# Entry, Cream Skimming, and Competition: Theory and Simulation for Chile's Local Telephony Market

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## Abstract

After privatizing local exchange companies (LEX), many countries are introducing competition in local telephony in order to encourage both allocative and productive efficiency. However, enormous sunk costs, and scale, scope and network economies cannot guarantee perfect competition. This paper shows that depending upon characteristics of the market – such as market structure or demand – competition may be complete, partial, or even nonexistent. We use a game theoretical three-step model in which an entrant firm cream skims the market. We illustrate our results by using consistent Chilean data, and the model predicts that Chile's local telephony market will not become a deeply competitive market. This result is robust to changes in the model, in particular to price cap regulation. This model provides us with two interesting economic policy conclusions. First, cream skimming makes more profitable the entrance in the market, but this practice reduces the possibility of full competition in the market. Second, Santiago's local telephony market should not be fully liberalized in the near future and prices of the dominant firm should still be regulated.

***Keywords***: Telecommunications, Entry, Cream Skimming, Network Competition, Chile

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# I. Introduction

After privatizing their local exchange companies (LEX), many countries are introducing competition in this market of the telecommunication industry. With such a policy, governments attempt both to improve productive efficiency and curb monopolistic rents in the market. Hence, competition is view as a better instrument than regulation to achieve both goals.

However, the policy of enhancing competition does not ensure neither productive nor allocative efficiency because this market is not competitive by definition. Enormous sunk costs after building the network, as long as scale, scope, and network economies in the operation of the facility make socially desirable to have a (natural) monopoly operating the market. Therefore, new entrants have very narrow opportunities to gain market share and just liberalizing the market does not ensure the development of competition.

As a consequence, the process of strengthening competition as not finished yet in those countries that opened the local telephony market to new entrants in the last 15 years. Still old monopolies dominate most of their markets. In the interim, new entrants are still in expansion with coverage that certainly we may hardly consider them as “competitive” (Newbery, 2000).

This paper shows that it is possible to introduce competition in local telephony. However, this market will not be perfectly competitive, except if new entrants using new technologies are able to operate to substantial lower costs than the incumbent’s. In other words, leaving aside technological shocks with asymmetric innovations – issue that we do not attempt to assess here – new LEXs will partially enter in the market. That is, new entrants would build its own network but with partial coverage.

According to recent literature on (telecommunications) network competition (e.g. Laffont, Rey, and Tirole, 1998; Laffont and Tirole, 2000; Armstrong, 2001) we ought to observe the following market behavior: given an incumbent firm with market power and imperfect regulation, equilibrium prices will be above marginal costs. Then, a new entrant has market power on the residual demand and so it will enter in the market charging some price in between its marginal costs and the incumbent’s price. However, the higher the new entrant’s coverage the lower the incumbent’s market power, so the more difficult the entry in the market. This literature, in particular Laffont, et. al, does not specify the final outcome of the competition process. They assume that the new entrant builds its own network with full coverage.

The theoretical importance of this paper to this literature is to model post-entry competition. We assume that the new entrant’s decision about whether or not to enter in the market is endogenous. We also assume that the new entrant has the strategy to cream skim the market. That is, this LEX may choose to cover only to the more profitable customers, such as big enterprises, richer neighborhoods, or business buildings, whose high level demands allow the new entrant a fast recovering of its investments. With such a policy, a new entrant leaves those less profitable customers to the incumbent firm (who has mandatory full coverage in all markets). Doing so, new entrant’s cream skimming negatively modifies the outcome of the post-entry competitive process in local telephony.

Whether new entrants extensively use this strategy is a matter of fact. However, new entrant’s cream skimming is fully consistent with practice in Chile.

The importance of assessing post-entry competition assuming cream skimming is that if new entrants extensively use such a practice, then competition will not be deep enough. The incumbent would still have market power to obtain monopolistic rents and final prices would be inefficient. In such unpleasant scenario, market competition in local telephony will not perform a good as a regulatory agency, making the society worse off with this liberalization process.[1]

Our theoretical approach to this topic is by using a perfect and full information three-step game. We assume that all customers hire local telephony only from two firms, for any given set of prices. This model attempts to characterize network competition and provide some economic policy conclusions based on such goal. It does not pretend to answer other related questions, such as performance of pricing regulation, welfare impacts of competition in telecommunications, optimal pricing in this sector, and so on. All of these other issues are rather than conveniently treated in the already mentioned literature.

Since it is impossible to obtain close solutions for our model, we solve it using both some algebraic analysis and, mainly numerical simulations. For simulations, we use data from Santiago de Chile's local telephony market from 1999.

The model has some simplifications that fortunately are without loss of generality. For instance, we assume a constant and inelastic demand. The latter is consistent with empirical evidence in other countries, where several authors have found very small elasticities for local telephony.[2]

The more important economic policy conclusions of this paper is that in most cases new entrants will not build its own network with full coverage. This conclusion is true whether or not the new entrant cream skim the market. Therefore, a total liberalization of the local exchange market will hardly produce the benefits to the society that some people tell about this type of policy. As a consequence, introducing competition in local telephony is not a sufficient mechanism to guarantee and efficient performance of the market.

Additionally, although cream skimming is not the only responsible for this outcome, this new entrant's strategy is inefficient because it increases equilibrium prices above those in which this strategy is not feasible. This conclusion is relevant since new entrant's cream skimming is common and it is not legally forbidden in most countries.

In the extension of the model we assume that regulatory fixed price caps are binding. We show that our main conclusions – about post entry competition – does not change after introducing this extension.

This paper is organized as follows. We present the model in section II; in particular, we describe assumptions and notation, we explain the functioning of the model, and we present its parameterization. In section III we solve the benchmark. In section IV we show theoretical and numerical results for the market cream-skimming scenario. Section V presents the extension with a binding price cap. Finally, section VI concludes.

[1] We ruled out the case of extremely inefficient regulation. Definetively, this is a good assumption considering the Chilean case.

[2] For example, see Mitchell (1978) or Park, Wetzel, and Mitchell (1983). Both articles estimated price-elasticities on around 0.1.

# II. The Model

## II.1 Assumptions and Notation

We model the competition process as a three-step sequential game. There are two players: player 1 is the incumbent firm that has full coverage of the market, and player 2 is the new entrant, which in turn have to choose about its market coverage. Regulators have a passive role in this model.

In the first step firm 2 chooses is coverage, denoted by $\mu$. We suppose that the new entrant immediately builds its facilities related to such coverage, with a cost of $d(\mu)$. This coverage is common knowledge. In the second step both firms compete "à la Bertrand", choosing what prices they will charge for their services ($p_1$, $p_2$).[3] Networks are imperfect substitutes, thus equilibrium prices may differ and they are above marginal costs. Finally, in the third step customers observe prices and then they make two decisions: to what network subscribe – denoted by $\alpha(p_1,p_2)$ – and how much to use the service – i.e. their demand $q(p_1,p_2)$ –. Section II.2 describes in detail each step of this game.

The structure of this game is similar to that of Laffont et.al. (LRT), so that we name this case as the *benchmark*. Additionally, we allow the new entrant to cream skim the market, that is firm 2 chooses its customers according the level of their demand. We suppose that customers can be of two types: high level demand or low level demand.

Payoff functions have the traditional structure, except by access charges needed for interconnect both telecomm networks. It is important to mention that when two or more networks are interconnected, calling can be classified in "on-net" – a call starts and finishes in the same network – and "off-net" – a call starts and finishes in different networks–. Since we do not attempt to assess optimal access charges, we just suppose a standard assumption on the literature, *Balanced Calling Pattern*. This assumption means that the percentage of "on-net" calls is equal to the percentage of customers belonging to such network. It implies that the flow of calls, in term of minutes, becomes balanced.

We assume that the regulator exogenously fixes both access charges and interconnection charges in a level that they do not impede the entry of the new entrant. Moreover, we suppose that access charges are symmetric.

Demand functions are $q(p_i)$, in which $p_i$ denotes firm's *i* price. So that, once a customer chooses a network her demand only depend on the price of such firm, not on the rival's. In the case of cream skimming, demand functions are $q_l(p_i)$ for low level demand customers and $q_h(p_i)$ for high-level demand customers.

The next table summarizes notation that we uses in this paper:

[3] We assume that each $p_i$ is a single price, not a vector of prices. These firms produce one good and they charge the same unit price at any time. That is, we do not allow for peak load pricing in our model. This assumption is without loss of generality.

| | |
|---|---|
| $p_i$ | Firm *i*'s profit function |
| $l$, $h$ | Percentage of low, high demand customer ($l + h = 1$) |
| $q(p_i)$ | Demand function when new entrant does not cream skim the market |
| $q_l(p_i)$, $q_h(p_i)$ | Demand functions with market cream skimming |
| $p_1$, $p_2$ | Incumbent and new entrant's prices |
| $X$ | Constant level demand without market cream skimming |
| $X$, $Y$ | Constant level demands with market cream skimming for low and high level demands, respectively |
| $f$ | Unit fixed cost (by customer or line) |
| $c$ | Marginal Cost (by minute) |
| $t$ | Transportation cost by customer |
| $a - c_0$ | Net access charge (access charge minus interconnection cost between networks), by minute |
| $\mu$ | New entrant's coverage without cream skimming |
| $\mu_l$ ,$\mu_h$ | New entrant's coverage in low and high level markets, respectively |
| $\alpha(p_1,p_2)$ | Ratio of customers in network 1 covered by both networks. If $\alpha$=0 all customers are in firm 2; if $\alpha$=1 all customers are in firm 1. |
| $\alpha_1(p_1,p_2)$, $\alpha_2(p_1,p_2)$ | Percentage of customers in networks 1 and 2, respectively. These values depend upon $\alpha$( ) and new entrants market coverage |
| $\alpha_l(p)$, $\alpha_h(p)$ | Similar to $\alpha$( ), but now for type of customer |

Note: subscript $i$ = 1,2 denotes firms 1 (incumbent) and 2 (entrant).

