

Tying and Entry Decision in Telecommunications

Xiaoting Wang*

January 2010

Abstract

In this paper, we consider the issue of entry in telecommunication market. When there exists consumer switching cost, a potential entrant could offer a new product bundled with an existing product and successfully penetrate the incumbent's market. Unlike previous literature on bundling, this paper focuses on the entrant's tying behavior instead of the incumbent's. We find out that tying is pro-competitive and improves social welfare.

In the second part of this paper, the potential entrant could rent the incumbent's facilities and offer a product of lower quality. Through bundling, the entrant compensates consumers of their switching cost. Successful entry results in vertical differentiation of products. The effect on social welfare is ambiguous. Comparison of the two models gives an economic motivation for the regulatory authorities to prefer facility-based entry.

Keywords: Tying, entry, consumer switching cost, vertical differentiation.

*Economics Department, Acadia University. Email: xiaoting.wang@acadiau.ca

1 Literature

Bundling has been proved to be a successful way of predatory pricing. If a firm is the monopolist in one market, it could use the leverage provided by this power to foreclose sales in and thereby monopolize another market. Bundling can also be a way of price discrimination if consumers have heterogeneous preferences.

Literatures in tying theory are vast. Adams and Yellen (1976) builds the foundations for the theory of tying. They showed that the profitability of commodity bundling stems from its ability to sort customers into groups with different reservation price characteristics and hence to extract consumer surplus.

Whinston (1990) is the seminal paper in tying literature. This paper examines the consequences of tying where the market structure for the tied good is not competitive, but oligopolistic. He showed that through a precommitment to tying the monopolist reduces the sales of its tied good market competitor, thereby lowering his profits below the level that would justify continued operation. This paper also showed that with heterogeneous valuations among consumers, tying can be a profitable strategy even in the absence of precommitment.

McAfee, McMillan and Whinston (1989) investigate the conditions under which bundling dominates unbundled sales. They showed that bundling is always an optimal strategy when reservation values for the various good are independently distributed in the population. When purchases can be monitored, bundling dominates unbundled sales for virtually all joint distributions of reservation values.

Mathewson and Winter (1997) investigate the profitability of tying in the case that the monopolist faces uncertain demand. When two-part pricing can not extract all surplus from consumers, tying offers the monopolist additional

margin to extract consumer surplus.

2 Background

The structure of the Canadian telecommunication industry is complex. Service providers rely on the accessibility of the competitor's crucial network components to provide an end-to-end service to their customers. CRTC's regulations make certain network facilities of the incumbent's available to competitors at regulated rates. The incumbent local exchange suppliers are often fully integrated service providers who are able to offer the same range of services and compete for the same customers.

Since the early 1980's, Industry Canada has licensed multiple suppliers of mobile and fixed wireless telecommunications services, and the CRTC has opened almost all telecommunications markets to competition. Given the complex relationships that exist within the Canadian telecommunication industry, the Competition Bureau needs careful judgement when it comes to anticompetitive conduct by firms that have market power. For example, an incumbent firm may prevent entry to eliminate effective competition in a market.

In the telecommunications industry, competitive entry can follow a number of models such as facilities-based entry, entry via unbundled network elements, resale and sharing, or a combination of these methods. Facilities-based entry will require at least two facilities-based service providers such as local exchange services.

Predatory marketing strategies by the incumbent firm, such as tying its products, are banned by regulations. Entrants, on the other hand, are encouraged to use such strategies to make entry successful. However, when the potential entrant was possessing market power in other industries prior to entry, then it is not fair that similar strategies of the two parties receive

different treatments. Armstrong and Sappington (2006) pointed out that liberalization policies that primarily aid some competitors and handicap others on an ongoing basis can hinder the development of vigorous long-term competition. Tirole (2005) argued that asymmetric competition policies exist when it comes to the tying behavior by firms with or without market power. Firms with market power may engage in tying in order either to monopolize the competitive segment or to protect their monopoly power in the monopoly segment. But, like firms without substantial market power, they also use ties for a variety of reasons that enhance economic efficiency, such as distribution cost savings, protection of intellectual property, or legitimate price responses. He suggested that tying should not be treated as a separate offence, but rather be analyzed through more general lens of predation tests.

