Mergers and Barriers to Entry in Pharmaceutical Markets

Granier, Laurent; Trinquard, Sébastien

Postprint / Postprint
Zeitschriftenartikel / journal article

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:
www.peerproject.eu

gesis
Leibniz-Institut
für Sozialwissenschaften

Mitglied der
Leibniz-Gemeinschaft

Mergers and Barriers to Entry in Pharmaceutical Markets

scholarONE™
Manuscript Central

Entry Deterrence and Mergers under Price Competition in Pharmaceutical Markets

Laurent Granier[*]and Sébastien Trinquard[†]

LASER-CREDEN

University of Montpellier I[‡]

July 17, 2007

Abstract

After patent expirations in pharmaceutical markets, brand-name laboratories are threatened by generic firms' entry. To fill the gap in the theoretical literature on this topic, we study brand-name firms' incentives either to deter entry, or to merge with the entrant. These strategies are considered along with the possibility of the brand-name firm producing its own generic drug, called a pseudo-generic drug. Using a vertical differentiation model with Bertrand-Stackelberg competition, we show that each strategy, merging and deterring entry, may be Nash equilibrium, according to the generic firm's setup cost level and to the rate of discount.

JEL Classifications: I11, L12.

Key words: barriers, endogenous mergers, limit pricing, pharmaceuticals, pseudo-generics.

[*]laurent.granier@univ-montp1.fr

[†]sebastien.trinquard@univ-montp1.fr

[‡]University of Montpellier I : CS 79706 34960 Montpellier Cedex 2 France.

1

1   Introduction

In pharmaceutical markets, drug producers apply for patents in order to protect their intellectual property rights. At the patent expiration dates, these rights become public property. Then, princeps copying is allowed and incumbents are threatened by generic firms' entry. These generic laboratories produce drugs bio-equivalent[1] to branded goods. Some companies see more than 20% of their sales threatened by competition[2] from generic drugs (Grandfils *et al.,* 2004). Therefore, they have incentives either to merge with generic firms, or to deter their entry in order to preserve their monopoly power. We study the trade-off between these practices to fill the gap in theoretical literature on this topic.

These strategies are considered along with the possibility of the brand-name firm producing its own generic drug, called a pseudo-generics good. Recently, pseudo-generics production became significant[3]. Therefore, economists' interest in the effect of pseudo-generics is recent, both at an empirical and theoretical level. Empirically, original studies of Hollis (2002, 2003) analyze the effects of these drugs on prices and generic entry. The author shows the presence of a first mover advantage. This advantage deters entry and leads to an increase in price, both for pseudo-generics and brand-name products. He concludes that the welfare decreases in the Canadian market. These results

---

[1] Generic drugs are manufactured with the same molecules as the brand-name drugs.

[2] To illustrate this competition, note that the expected global generic growth is about 7% in 2006 (IMS-Health). Caves *and al.* (1991), Frank and Salkever (1997), Morton (1999, 2000) analyze generic entry effects on princeps prices and market shares in the United-States.

[3] For instance, pseudo-generics have about one quarter of the generic market in Australia and Canada. They are also in a strong position in New Zealand, Germany, the UK, and Sweden (Hollis 2002).

2

corroborate the Ferrandiz theoretical model. In a complementary approach, Kong et Seldon (2004) use a two-stage game model with product differentiation and show the central role of cross price-elasticity in using pseudo-generic products to deter entry. Pseudo-generics drugs, by raising competitive pressure on the generic firm, make entry deterrence easier. From this perspective, Granier and Trinquard (2006) show that this increase in competitive pressure facilitates the generic firm's purchase by the brand-name laboratories. This justifies our present study i.e. the trade-off between mergers and barriers to entry in pharmaceutical markets.

Regarding barriers to entry, this model considers the limit-pricing strategies that consist of fixing the highest price that insures that the entrant realizes no profit[4]. A basic defect in the Bain/sylos limit-pricing model of entry deterrence stems from its assumption that the potential entrant believes that the established firm would maintain its output constant if entry occurred. The problem is that if entry did occur it would not generally be rational for the established firm to carry out this threat; thus the threat is not credible (see, e.g., Sherer, 1980, pp.246-48). Considering asymmetric information in a Bayesian game, Milgrom and Roberts (1982) solves the credibility problem. Even if this new model can qualify the efficacy of the limit-pricing strategy, in a compromise between generality and tractability, we assume generic firms are myopic producers. Regarding mergers, we construct a model of endogenous mergers (see, e.g., Kamien and Zang, 1990, 1993, Granier, 2007) to better consider merger dynamics. More exactly, we study preemptive mergers. These are

---

[4]In particular, the limit-pricing strategy is empirically validated by Sengupta (1983) for US computer industry.

3

initiated to prevent an unfavorable future event such as certain rival mergers (Brito, 2003, Fridolfsson and Stennek, 2005), or in our case, such as the generic entry.

The purpose of this paper is to study the trade-off between a limit-pricing strategy and a merger strategy. To achieve this aim, we develop a simple model in which a brand-name laboratory and a generic one compete à la Bertrand-Stackelberg in a therapeutic market with vertically differentiated goods. We find two main results. The limit-pricing strategy is always preferable to accommodating entry but the generic firm myopic assumption qualifies this result. Secondly, merger is preferable to entry deterrence depending on the entrant setup cost level and to the discount rate. Our paper extends Kong and Seldon (2004), and Granier and Trinquard (2006) models. Indeed, it studies the trade-off between entry deterrence and merger, also taking into account the possibility of pseudo-generic production. Moreover, it differs from these two models by assuming price competition. The rest of the paper is organized as follows. Section 2 sets out the model. In section 3, we analyze limit-pricing strategies. Section 4 is devoted to merger analysis and to its comparison with that of limit-pricing strategies. We conclude in section 5.

2   Model

We consider a drug market where the patent has expired. Thus, generic laboratories are able to produce. We take into account the fact that the brand-name firm can equally produce a pseudo-generic. Consumers may choose between a brand-name product and a generic product. The brand-name producer, threatened by the generic entry, may adopt three alternative strategies: either

4

accommodate entry or deter entry or merge as soon as a generic firm enters the market. We define a game in which these three strategies are available. By comparing profits associated with these three strategies, we compute the Nash equilibrium of the game (see figure 1). First, we present the model assumptions. Second, we establish existence conditions of the benchmark in which the three strategies can be analyzed.