## II.2 MODEL'S DESCRIPTION

Let us now describe in details each stage of the game. Let us do it backward in order to be consistent with the resolution of the game.

### *Third Step*

Taking as given prices and new entrant's coverage, customers choose in this steps how much minutes of telecom services consume and what company will provide them the service for. Demand function determines the usage of the service, which only depends on the price charged by the firm and not by its rival's. Similarly, if the new entrant is cream skimming the market each type of customer will make calls based on her pertinent demand, $q_l(p_i)$ or $q_h(p_i)$, in which $q_l(p_i) < q_h(p_i)$.

We solve the company's choice by using a Hotelling model for imperfect substitute goods. Doing so, we are capturing the diversity of service characteristics provided by a LEX – such as quality of the telecommunication service itself, customer services, tastes, marketing, etc. –. We suppose that customers are uniformly distributed over a straight line. Each consumer's location is given by function $\alpha(p_1,p_2)$, which may take any value in the interval [0,1]. Firms are located in each extreme of the straight line, firm 1 (incumbent) is located in the extreme left ($\alpha = 0$) and the new entrant is located in the extreme right of this line ($\alpha = 1$).

The further each consumer is located from its company, the higher transportation costs ($t$) that she has to pay. Therefore, this transportation cost is the variable that determines the degree of substitution between companies. Each consumer chooses a LEX that produce her higher benefits, function which is in turn decreasing on prices and transportation costs.[4]

At equilibrium, each customer is indifferent between networks because both of them with the same net utility. Let the consumer's indirect utility function be $v(p)$. Then, we have:

$$v(p_1) - ta = v(p_2) - t(1-a) \quad \text{(II.1)}$$

Solving for $a$, we obtain a function that allocates customers between networks according to prices and transportation costs:

$$a(p_1, p_2) = \frac{1}{2} + \frac{1}{2t}\left[v(p_1) - v(p_2)\right] \quad \text{(II.2)}$$

Since $\alpha \in [0,1]$, then $\alpha = 0$ implies none consumer is an incumbent's customer, whereas the contrary happens when $\alpha = 1$. When both networks charge similar prices the second expression of II.2 vanishes, thus $\alpha = 0.5$.[5]

By the envelope theorem, we can obtain de demand function from the indirect utility function. The converse is also true, thus:

$$v(p) = -\int_0^p q(p) \quad \text{(II.3)}$$

In the case that the demand is a constant, independently of price, $v(p) = -pX$, where $X$ is the number of minutes in which a customer uses the local telephony service. In such a case II.2 becomes:

$$a\left(p_1, p_2\right) = \frac{1}{2} + \frac{X}{2t}\left(p_2 - p_1\right) \quad \text{(II.4)}$$

### *Second Step*

In the second stage of the model, firms take new entrant's coverage as given. Then, they unilaterally choose their prices in order to maximize profits. Let us assume that the incumbent's equilibrium price is not higher than the regulated price. Since this assumption may change conclusions, we take account of it lately.

4 We insist in saying that $t$ is an abstraction, which represents different LEXs' attributes. The higher t, the lower substitutability between networks.

5 We know that the indirect utility function also depends on the individual's income. We are implicitly assuming here that all customers consume only one good, telecommunication services. This assumption is obviously without loss of generality.

**'Benchmark' Scenario**

In the case in that the new entrant cannot cream skim the market, both firms maximize the following profit function:

$$p_i(p_i, p_j) = a_i \times \left[\left(p_i - c - a_j \times \left(a - c_0\right)\right) \times q(p_i) - f\right] + a_i \times a_j \times \left(a - c_0\right) \times q(p_j) \qquad \text{(II.5)}$$

where $\alpha_1 = \alpha_1(p_1,p_2)$ and $\alpha_1 = \alpha_2(p_1,p_2)$ respectively represent the percentage of incumbent and new entrant's customers. By definition, these expressions are function of $\alpha(p_1,p_2)$ and $\mu$, where the latter corresponds to the new entrant's coverage. Then,

$$a_1\left(p_1, p_2\right) = 1 - m \times \left(1 - a\left(p_1, p_2\right)\right)$$
$$a_2\left(p_1, p_2\right) = m \times \left(1 - a\left(p_1, p_2\right)\right)$$

The first term of expression II.5 represents firm *i*'s profit when its customers use its network, network which has $a_i$ of the whole market. Net benefits per customer have variable and fix term. The variable term includes mark-up times demand minus payments to the other firm in term of net access charges. The fix term per customer (*f*) includes technical and commercial support, marketing, etc.

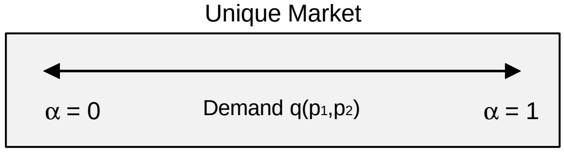
The second term of expression II.5 corresponds to firm *i*'s interconnection earnings when firm *j*'s customers make off-net calls. Our calling balanced pattern assumption yields:

$$p_i(p_i, p_j) = a_i \times \left[\left(p_i - c\right) \times q(p_i) - f\right] + a_i \times a_j \times \left(a - c_0\right) \times \left[q(p_j) - q(p_i)\right] \qquad \text{(II.5')}$$

Notice that if $q(p_j) = q(p_i)$ then the last term of II.5' vanishes because the flow of calls cancels. This characteristic of the profit function is in extreme useful. A sufficient condition to fulfill it is that both firms confront infinitely inelastic demands.

Next figure shows the functioning of the model in the benchmark scenery.

Unique Market




**'Market Cream Skimming' Scenario**

As previously mentioned, this scenario assumes two types of customers, those with high level demand (*h*) and those with low level demand (*l*). Subscripts *h* and *l* mean that the precedent variable corresponds to one of them. Similarly, variables *h* and *l* indicate the ratio of these customers in the market. Hence, firm *i* chooses $p_i$ in order to maximize the following profit function:

$$p_i = h \times a_{hi} \times \left[ \left( p_i - c - a_j \times (a - c_0) \right) \times q_h(p_i) - f \right] + \\ l \times a_{li} \times \left[ \left( p_i - c - a_j \times (a - c_0) \right) \times q_l(p_i) - f \right] + \\ a_i \times (a - c_0) \times \left[ h \times a_{hj} \times q_h(p_j) + l \times a_{lj} \times q_l(p_j) \right] \qquad \text{(II.6)}$$

where:

$$a_{h1}(p_1, p_2) = 1 - m_h \times \left[ 1 - a_h(p_1, p_2) \right]$$
$$a_{l1}(p_1, p_2) = 1 - m_l \times \left[ 1 - a_l(p_1, p_2) \right]$$
$$a_{h2}(p_1, p_2) = m_h \times \left[ 1 - a_h(p_1, p_2) \right]$$
$$a_{l2}(p_1, p_2) = m_l \times \left[ 1 - a_l(p_1, p_2) \right]$$
$$a_1(p_1, p_2) = h \times a_{h1}(p_1, p_2) + l \times a_{l1}(p_1, p_2)$$
$$a_2(p_1, p_2) = h \times a_{h2}(p_1, p_2) + l \times a_{l2}(p_1, p_2)$$

Regarding the benchmark, it is possible to remark some changes. First, new entrant has two market coverage, one for the low demand consumers ($\mu_l$) and the other form high demand consumers ($\mu_h$). New entrant chooses both, $\mu_l$ and $\mu_h$, at the first stage. Therefore, total market shares of both firms ($\alpha_1$ and $\alpha_2$) are weighted averages of their participation in each market's.

Next figure summarizes firm's pricing decision in this scenery. We represent new entrant's cream skimming by cut arrows starting in "Firm 2":


## *First Step*

In the first stage of the model, new entrant strategically chooses its coverage in order to maximize profits. The number of coverage depends upon the number of types of customers that we assume in the market. In the benchmark we have only one type of customer, so that firm 2 just chooses $\mu$, but in the case of cream skimming this firm chooses a different coverage for each type of customer.

In addition, to bid a telecomm network implies an important fixed cost for new comers. We represent such a cost by the expression $d(\mu)$. By simplicity, we will ignore this cost when doing numerical simulations, which in turn only has quantitative impact on our conclusions. Anyway, at the end of the paper we perform some simulations to show that ignoring $d(\mu)$ is innocuous.[6]

New entrant chooses its coverage in order to maximize:

'Benchmark' Scenario: $$\underset{m}{Max}\, p_2\left(m\left(p_1, p_2\right)\right) - d\left(m\right)$$

'Cream Skimming' Scenario: $$\underset{m_l, m_h}{Max}\, p_2\left(m_l\left(p_1, p_2\right), m_h\left(p_1, p_2\right)\right) - d\left(m_l, m_h\right)$$

## II.3 PARAMETERIZATION OF THE MODEL

As having mentioned in the introduction, we suppose that the demand of the consumers for phone calls is constant and independent of the price. Nevertheless, this doesn't impede the existence of more than a demand level, when the presence is supposed of more than client's type.