In the next two sections, we will look at the role of bundling in two types of entry: facility-based entry and renting from the incumbent firm. In Section Five we will examine how the incumbent firm can optimally set a rental fee.

3 Facility-Based Entry

3.1 Setup

The group of people we will focus on in this paper, are originally all firm I 's (the incumbent's) customers in the market for product A . The amount of customers are a continuum of measure 1. Consumers are differentiated in their costs switching from firm I to firm E (the potential entrant) for buying one unit of product A . Assume switching costs t are uniformly distributed on $(0, \bar{t})$.

Consumers have unit demand for product A . The evaluation for product A is v_A (constant) for all consumers. Consumers also have unit demand for

product B . The willingness to pay for product B is v_B (constant) for all consumers.

Denote a consumer's utility function by $V(p_A^I) = v_A - p_A^I + v_B - p_B$ if he does not switch after entry has occurred. If a consumer switches to the individual product A offered by the entrant, his utility is given by $V(p_A^E, t) = v_A - p_A^E - t + v_B - p_B$. His utility is given by $V(p^{AB}, t) = v_A + v_B - p^{AB} - t$ if he switches to the bundle offered by the entrant.

Before the entry game starts, firm I is a monopolist in the market of product A ; firm E , the potential entrant into market for good A , competes with other firms in the market for product B . Suppose the market for B is composed of n firms. They offer identical products with constant marginal cost c . Assume $0 < c < \bar{t} < v_A$. The n firms in market B compete in prices. Price for product B is fixed in this paper at p_B , where $p_B \geq c$. We will set the tie-breaking rule as follows. If n firms charge the same price for product B , the market share of any firm in this market is $1/n$. Assume that demand for A and B are independent. So ex ante $1/n$ consumers from the target group purchase good B from firm E . For simplicity we assume that consumers' switching cost in market B is negligible.

If firm E does enter market A , and offers an identical product as firm I does, firm E has to pay a fixed cost F . Both firms produce A at zero marginal cost.

We will model the entry problem as follows. Firm E decides whether to enter the market for product A . If firm E enters, it pays the fixed cost F , and sets price p^{AB} for the bundle and p_A^E for the individual product A . Firm I , observing whether entry has occurred (but not the prices set by firm E), chooses its own price p_A^I . After observing the prices, consumers decide whether to switch to firm E 's plan, or to stay with the incumbent firm.

Before analyzing the equilibrium, we will briefly review the three types

of bundling. “Pure component” is when products are sold individually and no bundles are offered. “Pure bundling” is the case when products are sold only in bundles and no individual products are offered. “Mixed bundling” is when products can be bought either in a bundle or individually.

3.2 Equilibrium

Lemma 1: Pure component is a weakly dominated strategy.

Proof:

Since mixed bundling offers products both individually and as a bundle, mixed bundling can do at least as well as pure component. For example, if firm E uses the strategy of pure component, it offers product A and B individually at p_A^E and p_B . However, firm E can earn at least as much by offering product A , product B and the bundle at p_A^E , p_B and $p_A^E + p_B$. This argument holds no matter whether there is consumers’ switching cost or not. Q.E.D.

Lemma 2: When the market for product A is mature (no new consumers), and all consumers have identical evaluation v_A for product A and v_B for product B , firm E will choose to offer either pure component or pure bundling.

Proof:

Suppose firm E adopts the mixed bundling strategy, i.e. firm E offers product A both as an individual product and in a bundle.

