$ increases, the left-hand side of (26') also decreases. So, the effects of $c_e$ and $c_{ne}$ established in the proposition are proven. Finally, as we showed in the proof of proposition (1), $\delta \Pi_{ind}/\delta U_2 = 0$.

The main points are clear. High values of the access regulated mark-up $\delta$ and of the size of the linear city $k$ increase the opportunity cost of the access business of the incumbent when it fully forecloses the entrant. A greater $c_{1m}(U_{1M})$ reduces (increases) the forgone
profits of the incumbent in the second period in the cases when it disputes the local service with the entrant after granting access in the long distance in the first period. This also reduces (increases) the propensity for a full foreclosure behaviour of the incumbent. Greater values of the entrant’s future marginal costs $c_e$ and $c_{ne}$ decrease the likelihood of entry, in the local service, in the second period, after entry in the long distance service in the first period, decreasing the incentives for foreclosure.

The interesting case occurs when $c_e$ and $c_{ne}$ are different enough so that the entrant enters the local service when it is of the $ef$ type and does not enter when it is of the $nef$ type and the relevant expression to address foreclosure is (26’). Direct inspection of (26’) shows that the role of the likelihood of being $nef$, $\rho$, is more important than in the case of (24’), when the entrant always enters the local service, regardless of being $ef$ or $nef$. When $c_e$ and $c_{ne}$ are different enough in that sense, information asymmetry becomes crucial in the solution of the game.

An important remark is that the effect of the incumbent’s marginal cost $c$ on its incentive for full foreclosure is ambiguous. In (24’), for instance, a larger $c$ reduces the first two terms that have positive signs but also reduces (in absolute terms) the third and the fourth terms that have a negative sign.

Therefore, the incentives of the incumbent to drop the entrant out of the market appear, independent of (10) being zero or not, when the long run is incorporated into the problem. The important message of this section is that incomplete information can be a source of foreclosure behaviour, given the long-run considerations of the incumbent.


Our purpose in this paper was to provide some guidance about
how vertical foreclosure, by way of interconnection quality deterioration, can occur based on reasonable definitions. Both definitions aim at isolating the effect of vertical integration on the incentives to reduce quality and/or increase the costs of interconnection for the entrant. For this purpose, we purify for the natural incentive of the upstream firm to capture as much profit as it can from downstream firms, that being independent of the fact that it owns a downstream subsidiary or not. In the model presented in the last section, we showed why the incumbent could have an incentive to go further and, from the partial foreclosure strategy assessed in section II, undertake a full-foreclosure behaviour towards the entrant. This occurs when we introduce the long run and the incumbent’s fear of having his local service market taken over in the long run after it left entry in the long distance in the short run. The main point is that the entrant passes by a learn-by-doing process in the short run and is able to enter the local service in the long run.

This contradicts the Chicago critiques against the theory of vertical foreclosure that points to the lack of rationality of this practice. Laffont and Tirole (2000) had already shown that quality foreclosure could emerge when access price regulation is tight enough. We provided a model in section II according to which partial quality foreclosure can emerge, regardless of access price regulation. In section III, we extended the model for a two-period game representing the long-run, in which the fear of the incumbent about having its local service market contested by the entrant in the future can guide the behaviour of the vertically integrated incumbent towards full foreclosure of the entrant.

Indeed, long run motivations are a very intuitive and plausible behaviour: the incumbent can profit in the short run by providing access to its competitor, but the fear of being replaced or challenged in the long run, in the local service or other related services that
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demand a previous ticket, such as the long distance service in this model, can influence its decision. This generates the incentive of the incumbent to fully foreclose the entrant. In our model, interconnection quality deterioration is the tool of foreclosure to be used by the incumbent.

This rationale reassures that regulation of the interconnection conditions is crucial to guarantee a competitive market in telecommunications. Furthermore, regulation of the access price is not a sufficient condition to avoid foreclosure behavior by the incumbent over the entrant, justifying emphasis on a heavy-hand regulation on the interconnection quality and costs.

In Brazil, there was a special concern regarding the issues addressed in this paper. First, TELEBRAS was broken-up between the local and the long distance service to avoid such kind of discrimination. Second, the Brazilian regulator issued a very tight interconnection regulation, the “Regulamento Geral de Interconexão”, according to which several provisions to assure the quality of interconnection can be found. We think that the enforcement of those provisions will be crucial to guarantee the introduction of competition at least in the long distance segment of the Brazilian telecom sector.


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