The use of a constant demand doesn't only have as objective to facilitate the resolution of the pattern, but rather it is also appropriate with some empiric evidence regarding the elasticity price of the demand for local phone service. The article by Park et. al (1983) estimates the elasticity of the demand for local phone calls, with simulated data for the state of Illinois, USA. Although the elasticities estimated by them are significantly different from zero, these take reduced values that are around 0.1 (in absolute value). It is also important to mention the work of Mitchell (1978), in which is considered the change in number of carried out calls when he/she spends of a system of fixed price ("flat rate") to a collection for carried out call ("metered service"). In this case, the obtained elasticity takes values that they are growing in the charged fixed rate and in the change in unit costs. When one of those two rates is reduced, the elasticity is near at 0. Mitchell also mentions the results obtained by Turner for the United Kingdom[7], who obtained elasticities smaller price at 0.1, in absolute value, for residential and entrepreneurial customers.

Nonetheless, the empiric evidence is not unanimous regarding the values of the elasticity of the demand. For example, Train et. al (1987) find elasticities price around 0.45 for the demand of local telephony. We should take into account that these results are not directly applicable to our model, since that article allows the substitutability among services of fixed rate and services of rate variable that it is a non available option for the fixed telephony in the Chilean case. Finally, Abdala et. al (1996) consider elasticities based on data for Argentina. Using alternatives

[6] To assume $d(\mu) = 0$ is an upper bound for competition. It is equivalent to assume unbundling entry in which the fixed cost of building the network ($f$) can be considered as the lease of the incumbent's network. This situation is perhaps the ideal for many regulators (see the discussion in Laffont and Tirole, 2000, Chapter 5), however our model predicts that even assuming this the market will probably not become fully competitive.

[7] Turner, W.M. (1975). CEPT Study of the Growth of the Telephone Service, Reported by the United Kingdom, Telecommunications Headquarters Marketing Dept., British Post Office, London.

econometric techniques, the authors find a wide range of elasticities for different cities, although in general these are not as low as estimated by Park et.al. (1983). In summary, although the evidence is not conclusive in this respect, the present document assumes that a constant demand is enough to represent the local phone market, at least for small variations of price.

It is important to mention that the elasticity mentioned in the previous paragraphs refers to the average variation in minutes consumed when the price of the service changes. Therefore, this elasticity is not related with the demand substitution among "normal schedule" and "reduced schedule" in the face of changes in the charged rates.

Since the number of consumed minutes doesn't respond to variations in prices, we should expect that the "action" in this model comes from the election of the clients regarding the signature to the firm which to belong, denoted by $\alpha(p_1,p_2)$. As it will be seen later on, this variable is decisive in the determination of the new entrant's optimal coverage.

Under the supposition "balanced calling patterns", the constant demand implies that both firms have an identical flow of calls "off-net." In consequence, the term corresponding to the interconnection cost among signatures disappears of the profit functions of both firms. In presence of "cream skimming" two different demand levels exist, so that the interconnection cost doesn't disappear in this case.

It is also necessary to point out that the second stage of the game presents multiple Nash equilibria for certain covering ranges. In the case that this happens, we use the minimum of those prices. It is preferred low prices because these they adapt better to the supposition that no client is excluded of the phone service.

The data were obtained starting from available information in the Subsecretaría de Telecomunicaciones de Chile (Subtel). We calibrate parameters in order to make them compatible with the format of the variables in our model. Thus, for example, the prices used in the model differ of actual prices of the local phone service in Chile. This happens for basically theree reasons. On the one hand, Chilean telecommunications regulation considers a kind of peak load pricing (normal and reduced hours). Since the model doesn't incorporate such a tariff schedule, the price that we use corresponds to a simple average of Chilean prices. On the other hand, the price for the service consists of a two-part tariff, a monthly fixed element and one variable per minute. Since our model doesn't have a fixed charge, we transform the monthly fixed charge for line in a variable charge per minute by dividing the former for the consumption average of minutes for phone line. Finally, in order to use consistent data we use that from Santiago de Chile, the capital city.

For October of 1999, the maximum prices fixed by Subtel to the Company of Telecommunications of Chile (CTC), for concept of Measured Local Service (SLM), correspond at 16.17 Ch$/minute in normal hours and 2.70 Ch$/minute in reduced hours. This implies on the average a maximum price of 9.43 Ch$/minute. When adding the maximum fixed charge, the (maximum) regulated price consistent with the model is about 16.2 Ch$/minute.

The cost of transport ($t$) it is not an observable variable, since it corresponds to an abstraction to allow imperfect substitutability among networks. To obtain a value of $t$, we assume that the price average that would be reached in the event of a complete entrance on the part of the new firm is of 12 Ch$/minute, under the benchmark. Supposing that the fixed component of the price is similar to the effective one at the moment, the variable part of the price is equal to 5.3

Ch$/minute. In turn, according to the observed relationship of normal and reduced prices, that value is equivalent to a SLM of 9.0 Ch$/minute in normal hours and of 1.5 Ch$/minute in reduced hours. Our best justification for the election of that price is that it is difficult to suppose that competition will reduce prices lower to those mentioned above. Therefore, cost of transport generated by means of this mechanism corresponds to $t$ = 1,248 Ch$/line/month.

The following chart summarizes the values used in the numeric simulations:

| | | |
|---|---|---|
| **"Benchmark" Scenario** | | |
| $c$ = | 3.7 | Ch$/min |
| $f$ = | 5,185 | Ch$/line/month |
| $t$ = | 1248 | Ch$/line/month |
| $X$ (total) = | 775 | Min/line/month |
| | | |
| **"Cream Skimming" Scenario** | | |
| $c, f, t$ = | Same as "*benchmark*" | |
| $X$ (low level) = | 600 | Min/line/month |
| $Y$ (high level) = | 1,300 | Min/line/month |
| $l$ = | 0.75 | |
| $h$ = | 0.25 | |
| $a - c_0$ = | 2.2 | Ch$/min |

# III. Resolution and Simulation of the Benchmark

First of all, we find algebraic expressions for the balance prices, maximizing – without restrictions – profit functions of each firm in the second stage of the game:

$$p_1 = c + \frac{f}{X} + \frac{t}{X}\left(\frac{4}{3m} - \frac{1}{3}\right) \qquad p_2 = c + \frac{f}{X} + \frac{t}{X}\left(\frac{2}{3m} + \frac{1}{3}\right) \tag{III.1}$$

For reasons that we will discuss later on, these functions are only valid when coverage is higher than 40% ($\mu > 0.4$) and the incumbent's price is inferior to the regulated maximum price, that is ($p_1 < p_{1\_reg}$). We can observe that both prices are growing in marginal cost ($c$), fixed cost ($f$), and cost of transport ($t$), and decreasing in coverage ($\mu$) and demand size ($X$). Additionally, for smaller coverage than 100%, $p_1 > p_2$; but when $\mu = 1$, $p_1 = p_2$.

The behavior of the model depends on important way of the function $\alpha(p_1,p_2)$; that is to say, in the way in which customers choose the firm to the one which to subscribe. When replacing equilibrium prices in the expression for $\alpha(p_1,p_2)$, we obtain the following equation:

$$a\left(p_1, p_2\right) = \frac{1}{6}\frac{5m - 2}{m} \tag{III.2}$$

This expression presents two interesting characteristics. In the first place, we observe that $\alpha(\ )$ is independent of cost parameters (c, f, t) and the demand (X). Therefore, the consumer's choice between firms is exclusively due to new entrant's coverage. Likewise, the difference between $p_1$ and $p_2$ only depends on the same coverage.

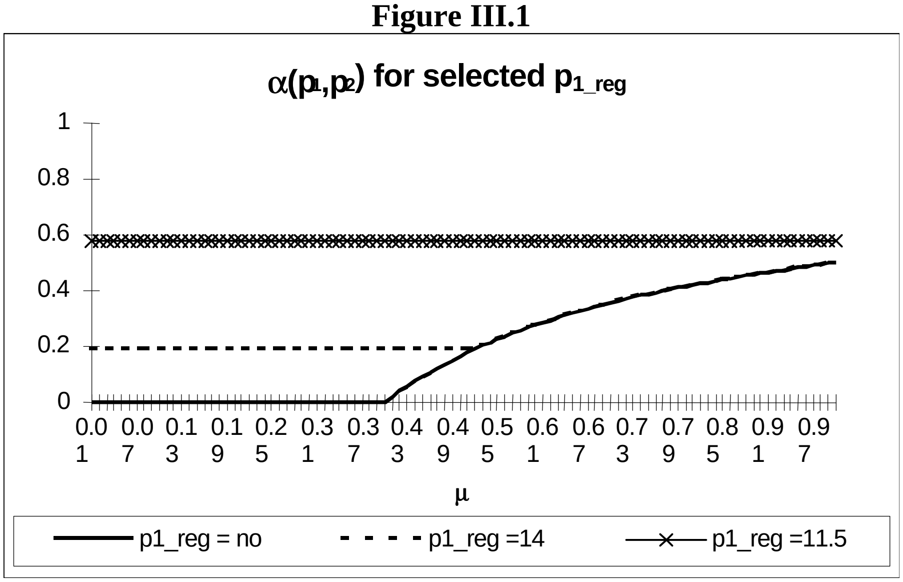
In second place, the equation written previously holds with $\alpha \geq 0$ only if $\mu \geq 0.4$. Therefore, a customer covered for both firms will decide to continue into the incumbent only when the new entrant's coverage exceeds 40% of the market. This result is remarkable because it takes place independently of the costs facing by the two firms, the level of the demand level, or the degree of substitutability between networks.