Insert Figure 1

2.1 Assumptions

The physician is considered as a perfect agent of the patient. In this context, the physician's utility and the patient's utility are one and the same. Their utility function is linear since we assume risk-neutral consumers. The absence of an insurance market is also assumed, which means that consumers pay their drugs bill in full and there is no public intervention in the market[5]. We assume a vertical product differentiation because of brand loyalties[6] and uncertainty

---

[5] «Price regulation is mainly concerned with the trade-off between R&D and cost containment, while insurance is concerned with moral hazard and adverse selection problems» (Brekke et Kuhn 2006). Our purpose is a very different one. We examine the trade-off between entry deterrence and mergers. Therefore, we do not take account of health insurance and price regulation. Therefore, we do not take account of health insurance and price regulation. However, there are papers focused on price regulation effects in pharmaceutical markets (e.g. Jones, Potashnik and Zhang, 2001).

[6] The empirical studies of Hudson (1992), Hellerstien (1998), or Kong (2004) show the existence of brand loyalties. These studies explain swithching costs by the search costs and the uncertainty about the relative quality of the entrant.

in quality differential in drugs. Consumers' utility function is assumed to be:

$$
U = \begin{cases}
u - p_b & \text{if the patient consumes the brand-name drug,} \\
\theta u - p_g & \text{if the patient consumes the generic drug,} \\
0 & \text{otherwise.}
\end{cases}
$$

The variable u is the drug quality, p_b the brand-name price and p_g the generic price. Each consumer is characterized by a value of θ. This parameter is the subjective cost of switching from the branded to the generic drug. Here, it is modeled as a probability. It is the perceived probability that the generic drug is of the same quality as the brand-name one. Consumption decisions are trade-offs between the perceived quality of a drug and its price. The parameter θ is assumed to be uniformly distributed over the interval $[0; 1]$. Let $F(\theta)$ be the distribution function. A patient θ purchases the brand-name drug if the following is true:

$$
u - p_b \geq \theta u - p_g \Rightarrow \theta \leq 1 - \frac{p_b - p_g}{u}, \tag{1}
$$

$$
u - p_b \geq 0 \Rightarrow p_b \leq u. \tag{2}
$$

From this, we compute market shares. Let s_g be the generic market share and s_b the brand-name one:

$$
s_g = 1 - F(1 - \frac{p_b - p_g}{u}) = \frac{p_b - p_g}{u}, \tag{3}
$$

$$
s_b = F(1 - \frac{p_b - p_g}{u}) = 1 - \frac{p_b - p_g}{u}. \tag{4}
$$

The literature on the pharmaceutical market usually assumes negligible marginal cost and focuses on sunk costs of R&D. Here, we leave aside these sunk costs since we do not consider innovation issues. However, the generic laboratory pays a setup cost to enter the pharmaceutical market. Let F denote

6

the setup cost in the rest of the paper. This is not the case for the brand-name firm when it produces its pseudo-generic drug because the pseudo-generic good may be manufactured on the same production lines as its brand-name equivalent (Kong and Seldon, 2004, footnote 2). Furthermore, we assume the brand-name producer can act as a Stackelberg leader because of brand loyalties. Moreover, the brand-name firm and the generic firm compete *à la* Bertrand[7]. We assume also the brand-name firm has no incentive to produce several different pseudo-generic drugs[8]. Now we have defined the benchmark conditions, we can to study the trade-off between entry deterrence, accommodation of entry and merger.

2.2 Benchmark conditions

In order to study the trade-off between accommodating entry, deterring entry, or purchasing the generic firm, we define a benchmark for which entry is profitable. To elucidate the topic, we restrict the study to the case in which entry is profitable if and only if the industry is monopolistic and there is only one entry at any time[9]. To check this assumption, a second entrant must realize no

---

[7]Because of the fixed market demand (i.e. covered market and unit density), we assume price competition and we consider limit pricing strategy.

[8]There are two justifications to this assumption. On one hand, brand-name laboratories have a reluctance to produce several types of pseudo-generic drugs so as not to degrade brand-loyalties from which they benefit. Indeed, for a given therapeutic class, the generics proliferation decreases the switching cost from the brand to the generic drug (Hurwitz and Caves, 1988). On the other hand, we note the absence of such pseudo-generic duplication in stylized facts.

[9]Results are not qualitatively modified if there are several entrants at the same time. Indeed, if several firms simultaneously enter the market, these share equally the generic market among themselves. Therefore, merger and entry deterrence strategies are unaffected.

7

profit. Therefore, we have to compare a duopolistic industry with a triopolistic one. Given that the brand-name firm can produce two goods, we must determine which strategy this firm follows, whether to produce only pseudo-generic drugs or not. First, we determine if it produces pseudo-generics when there is only one entrant. Second, we make the same study when there are two entrants. The comparison of these two studies determines the benchmark conditions where there is only one potential entrant at any one time.

2.2.1 Stackelberg duopoly *vs* Stackelberg pseudo-duopoly

To know if the brand-name laboratory has an incentive to produce a pseudo-generic when there is only one entrant, we compare its profits with and without a pseudo-generic drug. We call "pseudo-duopoly" the duopoly in which pseudo-generics are produced. We start by analyzing the Stackelberg duopoly before analyzing the Stackelberg pseudo-duopoly.

Stackelberg duopoly Let Π_b^D and Π_g^D be brand-name and generic firms duopoly profits. These profits are as follows:

$$\Pi_b^D = s_b p_b, \tag{5}$$

$$\Pi_g^D = s_g p_g - F. \tag{6}$$

Since the brand-name laboratory acts as a Stackelberg leader, we substitute the generic firm's reaction function into the brand-name firm's profit function to compute equilibrium prices and profits. Thus, we obtain the following equilibrium profits:

$$\Pi_b^{D*} = \frac{u}{2}, \tag{7}$$

$$\Pi_g^{D*} = \frac{u}{4} - F. \tag{8}$$

8

Proof. see appendix A. ∎

Stackelberg pseudo-duopoly Let Π_b^{PD} and Π_g^{PD} be brand-name and generic firms' duopoly profits. These profits are then given by:

$$\Pi_b^{PD} = s_b p_b + \frac{1}{2} s_g p_g, \tag{9}$$

$$\Pi_g^{PD} = \frac{1}{2} s_g p_g - F. \tag{10}$$

As the two generic drugs are homogeneous, the Bertrand competition leads to a unique price on this market. Thus, the two producers share the generic market equally among themselves. Since the brand-name laboratory acts as a Stackelberg leader, we substitute the generic firm's reaction function into the brand-name firm's profit function to establish equilibrium prices and profits. Thus, the equilibrium profits are:

$$\Pi_b^{PD*} = \frac{5}{8} u, \tag{11}$$

$$\Pi_g^{PD*} = \frac{1}{8} u - F. \tag{12}$$

Proof. see appendix B. ∎

Conclusion: which structure? The brand-name laboratory compares its profits in the two structures to decide whether or not to produce pseudo-generics.

$$\Pi_b^{PD*} - \Pi_b^{D*} = \frac{u}{8} > 0. \tag{13}$$

The brand-name firm, in competition with a generic firm, produces pseudo-generics. We deduce from that the generic firm enters the market if and only if it recovers its setup cost, that is if $F < \frac{u}{8}$. Now, we study the case for which there are two entrants to define the conditions under which a sole entry is profitable.