Consumers who switch to firm E ’s individual product A satisfy the following conditions,

$$t + p_A^E < v_A \tag{1}$$

$$t + p_A^E < p_A^I \tag{2}$$

$$p_A^E < p^{AB} - p_B \quad (3)$$

Consumers who switch to firm E 's bundle satisfy these conditions,

$$t + p^{AB} < v_A + v_B \quad (4)$$

$$t + p^{AB} < p_A^I + p_B \quad (5)$$

$$p^{AB} < p_A^E + p_B \quad (6)$$

It is obvious that inequalities (3.3) and (3.6) can not hold at the same time. When a price for the bundle is not simply the sum of the prices for its components, firm E will sell either the bundle or the individual product A . Mixed bundling is redundant for firm E . Q.E.D.

Given the results in Lemma 2, we can focus on firm E 's optimal behavior under each scenario.

3.2.1 Entry with Bundled Products

Define $t_1 \in (0, \bar{t})$, such that consumers with switching cost t_1 are indifferent between switching to firm E 's bundle and staying with the incumbent's product A , i.e.

$$V(p^{AB}, t_1) = V(p_A^I) \quad (7)$$

Solving for t_1 , we get

$$t_1 = p_B + p_A^I - p^{AB} \quad (8)$$

Lemma 3: When firm E enters the market for A using pure bundling strategy, firm E charges $\frac{1}{3}(2c + \bar{t} + p_B)$ for its bundle; firm I charges $\frac{1}{3}(c + 2\bar{t} - p_B)$ for its product A .

Proof:

Firm E maximizes its profits¹ $t_1(p^{AB} - c) - F$ by choosing p^{AB} . The first order condition for the optimization problem is,

$$2p^{AB} = c + p_B + p_A^I \quad (9)$$

Firm I maximizes its profits $(\bar{t} - t_1) \cdot p_A^I$ by choosing p_A^I . The first order condition is,

$$2p_A^I = \bar{t} - p_B + p^{AB} \quad (10)$$

Solving the above two equations jointly, we can get the equilibrium prices charged by each firm. Q.E.D.

It follows that the market share of firm E is $t_1 = \frac{1}{3}(\bar{t} + p_B - c)$. Firm E 's profits equal to $\frac{1}{9}(\bar{t} + p_B - c)^2 - F$; firm I 's profits equal to $\frac{1}{9}(2\bar{t} + c - p_B)^2$.

3.2.2 Entry with Individual Product A

Define $t_2 \in (0, \bar{t})$, such that a consumer with switching cost t_2 is indifferent between switching to firm E 's product A and staying with the incumbent firm, i.e.

$$V(p_A^E, t_2) = V(p_A^I) \quad (11)$$

It follows that

$$t_2 = p_A^I - p_A^E \quad (12)$$

Lemma 4: When firm E enters the market for A with individual product, it charges $\frac{\bar{t}}{3}$ for A ; firm I charges $\frac{2\bar{t}}{3}$ for A .

Proof:

¹Demand for E should be t_1/\bar{t} . Demand for I should be $(\bar{t} - t_1)/\bar{t}$. The results won't be affected by the misuse of notations.

Firm E maximizes its profits $t_2 \cdot p_A^E - F$ by choosing p_A^E . The first order condition is

$$p_A^E = \frac{p_A^I}{2} \quad (13)$$

Firm I maximizes its profits $(\bar{t} - t_2)p_A^I$ by choosing p_A^I . The first order condition is

$$2p_A^I = \bar{t} + p_A^E \quad (14)$$

Solving the two equations simultaneously, we obtain the equilibrium prices. Q.E.D.

It follows that the market share of firm E is $t_2 = \frac{\bar{t}}{3}$. Firm E 's profits are $\frac{1}{9}\bar{t}^2 - F$; firm I 's profits are $\frac{4}{9}\bar{t}^2$.

Proposition 1: When market B is competitive, i.e. $p_B = c$, firm E is indifferent between entering market A with and without bundling A with B . When firm E has market power in market B , i.e. $p_B > c$, pure bundling dominates pure components for firm E .

Corollary 1: At $p^{AB} = \frac{1}{3}(2c + \bar{t} + p_B)$ and $p_A^I = \frac{1}{3}(c + 2\bar{t} - p_B)$, firm E 's share in market A is $(\bar{t} + p_B - c)/3\bar{t}$. Firm E sells individual product B for a total of $(2\bar{t} + c - p_B)/3n\bar{t}$ consumers.