With coverage smaller than 40%, unconstrained maximization problems of the two firms in the second stage of the game would generate negative values for $\alpha(\ )$. This is because the lower $\mu$, the higher the difference between prices. As a matter of fact, it is possible that we arrive to the point in which the difference between $p_1$ and $p_2$ is as high as so that $\alpha(\ )$ takes negative values. Since this is not allowed, we carried out a constrained maximization whose result is $\alpha(p_1,p_2) = 0$ for any coverage $m \leq 0.4$. This result produces infinite Nash equilibria. Just as it was pointed out in the previous section, we choose the minimum price of them.

Since $p_1$ is decreasing in $\mu$ and that $p_1$ is constant for any coverage similar or smaller than 40%, the superior bound for that price is the lowest value that fulfill with $\alpha(\ ) = 0$ (supposing that new entrant optimally chooses $p_2$). That price is determined by the equation IV.1, for $\mu = 0.4$. Therefore, the highest price that the incumbent sets is given by $p_{1\_sup} = c + (1/X)*(f + 3*t)$. This value (15.22 Ch$/minute for the used data) is useful because it allows us to determine when the regulatory cap will become active. We assess this issue later in this paper.

Figure III.1 shows how the function $\alpha(p_1,p_2)$ changes according to the incumbent's coverage, for different caps on the regulated price ($p_{1\_reg}$). At the moment, we will concentrate on the case in which this cap is not active ($p_{1\_reg} \geq p_{1\_sup}$ or "$p_{1\_reg}$ = no" in the graph). We will see in a section ahead the case in which this restriction becomes active ($p_{1\_reg} < p_{1\_sup}$).

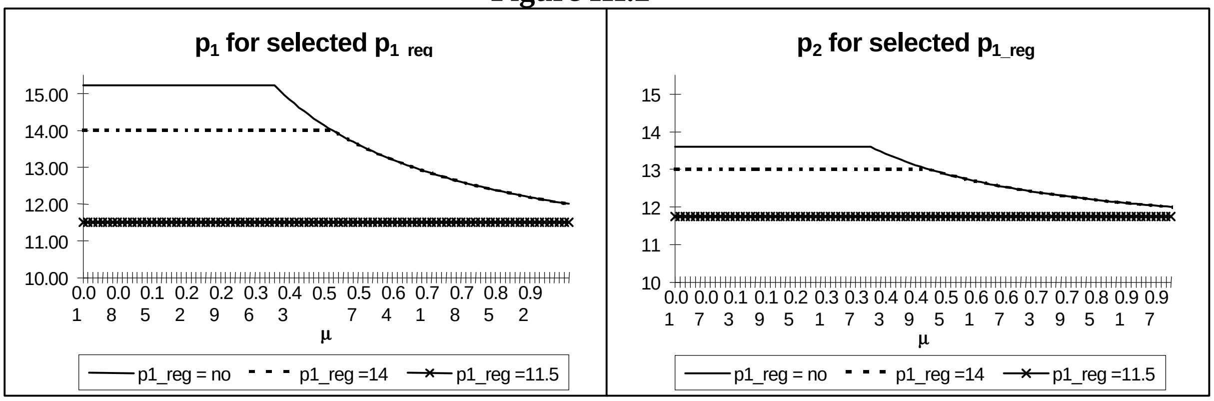
**Figure III.1**




Just as it was explained in the previous paragraphs, while $\mu \leq 0.4$ all consumers covered for the new entrant choose to be its customers. On the other hand, coverage above 40% makes that more and more customers prefer to stay in the incumbent's network. This result is due to that firm 1 reacts after firm 2 enter by reducing prices, so becoming the incumbent more and more attractive. When the entrance of firm 2 is total, perfect competition is reached. In such a case, each firm would have half of the market ($\alpha = 0.5$) and both firms charge the same prices.

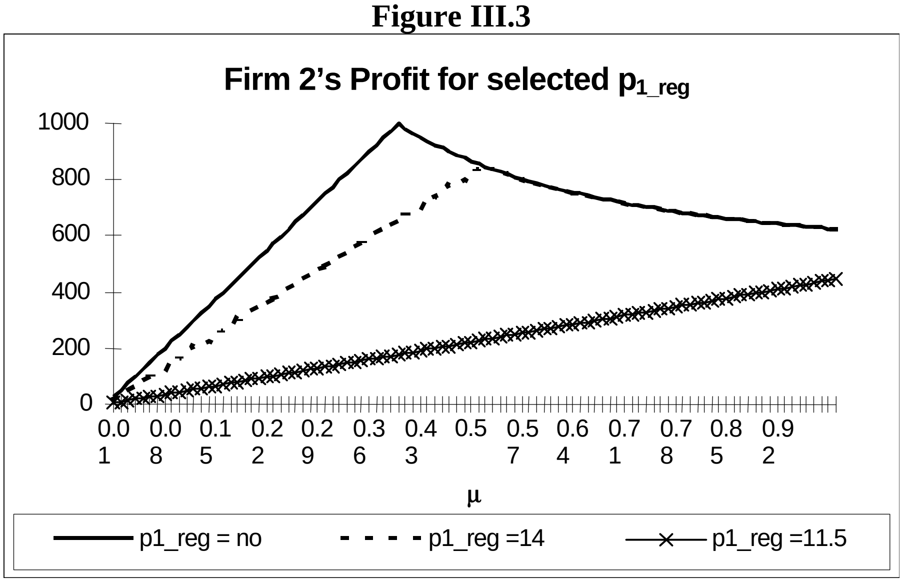
Prices charged by both firms have a similar pattern to the one of $\alpha(\ )$, as we may observe in the figure of below. Both $p_1$ and $p_2$ stay fixed when $\mu \leq 0.4$. As this coverage increases, not only prices decreases, but the difference between $p_1$ and $p_2$ also decreases (for each level of $\mu$). Eventually, both prices converge at $\mu = 1$.

**Figure III.2**




Through the Figure III.3 it is possible to observe what it happens to the new entrant's profit as its coverage increases. It can be observed its profits strictly increasing in $\mu$ provided the prices remain constant; that is to say, for any coverage smaller than 40%. For firm 2's coverage above 40%, higher $\mu$ implies smaller profits for this firm.

**Figure III.3**




Therefore, optimal coverage for the new entrant is the highest possible for the one which $\alpha(\ )$ remains constant. When the regulatory restriction on the price $p_1$ is not active, that optimal coverage is always 0.4. Since new entrant's profits are strictly increasing on $\mu$ when $\alpha(\ ) = 0$, it is impossible that $\mu$ is smaller than 40%. Additionally, any not binding constraint ($p_{1\_reg} > p_{1\_sup}$) will always generate the same result in both equilibrium prices and new entrant's coverage (in the previous picture, curves for any value of $p_{1\_reg} > 15.22$ will be exactly the same ones).

# IV. Resolution and Simulation of the "Market Cream Skimming" Scenario

Without taking into account incumbent's market discrimination, the regulation on the maximum price neither interconnection costs, equilibrium prices at the second stage – given $\alpha_h > 0$ – correspond to the following expressions:

$$p_1(m_l, m_h) = c + \frac{1}{3(lX^2 m_l + hY^2 m_h)}\left[(lXm_l + hYm_h)(3f - t) + 4t(lX + hY)\right]$$
$$p_2(m_l, m_h) = c + \frac{1}{3(lX^2 m_l + hY^2 m_h)}\left[(lXm_l + hYm_h)(3f + t) + 2t(lX + hY)\right] \qquad \text{(IV.1)}$$

Both functions are always increasing on the marginal cost ($c$), fixed cost ($f$), and the cost of transport ($t$). Regarding new entrant's coverage in the high demand market ($\mu_h$), both prices have positive derivatives, whereas they are ambiguous with respect to the coverage in the other market ($\mu_l$).[8] The equations IV.1 were obtained starting from unconstrained maximization problems, for what the same warnings are applied that for the "benchmark" scenario. Combinations of prices that imply $\alpha_h(p_1,p_2) < 0$ become in $\alpha_h(p_1,p_2) = 0$, using the lowest prices that are part of Nash equilibria.

### *Consumer's Choice of the Firm which to belong*

In a similar way to the "benchmark" scenario, we can analyze how the model works starting from the form in which customers choose the firm to the one which to belong. In this case, the expressions for $\alpha_h(p_1,p_2)$ and $\alpha_l(p_1,p_2)$ coming from equations IV.1 are:

$$a_l(m_l, m_h) = \frac{1}{2} + \frac{X}{3}\frac{lX(m_l - 1) + hY(m_h - 1)}{lX^2 m_l + hY^2 m_h}$$
$$a_h(m_l, m_h) = \frac{1}{2} + \frac{Y}{3}\frac{lX(m_l - 1) + hY(m_h - 1)}{lX^2 m_l + hY^2 m_h} \qquad \text{(IV.2)}$$

[8] $\partial p_1/\partial \mu_l > 0$ when $\mu_h > 4\lambda$, $\partial p_2/\partial \mu_l > 0$ when $\mu_h > 2\lambda$; where $\lambda = [tX\ (\ lX + hY\ )]\ /\ [hY\ (\ Y - X\ )\ (\ 3f - t\ )]$.