9

2.2.2 Stackelberg triopoly *vs* Stackelberg pseudo-triopoly

We call "pseudo-triopoly" the triopoly in which pseudo-generics are produced. Proceeding in the same way as in section 2.2.1 but with two potential entrants, we study the brand-name firm's decision to produce pseudo-generics. We start by analyzing the Stackelberg triopoly before analyzing the Stackelberg pseudo-triopoly.

Stackelberg triopoly   Let Π_b^T, Π_{g1}^T, and Π_{g2}^T be brand-name and generic firms' triopoly profits. These profits are as follows:

$$\Pi_b^T = s_b p_b, \tag{14}$$

$$\Pi_{g1}^T = \Pi_{g2}^T = \frac{1}{2} s_g p_g - F. \tag{15}$$

Subsequently, the equilibrium profits are:

$$\Pi_b^{T*} = \frac{u}{2}, \tag{16}$$

$$\Pi_{g1}^{T*} = \Pi_{g2}^{T*} = \frac{u}{8} - F. \tag{17}$$

Proof. see appendix C. ∎

Stackelberg pseudo-triopoly   Let Π_b^{PT}, Π_{g1}^{PT}, and Π_{g2}^{PT} be brand-name and generic firms' triopoly profits. These profits are given by:

$$\Pi_b^{PT} = s_b p_b + \frac{1}{3} s_g p_g, \tag{18}$$

$$\Pi_{g1}^{PT} = \Pi_{g2}^{PT} = \frac{1}{3} s_g p_g - F. \tag{19}$$

The generic market is divided into three equal shares because of the reasons mentioned in section 2.2.1. Subsequently, the profits are the following:

$$\Pi_b^{PT*} = \frac{7}{12} u, \tag{20}$$

$$\Pi_{g1}^{PT*} = \Pi_{g2}^{PT*} = \frac{1}{12} u - F. \tag{21}$$

10

Proof. see appendix D. ∎

Conclusion: which structure?   The brand-name laboratory compares its profits in the two structures in order to decide whether or not to produce pseudo-generics.

$$\Pi_b^{PT*} - \Pi_b^{T*} = \frac{u}{12} > 0. \tag{22}$$

The brand-name firm, in competion with two generic firms, produces the pseudo-generic. We deduce from this that two generic firms enter the market simultaneously or sequentially if and only if they recover their setup costs, that is if $F < \frac{u}{12}$. The pseudo-duopoly and the pseudo-triopoly are the market structures preferred by the brand-name firm in the case of a sole competitor or of two competitors respectively. By assumption, entry is profitable if and only if the initial structure is a monopolistic one and if there is an only one entry at a time. To check this assumption, the second entrant must realize no profit. By comparing the two structures, we ascertain the condition under which entry is profitable for one firm but not for two:

$$\frac{u}{12} < F < \frac{u}{8}. \tag{23}$$

The benchmark conditions having been studied, we focus on the deterrence of the entry of the generic firm.

3   Entry deterrence

In this Bertrand competition context, the brand-name firm may have an incentive to use a limit-pricing strategy to deter entry. This strategy consists in fixing the highest price which deters entry. Since the brand-name firm can

produce pseudo-generics, two sub-strategies exist. On one hand, to deter entry by producing only the brand-name good. On the other hand, to deter entry by producing the two drugs. We compare these two sub-strategies to ascertain the optimal strategy. We begin with the case in which the brand-name firm produces only its princeps. Second, we study the case in which it produces pseudo-generics also.

3.1 Limit-pricing strategy and Stackelberg duopoly

The limit-pricing strategy consists in determining the price which maximizes the brand-name firm's profit under the assumption that the generic producer realizes no profit:

$$\max_{p_b} \Pi_b^{LD} = s_b p_b \tag{24}$$
$$s/t \ \Pi_g^{LD} = s_g p_g - F \leq 0$$

Since the brand-name laboratory acts as a Stackelberg leader, we substitute the generic firm's reaction function into the brand-name firm's profit function to establish equilibrium prices and profits. The reaction function is:

$$RF(p_b) : p_g(p_b) = \frac{p_b}{2}. \tag{25}$$

The profit of the generic producer must be non-positive to deter entry. Since the brand-name firm's profit function is concave, we saturate the constraint so as to establish the equilibrium brand-name good price p_b^{LD*}:

$$\Pi_g^{LD} = s_g \frac{p_b}{2} - F = \frac{p_b^2}{4u} - F = 0 \tag{26}$$
$$\Rightarrow \ p_b^{LD*} = 2\sqrt{Fu}.$$

Given that the generic firm does not enter the market, the brand captures the whole demand if $p_b^{LD*} < u$, that is $F < \frac{u}{4}$. Note that if $F > \frac{u}{4}$, the limit

12

price exceeds the consumer's willingness to pay. The firm cannot fix this price, but in this case, the generic firm does not enter (see section 2.2.1). Thus, the equilibrium brand-name firm's profit is:

$$\Pi_b^{LD*} = s_b p_b^{LD*} = 2\sqrt{Fu}. \tag{27}$$

Under the benchmark conditions, the brand-name laboratory can deter entry without pseudo-generics production by fixing the equilibrium price p_b^{LD*}.

3.2　Limit-pricing strategy and Stackelberg pseudo-duopoly

Proceeding in the same way as in the previous section, the maximization problem becomes:

$$\max_{p_b} \Pi_b^{LPD} = s_b p_b + \frac{1}{2} s_g p_g \tag{28}$$
$$s/c\ \Pi_g^{LPD} = \frac{1}{2} s_g p_g - F \leq 0$$

Inserting (25) and saturating the constraint, we deduce the equilibrium brand-name good price p_b^{LPD*}:

$$\Pi_g^{LPD} = \frac{1}{2} s_g \frac{p_b}{2} - F = \frac{p_b^2}{8u} - F = 0 \tag{29}$$
$$\Rightarrow\ p_b^{LPD*} = 2\sqrt{2Fu}.$$

Given that the generic firm does not enter the market, the brand captures the whole demand if $p_b^{LPD*} < u$, that is $F < \frac{u}{8}$. Note that if $F > \frac{u}{8}$, the limit price exceeds the consumer willingness to pay. The firm cannot fix this price, but in this case, the generic producer does not enter (see section 2.2.1). Thus, the equilibrium brand-name firm's profit is:

$$\Pi_b^{LPD*} = s_b p_b^{LPD*} + s_g p_g^{LPD*} \tag{30}$$
$$= 2\sqrt{2Fu} - 2F.$$

13

This strategy is profitable if the brand-name profit is positive, that is the case if $F < 2u$. So, the benchmark holds if $F < \frac{u}{8}$. Thus, under the benchmark conditions, the brand-name firm can deter entry by producing its pseudo-generic good by fixing the equilibrium price p_b^{LPD*}.