Corollary 2: If firm E offers a bundle, all consumers will gain from the entry of firm E into market A .

Proof:

Before firm E 's entry, Firm I was the monopoly in market A . It charges the monopoly price v_A to all consumers. Consumer surplus comes only from the competitiveness in market B , i.e. $v_B - p_B$.

After firm E 's entry, consumers who switch to the bundle have consumer surplus greater than or equal to $v_A + v_B - t_1 - p^{AB}$. Substituting in the values

for p^{AB} and t_1 , the expression becomes

$$v_A - \frac{2}{3}\bar{t} + v_B - \left(\frac{2}{3}p_B + \frac{1}{3}c\right)$$

Under the assumption that $v_A > \bar{t}$ and $p_B \geq c$, this value is greater than $v_B - p_B$.

For consumers who stay with the incumbent's product A , they will gain from the entry of firm E as long as $p_A^I < v_A$. Given that $p_A^I = \frac{1}{3}(c + 2\bar{t} - p_B)$, clearly this group of consumers gain from firm E 's entry as well. Q.E.D.

Discussion

When the entrant builds its own physical facility and provides product of the same quality as the incumbent's, it costs a large amount of capital investment. For firm E , in order to cover the fixed cost of entry (F) and the lost profits in market B , long-run profitability of selling A has to be considerably high.

When setting up this model, we ignored the possibility for firm I to enter the market for B . The CRTC (regulatory authority in telecommunications and cable television) has put strict restrictions on promotions by the incumbents, in order to enhance the competitive market structure of the industry in the future. Iacobucci, et al.(2005) argued that promotion by the incumbents is a reflection of competition, not a deterrence to it. Here we admit that in the long run, it is possible for firm I to enter the market of B and provide bundled products. A recent advertisement from Cogeco (cable TV program provider in Ontario and Quebec), says they are now able to use cable lines to provide local telephone services. With the launching of this new product, we could foresee Cogeco's entry into telecommunications market by bundling this new service with its existing cable services.

4 Entry by Renting from the Incumbent Firm

When the entrant rents the incumbent's technical facilities instead of building its own, the quality of the entrant's product will not exceed that of the existing product. Given the incumbent firm's product quality, the entrant will respond by offering a product of equal or lower quality.

4.1 Setup

Consumer Preferences

Classical models of vertical differentiation, such as Shaked and Sutton (1982, 1983), are built on the assumption that consumers have different initial wealth levels. Here we make the following assumptions. As in the previous section, all consumers are firm I 's customers before entry begins. Assume that they all have identical evaluation v_A for one unit of high-quality A provided by the incumbent firm. Consumers differ in their switching costs t . Assume t is uniformly distributed on $(0, \bar{t})$. Switching costs here can be considered as a negative endowment to consumers. Instead of letting the agents be differentiated in two dimensions: initial income and switching costs. We make this assumption so that we can focus on the pure effect of switching costs. Consumers who were not firm I 's customers are not considered in this model, since switching costs in market A do not apply to them.

For a consumer who switches to firm E 's product A , his utility is given by

$$U(p_A^E, t, \mu_E) = \mu_E v_A - t - p_A^E + v_B - p_B$$

For a consumer who switches to firm E 's bundle, his utility is given by

$$U(p^{AB}, t, \mu_E) = \mu_E v_A + v_B - p^{AB} - t$$

For a consumer who does not switch after firm E 's entry, his utility is given by

$$U(p_A^I) = \mu_I v_A - p_A^I + v_B - p_B$$

μ_I and μ_E are parameters measuring the quality of product A . Assume $\mu_I = 1$, and $0 < \mu_0 \leq \mu_E \leq 1$.

Technology

Assume as in the previous section that firm I produces a high quality product A at zero marginal cost.