It can be observed that none of the two functions depends on marginal cost, fixed cost, or cost of transport (since the equations don't include variables c, f, or t). Rather, the choice of the consumers regarding the network to which to belong is only determined by the size of the demand, for the proportion of low and high demand customers, and for the coverage of the new entrant in each market.

Since $\mu_l \leq 1$ and $\mu_h \leq 1$, the values that $\alpha_h(\ )$ and $\alpha_l(\ )$ can take are between 0 and ½ . The slope of both functions is strictly increasing with regard to the coverage in each market. Also, it can be noticed that the slope of $\alpha_h$ is steeper than $\alpha_l$'s because $Y > X$ by definition. Since both variables converge to the same value when $\mu_l = \mu_h = 1$, $\alpha_h$ always takes inferior values to those of $\alpha_l$. This means that $\alpha_l > 0$ for any combination of prices $(p_1,p_2)$ such that $\alpha_h = 0$.

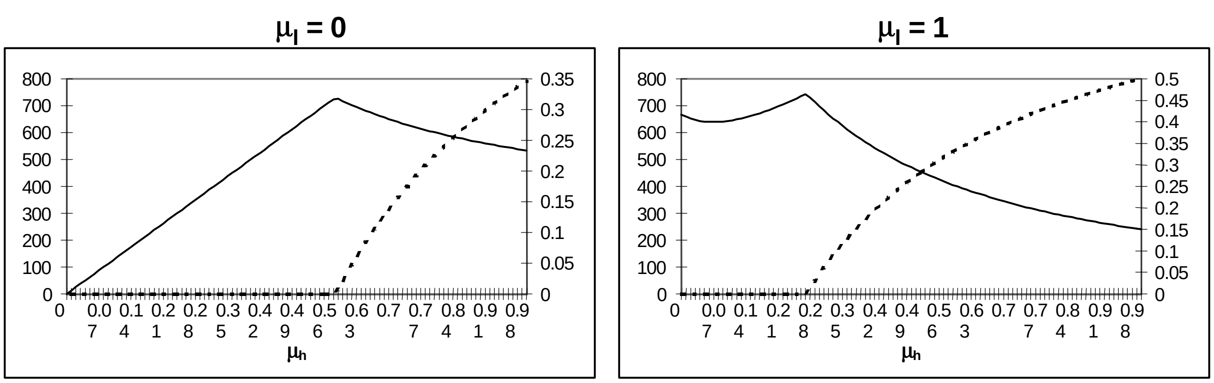
As we will see next, the maximum profit for firm 2 in this scenario is also determined in function of the number of customers that choose to belong to it. However, since $\alpha_h$ is the first that reaches the inferior bound when $\mu$ decreases, it is this variable the one that determines the new entrant's maximum profit. In conclusion, it is possible to forget $\alpha_l$ into the analysis from now on. It could be said that this variable "imitates" the $\alpha_h$'s behavior because both depend on the same prices $(p_1,p_2)$ and $\alpha_h$ and $\alpha_l$ only differ for their slope.

### *Optimal Coverage*

Figure IV.1 shows new entrant's profit and the choice of the customers on the firm to which they belong ($\alpha_h$), in function of the coverage in the market with high demand ($\mu_h$) for a given level of coverage in the residential (low demand) market. According to with that mentioned in previous paragraphs, we can observe that the maximum profit of the new entrant is reached when $\mu_h$ is the highest given $\alpha_h = 0$ (i.e. when all high demand customers who are covered by the two networks belong to firm 2). It is necessary to point out that this characteristic is also observed when the figure is carried out in function of the coverage in the market with lower demand.

**Figure IV.1**

**Firm 2's Profit and $\alpha_h(p_1,p_2)$ , by coverage in the High Demand Market**




(dotted line for $\alpha_h$ , continuous line for Firm 2's profit)

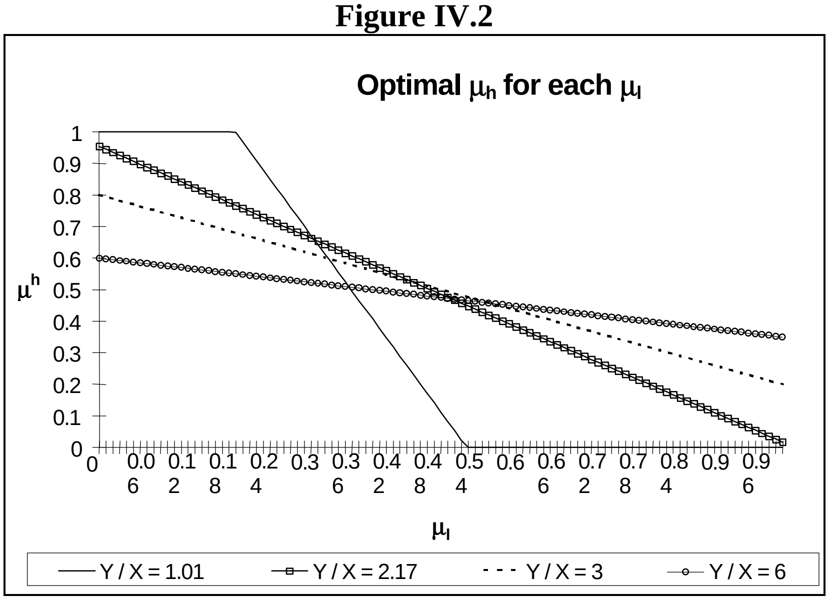
Starting from the same figure, we can conclude that the optimal coverage of the new entrant is the highest possible such that it avoids its potential customers to become incumbent's customers, for any coverage in the other market. This observation allows us to obtain an algebraic expression that determines the new entrant's optimal coverage in any market as a function of the coverage in the other market. Doing so, we work out with equations IV.2, evaluated at $\alpha_h = 0$:

$$m_h = \frac{2hY^2 + 2lXY - m_l\left(2lXY - 3lX^2\right)}{5hY^2} \qquad \text{(IV.3)}$$

Since we obtained equation IV.3 using expressions generated starting from an unconstrained maximization problem, it is possible that IV.3 takes values outside of the range [0,1]. In such a case, the new entrant's optimal coverage has to take the values 1 or 0, depending on if the unconstrained coverage is $\mu_h > 1$ or $\mu_h < 0$, respectively. Therefore, the correct mathematical expression for this optimal coverage in the high demand market is: max{min [(IV.3), 1], 0}.

As it can be observed in figure IV.1, there is an additional reason for which the expression IV.3 doesn't always hold. The right section of that figure shows that it would be also possible an optimal coverage of zero ($\mu_h = 0$). That is to say, there are cases in which it is not optimal for the new entrant to serve both markets. This is due to that the new entrant can find more profitable to charge high prices and to increase the profitability for customer, instead of to charge low prices and to maximize the number of subscribed customers. We develop this issue with more detail in the section corresponding to regulated price caps.

**Figure IV.2**




Based on the equation IV.3, Figure IV.2 shows combinations of $\mu_h$ and $\mu_l$ such that $\alpha_h = 0$; that is to say, this figure shows the optimal combinations of coverage in both markets that maximize new entrant's profit. The curves correspond to different relative sizes among the high demand market (Y) and the low demand market (X), maintaining constant the average demand (0.75 X + 0.25 Y = 775, according to the data).

A first characteristic of the mentioned figure is that the optimal coverage in a market is not increasing in the coverage in the other market ($\partial\mu_h / \partial\mu_l \leq 0$). This is a general condition that is not only apply for equation IV.3, but also when the optimal coverage is zero. Starting from this result, we can infer that to monopolize both markets at the same time will not be an equilibrium strategy for the new entrant in this model.

The slope of $\partial\mu_h/\partial\mu_l$ – that is to say, $\partial^2\mu_h/\partial\mu_l^2$ – decreases as the size of the high demand market increases with regard to the low demand market. In the next figure we observe that when the quotient Y/X goes to infinite, $\partial\mu_h/\partial\mu_l$ goes to zero. In the limit, the optimal coverage is $\mu_h = 0.4$ for any $\mu_l$ level, which is consistent with the benchmark ($Y/X \rightarrow \infty$). In the limit case, when $Y/X = 1$, $\partial\mu_h/\partial\mu_l = 1$ because in this case the new entrant is indifferent between the its different customers.

**Figure IV.3**

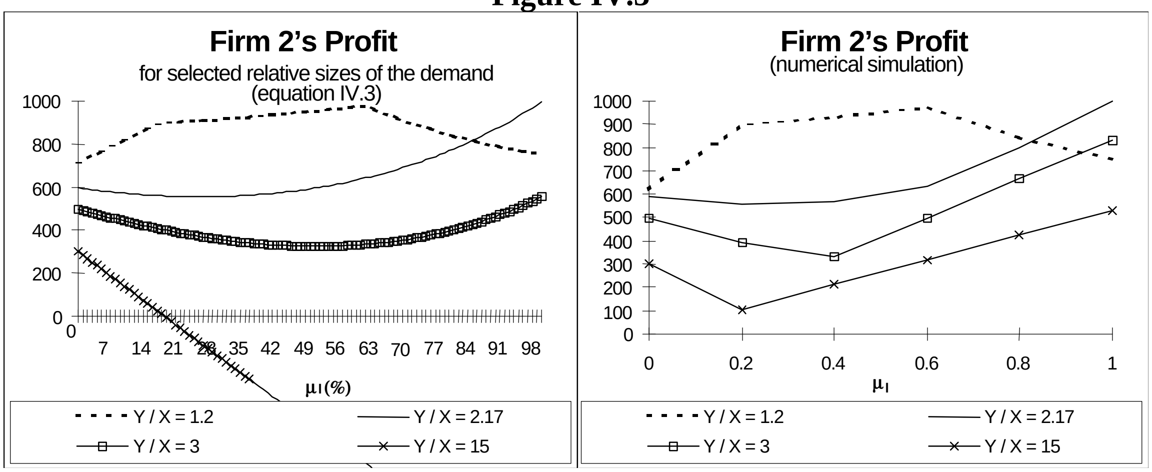



Figure IV.3 shows the new entrant's profit as a function of its coverage in the lower demand market, for different levels of relative demand. The left-hand side panel comes from equation IV.3, while the right hand side panel corresponds to a numeric simulation. It is possible to notice that both pictures differ basically in the curve corresponding to Y/X = 15. The divergence between both pictures take place for the previously mentioned reason: the maximum profit is obtained with $\mu_h = 0$, although that value doesn't represent the highest coverage for the one which $\alpha_h(p_1,p_2) = 0$. Given the evidence of the figure, it is reasonable to suppose that firm 2 won't act according to equation IV.3 in order to avoid losses, since when not entering in the higher demand market it can charge much higher prices.