3.3 Optimal limit-pricing strategy

In order to determine the optimal limit-pricing strategy, we compare brand-name firm's profits in the two sub-strategies: to produce or not pseudo-generics. By assumption, only one generic firm has an incentive to enter the market if condition (23) holds. Moreover, the two sub-strategies are applicable if condition (23) holds. The difference between the two profits is:

$$\Pi_b^{LPD*} - \Pi_b^{LD*} = 2\sqrt{2Fu} - 2F - 2\sqrt{Fu}. \tag{31}$$

This expression is a trinomial which admits two roots F_1 and F_2[10]. The benchmark conditions are between these two roots. We deduce from this:

$$\Pi_b^{LPD*} - \Pi_b^{LD*} > 0. \tag{32}$$

Therefore, the optimal limit-pricing strategy is that in which the brand-name firm produces pseudo-generics. In this case, brand and generic prices are fixed at p_b^{LPD*} and p_g^{LPD*}. The brand-name firm, preventing its competitor from entering the market, realizes a profit Π_b^{LPD*}. We determine if it is profitable for the brand-name firm to deter entry. Therefore, we compare the brand-name firm's profits in the case of limit-pricing strategy and in the case of accommodation strategy. This difference is analyzed for setup cost values in line with condition (23). Indeed, this condition makes the entry of only one

---

[10] $F_1 = 0$ and $F_2 = -2u\sqrt{2} + 3u \simeq 0.172u$

14

generic firm profitable at one time. The profit difference is given by:

$$\Pi_b^{LPD*} - \Pi_b^{PD*} = 2\sqrt{2}\sqrt{Fu} - 2F - \frac{5}{8}u > 0. \tag{33}$$

Proposition 1 *The limit-pricing strategy dominates the accommodation strategy.*

Proof. see appendix E. ∎

As we have already said, this result assumes a myopic generic firm, since by entering the market, this firm incites the brand-name firm to modify its strategy by fixing competitive prices.

4 Deter entry or merge?

The previous section underlines that entry deterrence strategy dominates accommodation strategy. The merger strategy is equivalent to the entry deterrence strategy. Indeed, it prevents the generic firm from producing. After studying the merger path, we analyze the relative profitability of the two strategies.

4.1 An alternative to entry deterrence: the "anticipative" merger

In the benchmark, we consider one potential entry in each period. Thus, we study the merger in a dynamic context. The brand-name firm must purchase one firm in each period. As the generic firm is bought before entering the market, this merger is called "anticipative" merger[11]. This merger is equivalent

---

[11]This idea belongs to a broader concept called preemptive merger. This is studied in endogenous merger literature. These mergers are initiated to prevent an unfavorable future event such as certain rival mergers (see, e.g., Brito, 2003, Fridolfsson and Stennek, 2005). In our case, the unfavorable event is a generic entry.

to a premium paid by the brand-name firm to prevent competition. The merger allows the brand-name producer to realize a monopoly profit. On the other hand, this firm has to purchase each entrant. We deduce a net merger gain.

4.1.1   Monopolization

Therefore, we study the brand-name monopoly, achieved by merger. Let Π_b^M be the monopoly profit. This profit is the gross merger gain for one period.

$$\Pi_b^M = s_b p_b + \frac{1}{2} s_g p_g. \tag{34}$$

The monopoly can extract the whole consumer surplus by selling the most valued drug to each consumer since the brand-name firm need not sell pseudo-generic drugs. Therefore, the branded good is not in competition with a generic good. It fixes the branded good price level at the maximum price allowing to sell the drug to each consumer, that is at $p_b^{M*} = u$. Thus, $s_b^{M*} = 1$. The brand-name firm's profit, which is then a mono-product monopoly profit[12], is $\Pi_b^{M*} = u$.

4.1.2   Buying price

According to the benchmark, only one generic firm has an incentive to enter the monopolistic market at each period. Such an entrant must, to set up in the market, invest in a production unit represented by a setup cost F. As soon as the potential entrant invests, the brand-name firm tries to purchase it to stay in a monopolistic situation. The repurchase process is a simultaneous auction

---

[12]The monopoly is a mono-product one but this must be nuanced because there is no insurance market. Such a market would incite the monopoly to produce pseudo-generics because of the reimbursement differential if we assume a non-covered drug market. This scenario would be more in accordance with empirical reality.

16

mechanism. The brand-name firm bids for the generic producer and the generic

firm gives a reservation price. As the generic firm cannot hope to earn more

than the Bertrand-Stackelberg gross profit (without deducting the setup cost)

which it would realize by refusing to be sold, it gives a reservation price[13]

equal to this profit. By anticipating this, the brand-name firm bids at this

level, called generic firm's buying price. We consider the auction mechanism

as an instantaneous one. This mechanism takes place at the moment of the

generic entry. Thus, no other firm has an incentive to enter the market since

there is already an entry at this period. Therefore, the buying price is the

actualized infinite flow of gross profit the generic firm would realize by entering

the market. Let δ be the discount rate with $0 < \delta < 1$ and let $BP(u, \delta)$ be the

buying price:

$$BP(u, \delta) = \frac{\Pi_g^{PD*} + F}{(1 - \delta)} = \frac{\frac{u}{8}}{(1 - \delta)}. \tag{35}$$

4.1.3 Net merger gain

Let $G(F, u, \delta)$ be the net merger gain. It is equal to the gross merger gain

minus the buying price. As the game horizon is infinite, the gross merger gain

is an actualized infinite flow of monopoly profit. The buying price is paid in

each period because there is an entrant to purchase in each period.

$$
\begin{aligned}
G(F, u, \delta) &= \frac{\Pi_b^{M*}}{1 - \delta} - \frac{BP(u, \delta)}{1 - \delta} \\
&= -\frac{1}{8} \frac{u}{(\delta - 1)^2} (8\delta - 7).
\end{aligned} \tag{36}
$$

We find the net merger gain is positive for $\delta < \delta^*$ and negative for $\delta > \delta^*$

with $\delta^* = \frac{7}{8}$.

---

[13]This reservation price makes the generic firm indifferent between producing and being

sold.