For the entrant, assume there is no fixed cost with entry. Assume the marginal cost for firm E to produce A increases in the quality of A chosen by firm E . For simplicity we assume that marginal cost equals to $\mu_E \cdot \tilde{c}$, where \tilde{c} is the access charge or rental fee set by firm I . In the next section we will allow firm I to strategically choose \tilde{c} . For now we assume \tilde{c} is constant and $0 < \tilde{c} < \bar{t} < v_A$.

Timing

Let's consider a two-stage game.

At stage one, firm E decides whether to enter the market for A and chooses the quality of its product A . No fixed costs need to be paid. The underlying assumption is that firm E rents from firm I for its physical facilities.

At stage two, if entry occurs, firms compete in prices. Firm I sets price for A ; firm E sets prices for its individual product A and the bundle.

4.2 Equilibrium

In the current setup, firm E chooses its quality parameter μ_E . Two types of product A can potentially be vertically differentiated. Moreover, there is

cost asymmetry between the incumbent and the entrant. Standard Bertrand equilibrium will not be the result of this game.

4.2.1 Entry with Bundled Products

In this subsection, we will look at the case when firm E bundles its product A with product B .

Price Competition

Define $t_B \in (0, \bar{t})$, such that a consumer with switching cost t_B is indifferent between staying with the incumbent's A and switching to the entrant's bundle at p^{AB} , i.e.

$$U(p_A^I) = U(p^{AB}, t_B, \mu_E) \quad (15)$$

Solving the above equation, we get

$$t_B = p_A^I + p_B - p^{AB} - (1 - \mu_E)v_A \quad (16)$$

Consumers whose switching costs are less than or equal to t_B will switch to firm E 's bundle, i.e. t_B is the demand for firm E in market A . Demand for the incumbent firm I is therefore given by $\bar{t} - t_B$.

Lemma 5: Given the entrant's choice of quality μ_E for product A , the Nash Equilibrium in the price setting game is

$$p_A^I = \frac{1}{3}[\mu_E \tilde{c} + c + 2\bar{t} - p_B + (1 - \mu_E)v_A]$$

$$p^{AB} = \frac{1}{3}[2\mu_E \tilde{c} + 2c + \bar{t} + p_B - (1 - \mu_E)v_A]$$

when the entrant sells product A in a bundle.

Proof:

Assume firm E 's profits in market B are negligible. (p_B does not have to be negligible, and it is exogenous in this paper.) Firm E chooses p^{AB} to

maximize $t_B \cdot (p^{AB} - c - \mu_E \tilde{c})$. The first order condition is necessary and sufficient for the maximum,

$$2p^{AB} = \mu_E \tilde{c} + c + p_A^I + p_B - (1 - \mu_E)v_A \quad (17)$$

Firm I chooses p_A^I to maximize $(\bar{t} - t_B) \cdot p_A^I$. The first order condition is necessary and sufficient for the maximum,

$$2p_A^I = \bar{t} - p_B + p^{AB} + (1 - \mu_E)v_A \quad (18)$$

Solving for p^{AB} and p_A^I simultaneously, we could obtain the equilibrium prices. Q.E.D.

Substituting equilibrium prices into the equation for t_B , we can obtain the demand function for firm E ,

$$t_B = \frac{1}{3}[\bar{t} + p_B - \mu_E \tilde{c} - c - (1 - \mu_E)v_A] \quad (19)$$

Choice of Quality

Lemma 6: When firm E bundles its product A with product B , the optimal quality for its product A is at $\mu_E = 1$. Firm E earns positive profits at $\mu_E = 1$.

Proof:

Given the demand function t_B , firm E will choose $\mu_E \in [\mu_0, 1]$ to maximize its profits. Profit function becomes $\frac{1}{9}[\bar{t} + p_B - \mu_E \tilde{c} - c - (1 - \mu_E)v_A]^2$.

Second order conditions show that this profit function is convex in the quality parameter μ_E . Therefore firm E 's optimal choice of quality will occur at one of the boundaries, i.e. either at $\mu_E = 1$, or at $\mu_E = \mu_0$.

At $\mu_E = 1$, firm E 's profits are $\frac{1}{9}[\bar{t} + p_B - \tilde{c} - c]^2$.