It is possible to observe that, except for very similar demand sizes among these two markets ($Y/X = 1.2$), the solution takes place in limit values; that it to say, $\mu_l = 0$ or 1. It is important to also highlight that, as the quotient $Y/X$ grows, profit function acquires a more and more steeper slope, such that the optimal coverage for the low demand market spreads to be zero. In conclusion, optimal coverage in this market spreads to be a solution of the type "all or nothing".

Starting from equation IV.3, we can determine the "breaking point" for $Y/X$; that is to say, the relationship among demands starting from which the optimal coverage $\mu_l$ moves from zero to one. Replacing equation IV.3 in the new entrant's profit function, we look for the condition that fulfills $\pi_2(\mu_l = 0) = \pi_2(\mu_l = 1)$. Given the non-linearity of the resulting expression, it is not possible to find an explicit solution in terms of the demand sizes. However, we can obtain an implicit condition in terms of the fixed cost divided by the cost of transport, $f / t$ :

$$\frac{f}{t} = \frac{X}{5} \frac{\left(24hY^2 + 25lXY - lX^2\right)}{2hY^3 - 2hXY^2 - 3lX^2Y + 3lX^3} \tag{IV.4}$$

Until here, our results are valid provided the new entrant's coverage in the residential (low demand) market is a corner solution. However, as *Y/X* decreases optimal $\mu_l$ can be interior, just as it is observed in figures IV.2 and IV.3. In order to determine the value for the which the optimal coverage takes a limit value, we look for an algebraic expression starting from the equations IV.2 and IV.3, evaluated at $\mu_l = 1$. Thus, next equation provides us with such value:

$$\frac{Y}{X} = \sqrt{\frac{3l}{2h}} \tag{IV.5}$$

For market sizes used in our numeric simulation, equation IV.5 gives us a value of $Y/X \approx 2.12$. This result is coherent with that observed in the previous figures. This means that numerical demands ($X = 600$, $Y = 1300$) are exactly in the limit so that the observed solution is a corner one (since we use $Y/X \approx 2.17$).

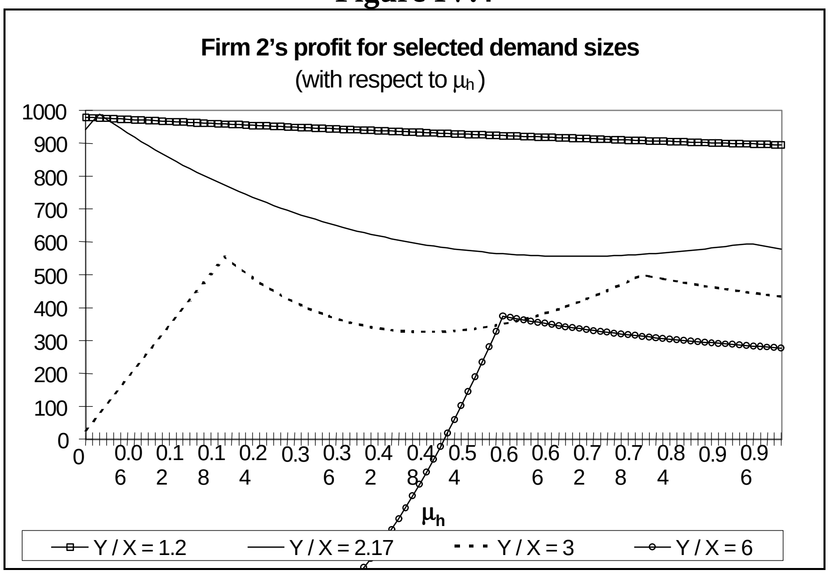
In summary, we may characterize the behavior of the new entrant regarding the low demand market in the following way: Either this firm will perfectly cream skim the market or fully enter in both markets, whenever $Y/X \leq (3l / 2h)^{0.5}$. For values which *Y/X* is higher than such a limit, the new entrant partially cream skim the market (optimal $\mu_l$ is interior). Therefore, in order that the optimal coverage in the low level demand market is zero (perfect cream skimming), it is required that the left hand side of equation IV.4 be higher than the right hand side of such equation. All these conclusions apply provided equation IV.3. In the case that this doesn't happen, it will be optimal for the new entrant perfectly cream skim the market in a very strange and counterintuitive fashion: its optimal coverage will be $\mu_l = 1$ and $\mu_h = 0$.

Using equation IV.3, we draw the relationship between the new entrant's profit and the optimal coverage in the high demand market ($\mu_h$), for different levels of relative demand (*Y/X*). Such as we may intuit from Figure IV.2, Figure IV.4 (next page) shows that the optimal coverage in the high demand market is usually an interior solution. Only as *Y/X* goes to 1, $\mu_h$ goes to 0.

It can also be observed that the new entrant's profit function presents two local maxima. For higher values of *Y/X*, the local maximum that corresponds to a higher value of $\mu_h$ prevails. For lower values of *Y/X*, this local maximum displaces down and right; the contrary happens to the left local maximum. Therefore, increases in the relative size of the residential demand (*X*) may make the left local maximum overcomes to the right local maximum (which happens when de actual level of the demand in the residential market is higher than that implicitly determined by equation IV.4). This means that, in exactly this point, the optimal coverage in the high demand market jumps toward a smaller value.

In summary, we can describe the effects of a change in *Y/X* on the new entrant's optimal coverage in the high demand market as follows: as $Y/X \to \infty$, $\mu_l \to 0$ y $\mu_h \to 0.4$. Then, we obtain a situation of cream skimming with partial coverage. As the residential demand ($X$) becomes higher, $\mu_h$ gradually increases and $\mu_l$ continues being zero. Arrived certain point, we again obtain the counterintuitive result, that is $\mu_l = 1$ and $\mu_h$ goes down drastically. Finally, if the difference between demands spreads to disappear ($Y/X \rightarrow 1$), optimal coverage in both markets is any combination that generates an entrance to the market of 40%; that is, $h \times \mu_h + l \times \mu_l = 0.4$.

**Figure IV.4**



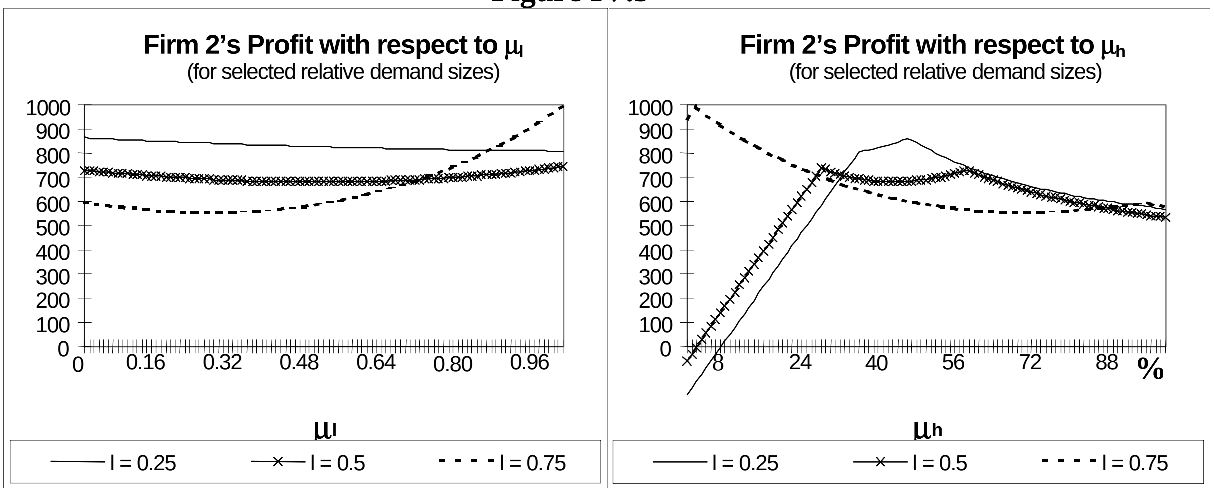

Let us explain those results. For most of cases, we can say that post entry competition is centered in the high demand (entrepreneurial) market. The low demand (residential) market is completely ignored by the new entrant when the demand of this market is small because it is not worthwhile to enter in a war of prices to attract those clients. However, if such demand is not so small, the strategy of war of prices makes sufficiently profitable the entrance market such that the new entrant fully enter in the residential. In such a case, the incumbent doesn't oppose resistance because the most profitable customers continue being those of the entrepreneurial market. But when the demand in the entrepreneurial sector is very low compared with the residential one, then the new entrant prefers to compete for the second market, leaving aside to the first one. That is the logic of the counterintuitive result.