17

Proof. see appendix F. ■

4.2   "Anticipative" merger strategy *vs* limit-pricing strategy

To solve the game, we compare two strategies: to merge with each entrant or to deter entry *ad vitam aeternam*. We compare the net merger gain with the actualized infinite flow of limit-pricing pseudo-duopoly profit. Let $MLI(F, u, \delta)$ be the difference between these payments. If $MLI(F, u, \delta)$ is positive, then the merger path is the Nash equilibrium of the game.

$$
\begin{aligned}
MLI(F, u, \delta) &= \frac{u}{1 - \delta} - \frac{\frac{1}{8}u}{(1 - \delta)^2} - \frac{2\sqrt{2}\sqrt{Fu} - 2F}{1 - \delta} \\
&= \frac{1}{8(\delta - 1)^2}\left[(-16F - 8u + 16\sqrt{2Fu})\delta + 16F + 7u - 16\sqrt{2Fu}\right].
\end{aligned}
\tag{37}
$$

Let $\delta^{**}(F, u)$ be the δ level for which $MLI(F, u, \delta) = 0$:

$$
\delta^{**}(F, u) = \frac{16F + 7u - 16\sqrt{2Fu}}{16F + 8u - 16\sqrt{2Fu}}.
\tag{38}
$$

Proposition 2 *The entry deterrence by the limit-pricing strategy is the Nash equilibrium of the game if $\delta > \delta^{**}(F, u)$. By contrast, the merger strategy is the Nash equilibrium of the game if $\delta < \delta^{**}(F, u)$. Moreover, $\delta^{**}(F, u)$ (see figure 2) is decreasing in F and $0.5 < \delta^{**}(F, u) < 0.643$ for the setup cost values allowing the benchmark existence.*

Proof. see appendix G. ■

Insert Figure 2

The interpretation of proposition 2 is as follows. There is a trade-off between the two strategies that depends on the discount rate level. If this is low $(\delta < \delta^{**}(F, u))$, it reduces the value of future payments in the merger path. The merger tends to be more profitable. If this is high $(\delta > \delta^{**}(F, u))$, it raises

18

the value of future payments in the merger path. The merger tends to be less profitable. Moreover, the higher the setup cost is, the lower the discount factor threshold $\delta^{**}(F, u)$ is. Therefore, the area of profitability of entry deterrence increases. This is due to the fact that the increase in setup cost makes the deterrence of a generic competitor easier. Note also that if $\delta > \delta^*$, the net merger gain is non-positive and the entry deterrence strategy is always preferred. For $\delta^{**}(F, u) < \delta < \delta^*$, the net merger gain is positive but not enough to offset the profitability of the entry deterrence strategy. For $\delta < \delta^{**}(F, u) < \delta^*$, the net merger gain is positive and exceeds the entry deterrence gain.

5　Concluding remarks

The entry of generic drugs in the pharmaceutical market encourages brand-name laboratories to use anti-competitive practices to stay in a monopolistic industry. More precisely, this article analyzes two anti-competitive practices: the "anticipated" merger strategy and the limit-pricing strategy. Each strategy may be implemented with or without pseudo-generics production. This topic is analyzed in a vertical differentiation model, in which laboratories compete *à la* Bertrant-Stackelberg. As to the profitability of the two strategies, we report the following findings: first, the entry deterrence is always preferable to entry accommodation. This result must be qualified by the credibility problem associated with the limit-pricing strategy. Secondly, "anticipated" merger is preferable to entry deterrence depending on the setup cost level and on the rate of discount level.

Three research perspectives appear in this simple model. First, we assume a myopic generic firm. Taking into account a Bayesian reasoning to elabo-

19

rate the limit-pricing strategy, as Milgrom and Roberts (1982), would refine

our results. Next, one of the results obtained is the mono-product monopoly

persistence. Nevertheless, an insurance market could incite the monopoly also

to produce pseudo-generics if we assume a non-covered drug market[14]. This

scenario would be closer to the empirical reality (e.g, Hollis, 2002, 2003).

Moreover, competition authorities could block the merger. However, taking

synergies into account could modify this decision, all the more so since the

monopoly may produce pseudo-generics. Finally, to explain the presence of

only one pseudo-generic product, we might consider the fact that the switching

cost from the brand to the generic drug decreases with generic proliferation.

This assumption could be endogenized in the model.

---

[14] To simplify the model, we ignore the insurance market. However, the higher incentive to produce generics induced by an insurance market does not affect qualitatively our trade-off between mergers and entry deterrence.

20

References

Bain, J. (1949) A note on pricing monopoly an oligopoly, *American Economic Review*, **39**, 448-64.

Brekke, K. R. and Kuhn, M. (2006) "Direct to consumer advertising in pharmaceutical markets", *Journal of Health Economics* **25**, 102-130.

Brito, D. (2003) Preemptive mergers under spatial competition, *International Journal of Industrial Organization,* **10**, 1601-22.

Caves, R., Whinston, M., and Hurwitz, M. (1991) Patent expiration, entry and competition in the U.S pharmaceutical industry, *Brookings Papers: Microeconomics*, 1-48.

Ferrandiz, J. M. (1999) The Impact of generic goods in the pharmaceutical industry, *Health Economics*, **8**(7), 599-612.

Frank, R. G. and Salkever, D. S. (1997) Generic entry and the pricing of pharmaceuticals, *Journal of Economics & Management Strategy,* **6**(1), 75-90.

Fridolfsson, S. and Stennek, J. (2005) Why mergers reduce profits, and raise share prices – A theory of preemptive mergers, *Journal of the European Economic Association,* **3**(5),1083-104.

Grandfils, N., Paris, V., and Sermet, C. (2004) Les laboratoires pharmaceutiques face à l'arrivée des génériques : quelles stratégies pour quels effets ?, *Bulletin d'Information en Economie de la Santé* **84**.

Granier, L. (2007) Endogenous mergers and cost heterogeneity, Forthcoming in *Applied Economics.*

Granier, L. and Trinquard, S. (2006) Pseudo-generics products and mergers in pharmaceutical markets, Working Paper, *Cahier LASER* 18.01.06, Université Montpellier I.

Hellerstein, J. K. (1998) The Importance of the physician in the generic versus trade-name prescription decision, *Rand Journal of Economics,* **29**(1), 108-136.

Hollis, A. (2002) The importance of being first : evidence from canadian generic pharmaceutical, *Health Economics*, **11**, 723-34.

Hollis, A. (2003) The anti-competitive effects of brand-controlled 'pseudo-generics' in the canadian pharmaceutical market, *Canadian Public Policy*, **29**(1), 21-32.

Hudson, J. (1992) Pricing dynamics in the pharmaceutical industry, *Applied Economics*, **24**, 103-12.

Hurwitz, M. and Caves, R. (1988) Persuasion or information? Promotion and the shares of brand name and generic pharmaceutical, *Journal of Law & Economics* **35**, 299-320.

Jones, J.C.H., Potashnik, T., and Zhang, A. (2001) Patents, brand-generic competition and the pricing of ethical drugs in Canada: some empirical evidence from British Columbia, 1981-1994, *Applied Economics*, **33**, 947-56.