At $\mu_E = \mu_0$, firm E 's profits are $\frac{1}{9}[\bar{t} + p_B - \mu_0 \tilde{c} - c - (1 - \mu_0)v_A]^2$.

Since $\tilde{c} < v_A$, it follows that $\bar{t} + p_B - \tilde{c} - c > \bar{t} + p_B - \mu_0 \tilde{c} - c - (1 - \mu_0)v_A$. Therefore firm E 's profit is maximized at $\mu_E = 1$.

Given that $0 < \tilde{c} < \bar{t}$ and $p_B \geq c$, firm E 's equilibrium profit at $\mu_E = 1$ is above zero. Q.E.D.

4.2.2 Entry with Individual Product A

Now let us look at the case when firm E enters the market for product A without bundling A with B .

Price Competition

Define $t_I \in (0, \bar{t})$, such that a consumer with switching cost t_I is indifferent between staying with the incumbent's A at price p_A^I and switching to the entrant's individual product A at p_A^E , i.e.

$$U(p_A^I) = U(p_A^E, t_I, \mu_E) \quad (20)$$

Solving the above equation, we get

$$t_I = p_A^I - p_A^E - (1 - \mu_E)v_A$$

Consumers whose switching costs are less than or equal to t_I will switch to firm E 's product A , i.e. t_I is the demand for firm E in market A . Demand for the incumbent firm I is therefore given by $\bar{t} - t_I$.

Lemma 7: Given the entrant's choice of quality μ_E for product A , the Nash Equilibrium in the price-setting game is

$$p_A^I = \frac{1}{3}[2\bar{t} + \mu_E \tilde{c} + (1 - \mu_E)v_A]$$

$$p_A^E = \frac{1}{3}[\bar{t} + 2\mu_E \tilde{c} - (1 - \mu_E)v_A]$$

when the entrant sells individual product A .

Proof:

Firm E chooses p_A^E to maximize its profit $t_I \cdot (p_A^E - \mu_E \tilde{c})$. The first order condition is necessary and sufficient for the maximum,

$$2p_A^E = p_A^I + \mu_E \tilde{c} - (1 - \mu_E)v_A \quad (21)$$

Firm I chooses p_A^I to maximize its profit $(\bar{t} - t_I) \cdot p_A^I$. The first order condition is necessary and sufficient for the maximum,

$$2p_A^I = \bar{t} + p_A^E + (1 - \mu_E)v_A \quad (22)$$

Equilibrium prices are obtained by solving these two first order conditions jointly. Q.E.D.

Given the equilibrium prices, we can calculate demand for each firm in the market for A . Demand for the entrant is

$$t_I = \frac{1}{3}[\bar{t} - \mu_E \tilde{c} - (1 - \mu_E)v_A]$$

Choice of quality

Lemma 8: When firm E offers product A as an individual product, the optimal quality for its product A is at $\mu_E = 1$. Firm E earns positive profits at $\mu_E = 1$.

Proof:

Let firm E choose an optimal quality $\mu_E \in [\mu_0, 1]$ that maximizes its profit $t_I(p_A^E - \mu_E \tilde{c})$. Firm E 's profit function can be rewritten as $\frac{1}{9}[\bar{t} - \mu_E \tilde{c} - (1 - \mu_E)v_A]^2$.

Second order conditions show that firm E 's profit is convex in the quality parameter μ_E . So maximum profit will occur at one of the boundaries, i.e. either at $\mu_E = \mu_0$, or at $\mu_E = 1$.

Firm E 's profits at $\mu_E = 1$ are $\frac{1}{9}[\bar{t} - \tilde{c}]^2$. Its profits at $\mu_E = \mu_0$ are $\frac{1}{9}[\bar{t} - \mu_0 \tilde{c} - (1 - \mu_0)v_A]^2$.

For $\tilde{c} < v_A$, it follows immediately that firm E 's profits are maximized at $\mu_E = 1$.

Under the assumption that $0 < \tilde{c} < \bar{t}$, firm E 's equilibrium profit is bounded above zero. Q.E.D.