Figure IV.5 (next page) shows the new entrant's profit as a function of the coverage in both markets, for selected relative demands. Regarding the coverage in the low demand market, we can observe that optimal $\mu_l = 0$ for relative small size of this market. The contrary happens for high sizes of this market. Then, we can say that as the optimal coverage in the residential market passes of being none to be absolute (it should not be forgotten that we have here corner solutions for this market).

Regarding the covering in the entrepreneurial market ($Y$), as before we also observe two local maxima for the profit function. An increase in the size of that market elevates the right maximum point and diminishes the left maximum. Therefore, as $\boldsymbol{h}$ increases (or $\boldsymbol{l}$ diminishes), firm 2 penetrates the entrepreneurial market in a more aggressive way. These results are coherent with that found for changes in $Y/X$. We may concluded that a reduction in both, $Y/X$

and *h/l* makes more attractive post entry competition in the residential market.

**Figure IV.5**




## *New Entrant's Equilibrium Price*

Before concluding with this section, it is interesting to verify how the price gotten paid by firm 2 behaves. An expression for $p_2(\mu_h)$ is obtained by substituting equation IV.3 in equation IV.1. We are only interested on the sign of $\partial p_2 / \partial \mu_h$ because $\mu_l$ corresponds to its optimal value for each $\mu_h$. This sign is determined by the following condition:

$$\frac{\partial p_2(\mu_h)}{\partial \mu_h} < 0 \quad \text{if and only if} \quad 2hY^3 + (2l+h)XY^2 + (l-3h)X^2Y - 3lX^3 > 0$$

Since this condition is always true, the sign of the derivative is always negative. Therefore, a higher coverage of the new entrant in the high demand market implies smaller final prices. This, in turn, is coherent with that observed in the benchmark.

The behavior of $p_2$ is interesting for an additional reason. If equation IV.3 doesn't hold – i.e. the maximum profit is not obtained with the highest coverage that fulfills $\alpha_h = 0$, but with $\mu_h = 0$ – it generates equilibrium prices considerably higher than those obtained when the mentioned equation holds. This is due to that the lower $\mu_h$, higher equilibrium prices and, for this reason, the new entrant obtains higher profits. Therefore, we should hope that regulation of prices – that we will analyze next - avoids that the new entrant's coverage in the high demand market be zero.

Summarizing the analysis carried out until here, the cream skimming scenario provide us with the following results:

- It is sufficient with analyzing the choice taken by entrepreneurial customers regarding the firm which to belong ($\alpha_h$) to characterize the new entrant's profit function.
- Optimal coverage in any market is always decreasing with respect to the optimal

coverage in the other market. Then, it is not likely that a new entrant obtains high participation in both markets.

- Quite big residential markets make firms interested in provide it with their telecomm services. However, for most of cases, post entry competition usually develops in the entrepreneurial market, with corner solutions in the residential market.

# V. Extension: Price Caps Regulation [9]

Until here, the analysis has not paid attention to the case in which the price cap fixed by the regulator is active; that is to say, $p_{1\_reg} < p_{1\_superior}$ in our model. Let us recall to the reader that we suppose that price regulation consists of a maximum price (cap) above which the incumbent cannot charge for its services. Moreover, our new entrant firm is free to charge any price for its services.

## *Price Caps in the Benchmark*

Let us go back to Figure III.1. It shows that to impose a restriction on $p_1$ is equivalent to fix a minimum for α( ). As the new entrant's coverage increases, α( ) remains constant in its minimum value, provided that this value is not inferior to the one that would be obtained if the incumbent's price were unconstrained. Once arrived to the point in which α( ) without regulation exceeds to α( ) with regulation, growths in μ make both α( )'s behave in a similar manner, so that α( ) = 0.5 when μ = 1. Hence, full coverage means both firms have fifty percent of the market.

This implies that since α( ) is increasing on μ, the result of the regulatory constraint is to prolong the coverage interval for which the customer's choice remains constant. In conclusion, since maximum profits are obtained with the highest coverage for which α( ) remains constant, the implication of an active regulation over prices is to increase the new entrant's optimal coverage (see Figure III.3 for an illustration of this result).

It is also possible that tariff regulation be too much "restrictive". In an extreme case, the regulator would fix cap price lower to which had been reached under perfect competition (i.e. when μ = 1). In this case – corresponding to the curve $p_{1\_reg} = 11.5$ in all section III's figures – we observe a change in the behavior of the equilibrium prices. The incumbent will charge the maximum price ($p1 = p_{1\_reg}$) for any value of μ. Firm 2 will charge a higher price to that of the firm 1, so that $\alpha(p_1,p_2) > 0.5$. In this case, the new entrant's profits are always growing in μ, so that its optimal coverage becomes 100%. Notice that our model with differentiated goods allows the entrant firm to charge higher prices than the regulated one.

[9] We also performed two other extensions. One assumes that the incumbent discriminates in prices among markets. The second one assesses the effects of considering alternative interconnection costs between firms. However, we don't present these extensions because their results are still preliminary and both assumptions are further of the cream skimming issue that is the focus of this paper.

Let us provides the intuition behind these results. The incumbent has an established schedule of prices for each new entrant's coverage. The incumbent begins to reduce its optimal price starting from certain level of μ. When the regulator fixes a lower cap than the optimal unconstrained price, firm 1 continues maintaining its schedule of prices and coverage, i.e. its reduction of prices only begins starting from the point in which its optimal price without regulation is smaller than that regulated. Only when firm 1 begins to reduce prices, some customers will choose to remain in that company, only after that firm 2's profit will be falling in μ. Therefore, the lower $p_{1\_reg}$ , the higher the optimal coverage of the new entrant.

As a summary of the benchmark with price cap regulation, let us say that the use of a constant demand implies that all the "action" of the model is given by the incumbent's market share, α(). The optimal coverage of the new entrant is the highest value for which α( ) remains constant. Additionally, the only variable that can affect the behavior of α( ) – and hence the optimal coverage of the new entrant – is the incumbent's maximum price fixed by the regulator. Changes in *c, f, t* or *X* only affect equilibrium prices.

## *Price Caps with Cream Skimming*

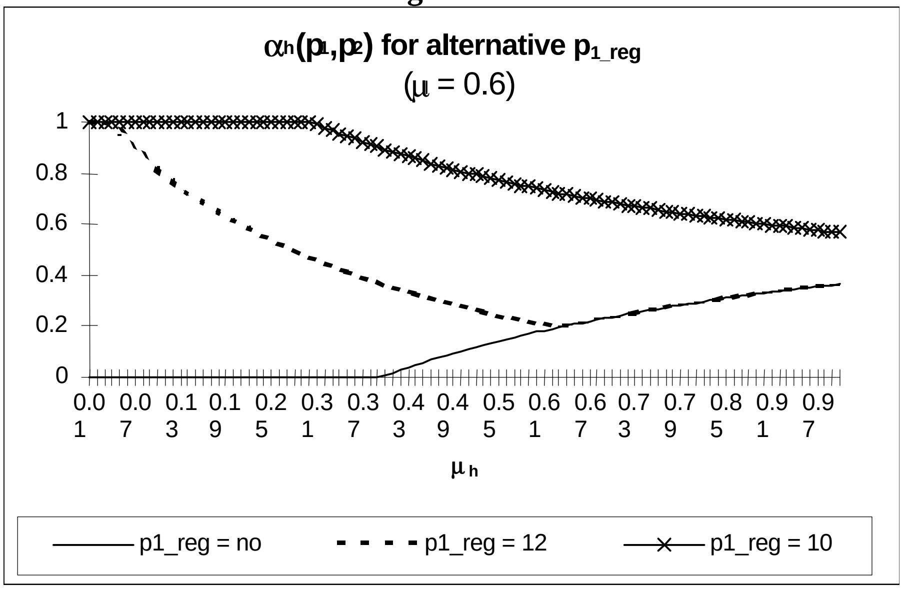
Lets know see how regulation on prices changes the results for the cream skimming scenario. In particular, we are interested on both the incumbent's market share in the high demand market and on new entrant's optimal coverage in both markets.

Figure V.1 shows the trajectories of the incumbent's market share in the high demand market, $\alpha_h(p_1,p_2)$ for different levels of the regulated maximum price. Remember that this variable, $\alpha_h()$, is crucial in the determination of the maximum profit for the new entrant. In such figure we observe that an active regulation of prices make firm 2 charges higher prices than firm 1's (because $\alpha_h$ takes values above 0.5). Furthermore, the higher cost of transport (*t*), the lower the substitutability between networks and, therefore, the higher the maximum difference between $p_2$ and $p_1$.

Previously, we observed that the new entrant maximizes its profits as a function of the number of customers that subscribed to it. Now, with binding regulation, we see that it is also possible that this firm maximizes its profits through high prices, although that means fewer customers. Despite Figure V.1 doesn't show the new entrant's profit, it reaches its maximum point in the coverage for which the function $\alpha_h$ stops falling (to be more precise, it stops non-increasing). Hence, this result is similar to the one observed for the benchmark, when regulated prices were introduced.