Kamien, M. I. and Zang, I. (1990) The limits of monopolization through acquisition, *Quarterly Journal of Economics*, **105**(2), 465–99.

Kamien, M. I. and Zang, I. (1993) Monopolization by sequential acquisition, *Journal of Law, Economics and Organization*, **9**(2), 205–29.

Kong, Y. (2004) The price premium of generic to brand-names and pharmaceutical price index, *Applied Economics*, **36**, 731-37.

Kong, Y., and Seldon, J. R. (2004) Pseudo-genenric products and barriers to entry in pharmaceutical markets, *Review of Industrial Organization*, **25**, 71-86.

22

Milgrom, P. and Roberts, J. (1982) limit-pricing and entry under incomplete information: an equilibrium analysis, *Econometrica*, **50**(2), 443-59.

Morton, F. M. S. (1999) Entry decisions in the generic pharmaceutical industry, *Rand Journal of Economics*, **30**(3), 421-44.

Morton, F. M. S. (2000) Barriers to entry, brand advertising, and generic entry in the US pharmaceutical industry, *International Journal of Industrial Organization*, **18**, 1085-104.

Scherer, F. M. (1980) Industrial market structure and economic performance, *2d ed. Chicago: Rand McNally*.

Sengupta, J. K., Leonard, J. E. and Vanyo, J. P. (1983) "A limit-pricing model for US computer industry : an application" *Applied Economics*, **15**, 297-08.

Sylos-Labini, P. (1962) Oligopoly and Technical Progress, Harvard University Press, Cambridge, MA.

Appendix A

The generic firm's reaction function is given by the first order condition:

$$\frac{\partial \Pi_g^D}{\partial p_g} = \frac{\partial(\frac{p_b - p_g}{u} p_g - F)}{\partial p_g} = \frac{1}{u} \left(p_b - 2p_g\right) = 0. \qquad (A.1)$$

The generic firm's profit function is concave in p_g since the second order condition is checked:

$$\frac{\partial^2 \Pi_g^D}{\partial p_g^2} = \frac{\partial(\frac{1}{u}\left(p_b - 2p_g\right))}{\partial p_g} = -\frac{2}{u} < 0. \qquad (A.2)$$

Therefore, the generic firm's reaction function is:

$$RF(p_b) : p_g(p_b) = \frac{p_b}{2}. \qquad (A.3)$$

23

Thus, the brand-name firm's profit can be rewritten:

$$
\begin{aligned}
\Pi_b^D &= s_b p_b \\
&= (1 - \frac{p_b - \frac{p_b}{2}}{u}) p_b = -\frac{1}{2u} \left(p_b^2 - 2u p_b \right).
\end{aligned}
$$
(A.4)

The first order condition of the brand-name firm's profit function determines the branded good equilibrium price:

$$
\frac{\partial \Pi_b^D}{\partial p_b} = \frac{\partial (-\frac{1}{2u} \left(p_b^2 - 2u p_b \right))}{\partial p_b} = \frac{1}{u} \left(u - p_b \right) = 0.
$$
(A.5)

The second order condition holds since:

$$
\frac{\partial^2 \Pi_b^D}{\partial p_b^2} = \frac{\partial (\frac{1}{u} \left(u - p_b \right))}{\partial p_b} = -\frac{1}{u} < 0.
$$
(A.6)

We deduce the following equilibrium prices and market shares:

$$
\begin{aligned}
p_b^{D*} &= u, \\
p_g^{D*} &= \frac{u}{2}, \\
s_b^{D*} &= s_g^{D*} = \frac{1}{2}.
\end{aligned}
$$
(A.7)

Appendix B

Proceeding in the same way as in the appendix A, the brand-name firm's profit can be rewritten:

$$
\begin{aligned}
\Pi_b^{PD} &= s_b p_b + \frac{1}{2} s_g p_g \\
&= (1 - \frac{p_b - \frac{p_b}{2}}{u}) p_b + \frac{p_b - \frac{p_b}{2}}{2u} \frac{p_b}{2} = -\frac{1}{8u} p_b \left(3 p_b - 8u \right).
\end{aligned}
$$
(B.1)

The price maximizing the profit function is:

$$
p_b^{PD} = \frac{4u}{3}.
$$
(B.2)

24

Condition (2) implies that $p_b^{PD*} \leq u$, so, $\frac{4u}{3} > u$. As the profit function is increasing and concave for $p_b^{PD} < \frac{4u}{3}$, we deduce the brand-name good equilibrium price $p_b^{PD*} = u$. We establish the following equilibrium prices and market shares:

$$
\begin{aligned}
p_b^{PD*} &= u, \quad\quad\quad (\text{B.3})\\
p_g^{PD*} &= \frac{u}{2},\\
s_b^{PD*} &= s_g^{PD*} = \frac{1}{2}.
\end{aligned}
$$

Appendix C

Proceeding in the same way as in the appendix A, the brand-name firm's profit can be rewritten:

$$
\begin{aligned}
\Pi_b^T &= s_b p_b \quad\quad\quad (\text{C.1})\\
&= (1 - \frac{p_b - \frac{p_b}{2}}{u})p_b = -\frac{1}{2u}\left(p_b^2 - 2u p_b\right).
\end{aligned}
$$

We deduce the following equilibrium prices and market shares:

$$
\begin{aligned}
p_b^{T*} &= u, \quad\quad\quad (\text{C.2})\\
p_g^{T*} &= \frac{u}{2},\\
s_b^{T*} &= s_g^{T*} = \frac{1}{2}.
\end{aligned}
$$

Appendix D

Proceeding in the same way as in the appendix A, the brand-name firm's profit can be rewritten:

$$
\begin{aligned}
\Pi_b^{PT} &= s_b p_b + \frac{1}{3}s_g p_g \quad\quad\quad (\text{D.1})\\
&= (1 - \frac{p_b - \frac{p_b}{2}}{u})p_b + \frac{p_b - \frac{p_b}{2}}{3u}\frac{p_b}{2} = -\frac{1}{12u}p_b\left(5p_b - 12u\right).
\end{aligned}
$$

25

The price maximizing the profit function is:

$$p_b^{PT*} = \frac{6u}{5}. \tag{D.2}$$

Condition (2) implies that $p_b^{PT*} \le u$, so, $\frac{6u}{5} > u$. As the profit function is increasing and concave for $p_b^{PT} < \frac{4u}{3}$, we deduce the brand-name good equilibrium price $p_b^{PT*} = u$. We report the following equilibrium prices and market shares:

$$
\begin{aligned}
p_b^{PT*} &= u, \\
p_g^{PT*} &= \frac{u}{2}, \\
s_b^{PT*} &= s_g^{PT*} = \frac{1}{2}.
\end{aligned}
\tag{D.3}
$$