4.2.3 Subgame Perfect Equilibrium

Proposition 2: If the market price for product B is at its marginal cost c , firm E faces the same level of profits whether it bundles (A and B) or not, and selling an individual product A is not a dominated strategy for firm E .

Proof:

When firm E offers individual product A , its maximum profits are $\frac{1}{9}[\bar{t} - \tilde{c}]^2$.

When firm E offers product A in a bundle, its maximum profits are $\frac{1}{9}[\bar{t} + p_B - \tilde{c} - c]^2$.

At $p_B = c$, two profit functions are equal. When $p_B > c$, bundled sale dominates offering individual products. Q.E.D.

5 To Build or To Rent?

In the previous two sections, we have derived the outcomes under each type of entry. Now the question is, will firm E choose to build its own facilities or to rent from the incumbent firm? To solve this question, let us consider the following setup of the game.

Firm I first decides the rental fee \tilde{c} . After observing \tilde{c} , firm E will choose from the three options: renting from firm I ; building its own facilities; not entering market A .

Using backward induction, we first look at firm E 's optimal choice. Not entering yields zero profit. When market B is perfectly competitive, i.e.

pure bundling and pure components are equally profitable for firm E , renting yields profits of $\frac{1}{9}[\bar{t} - \tilde{c}]^2$; building yields profits of $\frac{1}{9}\bar{t}^2 - F$. It follows immediately that renting from incumbent is more profitable if

$$F > \frac{1}{9}\tilde{c}(2\bar{t} - \tilde{c}) \quad (23)$$

Knowing how firm E will react to its rental charge \tilde{c} , firm I will set \tilde{c} strategically. If firm E rents as in Section 3, firm I 's profits equal to $\frac{1}{9}(2\bar{t} + \tilde{c})^2$. If firm E builds its own facilities as in Section 2, firm I 's profits equal to $\frac{4}{9}\bar{t}^2$. Clearly firm I 's profits are always higher when firm E rents its facilities.

Take a closer look at the above inequality. Firm I , by setting $\tilde{c} = \bar{t} - \sqrt{\bar{t}^2 - 9F}$, makes firm E rent from her in the equilibrium.

6 Conclusion

In this paper we compared two types of entry into a monopolistic market: facility-based entry and renting from the incumbent firm. We also looked at the role of bundling in the process of entry. Our analysis focuses on bundling as means of price discrimination, instead of leveraging market power (by assuming the competitiveness in market B).

Although facility-based entry is preferred by the regulatory authorities, we found out that by setting a lower rental charge, renting instead of building facilities benefits both the incumbent firm and the new entrant.

Further studies on this subject include the case when both parties are allowed to use bundling strategy and how firms use bundling in repeated price-setting games.

References

- [1] Armstrong, M., and Sappington D. (2006), "Regulation, Competition and Liberalization," *Journal of Economic Literature*, 44(2), 325-366.
- [2] Chen, Y. (1997), "Equilibrium Product Bundling," *Journal of Business*, 70(1), 85-103.
- [3] McAfee, R.P., McMillan J., and Whinston, M. (1989), "Multiproduct Monopoly, Commodity Bundling, and Correlation of Values," *Quarterly journal of Economics*, 104, 371-384.
- [4] Shaked, A., and Sutton, J. (1982), "Relaxing Price Competition Through Product Differentiation," *Review of Economic Studies*, 49, 3-14.
- [5] Shaked, A., and Sutton, J. (1983), "Natural Oligopolies," *Econometrica*, 51(5), 1469-1483.
- [6] Tirole, J. (2005), "The Analysis of Tying Cases: A Primer," *Competition Policy International*, 1(1), 1-25.
- [7] Wang, R. and Wen, Q. (1998), "Strategic Invasion in Markets with Switching Costs," *Journal of Economics and Management Strategy*, 7(4), 521-549.
- [8] Whinston, M.D. (1990), "Tying, Foreclosure and Exclusion," *American Economic Review*, 80(4), 837-859.