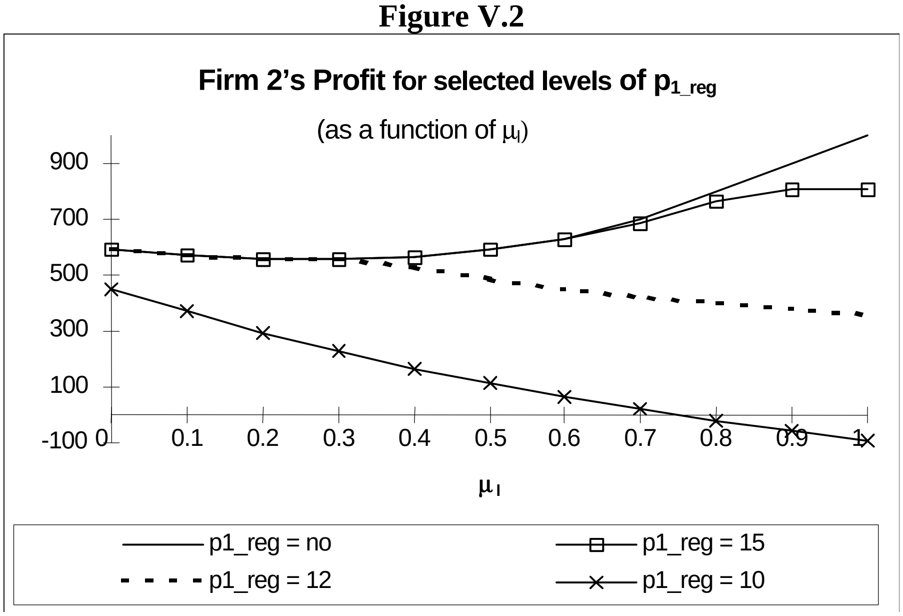
Therefore, regulation of prices allows us to notice that the new entrant doesn't only maximize profits when it monopolizes all the covered customers for both networks, but rather it can also make it charging higher prices to those of the incumbent. Doing so, the new entrant may considerably elevate its profitability by customer. This behavior is the same of the one that explains equation IV.3 may not hold; when the coverage in a market is zero grow considerably.

**Figure V.1**




Once analyzed the effect on equilibrium prices and optimal firm's choice on the part of the customers, let us see how a binding regulation of prices changes the optimal coverage in the low demand (residential) market. Figure V.2 shows how new entrant's profits varies according to its market share in the residential market, for different regulated prices.[10]

**Figure V.2**




[10] We draw this figure according to Chilean parameters: X = 600, Y = 1300, l = 75%, and h = 25%.

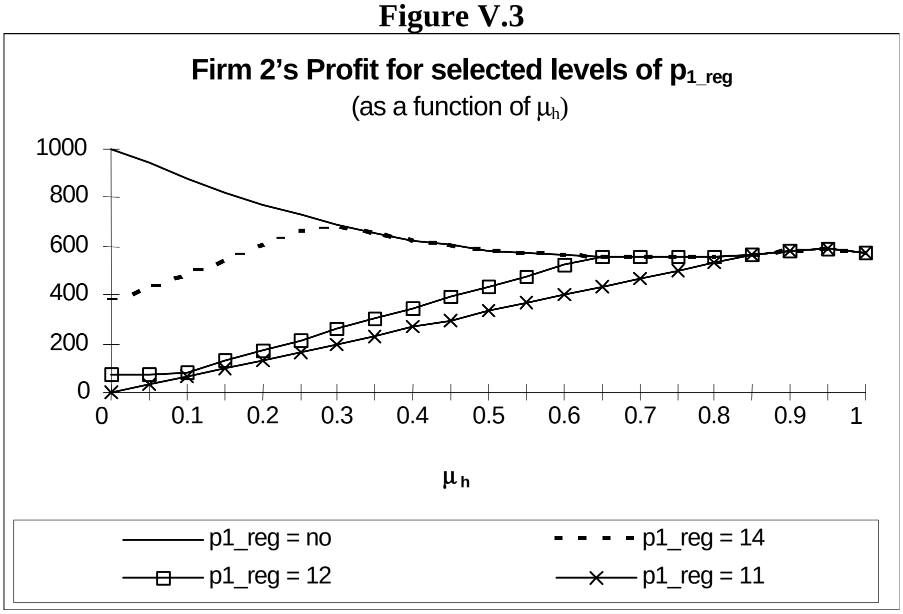
Regulation of prices can change the form and the position of the profit function of the firm 2. A regulation a little "strict" – but still binding – is represented by the curve "p1_reg = 15". Over such a curve, we observe a slope change for high levels of $\mu_l$, although in any case the optimal coverage in this market continues being of 100%.

A little bit stricter regulation ($p_{1\_reg}$ = *12*) tends to reduce even more the slope of the profit function, although it doesn't necessarily changes its position. In this case, the new entrant's optimal coverage in the low demand market becomes zero. If the regulated price cap for the incumbent is reduced even more, we observe a shift down of the profit function of firm 2 which, in turn implies lower profits for the new entrant (it might even be negative).

In summary, the introduction of binding regulated prices may shift the new entrant's profit function. If the optimal $\mu_l = 1$ with not binding regulation, then with binding but not such small price cap this optimal coverage will continue being complete. However, even lower maximum prices reduce profits for high coverage, then the solution may now be $\mu_l = 0$. In general terms, if the original solution was in a limit value, it will continue being so under stricter regulation of prices of the dominant firm.

Figure V.3 shows what happens to the optimal coverage in the high demand market with a binding regulation of prices. We observe that as the regulation of prices becomes stricter (that is to say, as $p_{1\_reg}$ diminishes), the new entrant's profit function shift toward the right. Hence, the regulation of prices increases the new entrant's market share in the high demand market.

**Figure V.3**




This behavior is quite intuitive. Prices that charge both firms are particularly sensitive to the coverage of the newcomer in the high demand market. For this reason, in absence of regulation of prices, it can be better to the new entrant not to enter aggressively to this market. Doing so, firm 2 may increase its prices and profits by customer in the high demand market. If regulation of prices is introduced, it is no longer possible to charge high prices. Then, it is better to attempt to monopolize the cream of the market. However, as the regulator reduces the cap the new entrant increases its coverage in this market resulting in a more likely “war of prices” by the incumbent. Therefore, it should be noticed that regulation of prices doesn't only imply a wider entrance to the entrepreneurial market, but also it means smaller profits for both firms.

# VI. Preliminary Conclusions

Post entry competition in the local telephony market is a process that incorporates many elements. A model that embraces all they probably generates nearer results to those observed in the reality, but it will be useless. Our model belongs rather to a second group: although it is not able to reproduce the exact situation of the local telephony in Santiago, it allows us to understand the strategic behavior of firms participating in it. In this sense, seemingly restrictive suppositions – as that of a constant demand – are not an obstacle to simulate a series of interactions among firms and generate interesting economic policy results.

The more remarkable results that each scenario generates (assuming a binding regulation of prices) – for the specific case of Santiago de Chile are the following ones:

- Benchmark scenario simulates a new entrant’s optimal coverage of 40%, for both binding and not binding regulation. This result should not be interpreted as a normative prediction, but as a reference value to be compared with the strategies analyzed in the other scenario. The resulting prices in the benchmark are $p_1$ = 15.22 and $p_2$ = 13.61 (both measured in Chilean pesos by minute)

- According with our parameterization, the capacity of cream skim the market on the part of new entrants produces a counterintuitive result: it is more convenient to a new entrant to fully penetrate into the residential (low demand) market and not to enter into the entrepreneurial (high demand) market. Doing so is more profitable for a new entrant because in equilibrium it fixes higher prices that overcomes losses by not entering into de high demand market. Moreover, new entrant’s optimal coverage is higher in comparison with the benchmark, since 1 * 75% + 0 * 25% implies $\mu = 0.75$. Simulated prices are $p_1$ = 15.7 and $p_2$ = 14.74.

Then, the most important difference between our simulations and the empiric evidence refers to the prediction of an absolute entrance in the residential (low demand) market. This can be a consequence of considering that a new entrant has negligible costs of installation. However, our assumption is fully consistent with assuming network disintegration. If we think in those terms, our model predicts that allowing potential new entrants don’t incur in the sunken cost of building its own networks will not generate deep competition in local telephony. Then, this is an important result because policy makers and academics are tempted to thinks the contrary, i.e. network disintegration is “the” solution to lack of competition in this market. Unfortunately, this is not necessarily true, as we have showed in this paper.

In conclusion, according to the analysis, our model seems to be pertinent to answer the initial question, how post entry competition develops with and without cream skimming on the part of the new entrant. It has been shown that the competition cannot fully develop. Only an extremely strict regulation of prices is able to produce a total entrance of firm 2. However, this full entry usually implies negative benefits for the incumbent. Hence, this strategy is politically not viable because it means to take property rights away from the incumbent (besides negative effects on investments, regulatory commitment, and other extremely important variables that our model doesn't analyze).

It can be inferred, then that network competition doesn't generate the market results wanted by the authorities at the moment to liberalize the market of local telephony. Although it is possible that new firms partially enter, they cannot make it in an enough scale in order to generate fully efficient equilibrium prices. To allow for a deeper competition in local telephony, it may be necessary to implement incentives to enter, for example by initial subsidies, just as several authors have mentioned (Armstrong, Cowan and Vickers, 1994 and Vickers, 1995). On the contrary, it is still impossible to trust on the free market competition as the institutional arrangements that replace a regulatory agency in this market.

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