Appendix E

$$\Pi_b^{LPD*} - \Pi_b^{PD*} = 2\sqrt{2Fu} - 2F - 2\sqrt{Fu}. \tag{E.1}$$

This difference is a trinomial admitting two roots:

$F_3 = \frac{1}{4}\sqrt{2}(2\sqrt{2} - \sqrt{3})u - \frac{5}{16}u \simeq 0.751u$ and $F_4 = \frac{1}{4}\sqrt{2}(2\sqrt{2} + \sqrt{3})u - \frac{5}{16}u \simeq 1.300\,u$

The benchmark conditions are between these two roots. Therefore, we obtain:

$$\Pi_b^{LPD*} - \Pi_b^{PD*} > 0. \tag{E.2}$$

Appendix F

We study the sign of the net merger gain. We derive the net merger gain function in δ.

$$\frac{\partial G(F, u, \delta)}{\partial \delta} = \frac{1}{4}\frac{u}{(\delta - 1)^3}(4\delta - 3) \begin{cases} > 0 \text{ pour } \delta < \frac{3}{4}, \\[2mm] < 0 \text{ pour } \delta > \frac{3}{4}. \end{cases} \tag{F.1}$$

26

Therefore, the net merger gain is increasing for $\delta < \frac{3}{4}$ and decreasing for $\delta > \frac{3}{4}$. The net merger gain is equal to zero for $\delta^* = \frac{7}{8} > \frac{3}{4}$. As $\lim\limits_{\delta \to 0^+} G(F, u, \delta) = \frac{7u}{8} > 0$, then $G(F, u, \delta) > 0$ for $\delta < \delta^*$ and $G(F, u, \delta) < 0$ for $\delta > \delta^*$.

Appendix G

We search for $MLI(F, u, \delta)$ sign. This one is the same than the sign the function numerator. Thus, we derive this numerator in δ.

$$\frac{\partial(-16F - 8u + 16\sqrt{2Fu})\delta + 16F + 7u - 16\sqrt{2Fu})}{\partial\delta} = -16F - 8u + 16\sqrt{2Fu}. \tag{G.1}$$

This derivative is a trinomial admitting two roots:

$$F_5 = -\frac{u}{16}\left(4\sqrt{2} - 9\right) \simeq 0.209u, \tag{G.2}$$

$$F_6 = \frac{u}{16}\left(4\sqrt{2} + 9\right) \simeq 0.916u.$$

The benchmark conditions imply the negativity of $MLI(F, u, \delta)$ derivative (in δ). We compute the $MLI(F, u, \delta)$ root in δ:

$$\delta^{**}(F, u) = \frac{16F + 7u - 16\sqrt{2Fu}}{16F + 8u - 16\sqrt{2Fu}}. \tag{G.3}$$

Under the benchmark conditions, we study this root:

$$\frac{\partial(\delta^{**}(F, u))}{\partial F} = -\frac{1}{8}\frac{(-2\sqrt{Fu} + \sqrt{2}u)u}{2F + u - 2\sqrt{2Fu}} < 0 \text{ pour } F \in \left[\frac{u}{12}; \frac{u}{8}\right]. \tag{G.4}$$

$$\delta^{**}(F, u)\Big|_{F = \frac{u}{12}} = \frac{25u - 4\sqrt{24}u}{28u - 4\sqrt{24}u} \simeq 0.643 \in [0; 1].$$

$$\delta^{**}(F, u)\Big|_{F = \frac{u}{8}} = \frac{1}{2} \in [0; 1].$$

Under the benchmark conditions, $\delta^{**}(F, u)$ is decreasing in F from 0.643 (approximatively) to $\frac{1}{2}$. As $0 < \frac{1}{2} < 0.643 < 1$, whatever the setup cost level, there are discount factor values lower or higher than $\delta^{**}(F, u)$.
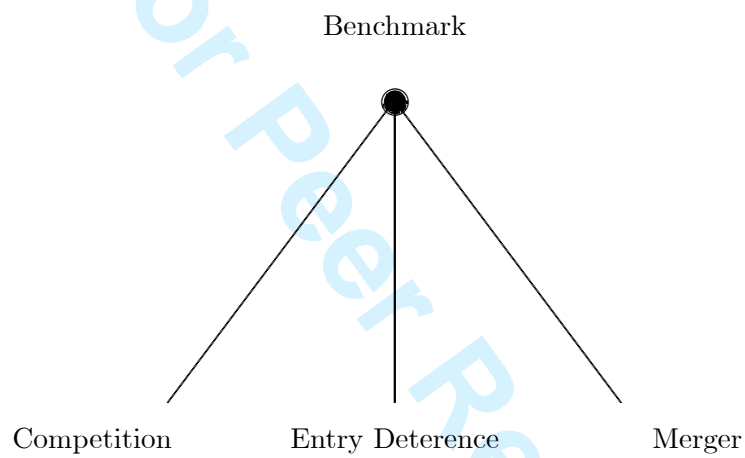
27

Benchmark

Competition   Entry Deterence   Merger
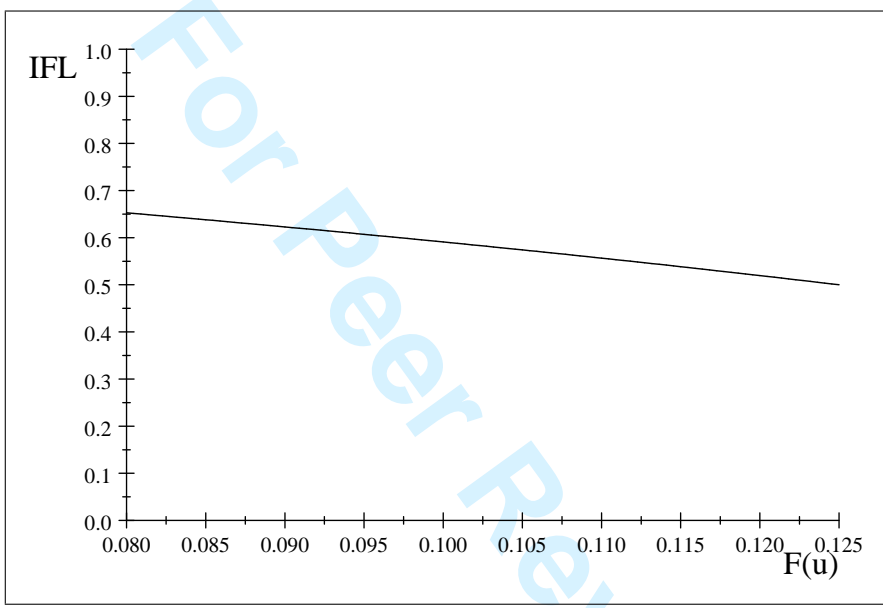
Figure 1. Game Tree

1

Figure 2. Indifference curve between entry deterrence and "anticipative" merger

Extended appendices

Appendix A

The generic firm's reaction function is given by the first order condition:

$$\frac{\partial \Pi_g^D}{\partial p_g} = \frac{\partial(\frac{p_b - p_g}{u} p_g - F)}{\partial p_g} = \frac{1}{u} (p_b - 2p_g) = 0. \tag{A.1}$$

The generic firm's profit function is concave in p_g since the second order condition is checked:

$$\frac{\partial^2 \Pi_g^D}{\partial p_g^2} = \frac{\partial(\frac{1}{u}(p_b - 2p_g))}{\partial p_g} = -\frac{2}{u} < 0. \tag{A.2}$$

Therefore, the generic firm's reaction function is:

$$RF(p_b) : p_g(p_b) = \frac{p_b}{2}. \tag{A.3}$$

Thus, the brand-name firm's profit can be rewritten:

$$\Pi_b^D = s_b p_b \tag{A.4}$$

$$= (1 - \frac{p_b - \frac{p_b}{2}}{u})p_b = -\frac{1}{2u} \left(p_b^2 - 2up_b \right).$$

The first order condition of the brand-name firm's profit function determines the branded good equilibrium price:

$$\frac{\partial \Pi_b^D}{\partial p_b} = \frac{\partial(-\frac{1}{2u} \left(p_b^2 - 2up_b \right))}{\partial p_b} = \frac{1}{u} (u - p_b) = 0. \tag{A.5}$$

The second order condition holds since:

$$\frac{\partial^2 \Pi_b^D}{\partial p_b^2} = \frac{\partial(\frac{1}{u}(u - p_b))}{\partial p_b} = -\frac{1}{u} < 0. \tag{A.6}$$

1

We deduce the following equilibrium prices and market shares:

$$p_b^{D*} = u, \tag{A.7}$$

$$p_g^{D*} = \frac{u}{2},$$

$$s_b^{D*} = s_g^{D*} = \frac{1}{2}.$$

Appendix B

The generic firm's reaction function is given by the first order condition:

$$\frac{\partial \Pi_g^{PD}}{\partial p_g} = \frac{\partial(\frac{p_b - p_g}{2u}p_g - F)}{\partial p_g} = \frac{1}{2u}\left(p_b - 2p_g\right) = 0. \tag{B.1}$$

The generic firm's profit function is concave in p_g since the second order condition is checked:

$$\frac{\partial^2 \Pi_g^{PD}}{\partial p_g^2} = \frac{\partial(\frac{1}{2u}\left(p_b - 2p_g\right))}{\partial p_g} = -\frac{1}{u} < 0. \tag{B.2}$$

Therefore, the generic firm's reaction function is:

$$RF(p_b) : p_g(p_b) = \frac{p_b}{2}. \tag{B.3}$$

Thus, the brand-name firm's profit can be rewritten:

$$\Pi_b^{PD} = s_b p_b + \frac{1}{2} s_g p_g \tag{B.4}$$

$$= (1 - \frac{p_b - \frac{p_b}{2}}{u})p_b + \frac{p_b - \frac{p_b}{2}}{2u}\frac{p_b}{2} = -\frac{1}{8u}p_b\left(3p_b - 8u\right).$$

The first order condition of the brand-name firm's profit function determines the branded good equilibrium price:

$$\frac{\partial \Pi_b^{PD}}{\partial p_b} = \frac{\partial(-\frac{1}{8u}p_b\left(3p_b - 8u\right))}{\partial p_b} = -\frac{1}{4u}\left(3p_b - 4u\right) = 0. \tag{B.5}$$

The second order condition holds since:

$$\frac{\partial^2 \Pi_b^{PD}}{\partial p_b^2} = \frac{\partial(-\frac{1}{4u}\left(3p_b - 4u\right))}{\partial p_b} = -\frac{3}{4u} < 0. \tag{B.6}$$

2

Therefore, the price maximizing the profit function is:

$$p_b^{PD} = \frac{4u}{3}. \tag{B.7}$$

Condition (2) implies that $p_b^{PD*} \leq u$, so $\frac{4u}{3} > u$. As the profit function is increasing and concave for $p_b^{PD} < \frac{4u}{3}$, we deduce the brand-name good equilibrium price $p_b^{PD*} = u$. We establish the following equilibrium prices and market shares:

$$
\begin{aligned}
p_b^{PD*} &= u, \\
p_g^{PD*} &= \frac{u}{2}, \\
s_b^{PD*} &= s_g^{PD*} = \frac{1}{2}.
\end{aligned}
\tag{B.8}
$$

Appendix C

The generic firms' reaction function is given by the first order condition:

$$\frac{\partial \Pi_{g1}^T}{\partial p_g} = \frac{\partial \Pi_{g2}^T}{\partial p_g} = \frac{\partial(\frac{p_b - p_g}{2u} p_g - F)}{\partial p_g} = \frac{1}{2u}(p_b - 2p_g). \tag{C.1}$$

The generic firms' profit function is concave in p_g since the second order condition is checked:

$$\frac{\partial^2 \Pi_{g1}^T}{\partial p_g^2} = \frac{\partial^2 \Pi_{g2}^T}{\partial p_g^2} = \frac{\partial(\frac{1}{u}(p_b - 2p_g))}{\partial p_g} = -\frac{2}{u} < 0. \tag{C.2}$$

Therefore, the generic firms' reaction function is:

$$RF(p_b) : p_g(p_b) = \frac{p_b}{2}. \tag{C.3}$$

Thus, the brand-name firm's profit can be rewritten:

$$
\begin{aligned}
\Pi_b^T &= s_b p_b \\
&= (1 - \frac{p_b - \frac{p_b}{2}}{u})p_b = -\frac{1}{2u}(p_b^2 - 2u p_b).
\end{aligned}
\tag{C.4}
$$

3

The first order condition of the brand-name firm's profit function determines the branded good equilibrium price:

$$\frac{\partial \Pi_b^T}{\partial p_b} = \frac{\partial(-\frac{1}{2u}\left(p_b^2 - 2up_b\right))}{\partial p_b} = \frac{1}{u}\left(u - p_b\right) = 0. \tag{C.5}$$

The second order condition holds since:

$$\frac{\partial^2 \Pi_b^T}{\partial p_b^2} = \frac{\partial(\frac{1}{u}\left(u - p_b\right))}{\partial p_b} = -\frac{1}{u} < 0. \tag{C.6}$$

We deduce the following equilibrium prices and market shares:

$$p_b^{T*} = u, \tag{C.7}$$

$$p_g^{T*} = \frac{u}{2},$$

$$s_b^{T*} = s_g^{T*} = \frac{1}{2}.$$

Appendix D

The generic firms' reaction function is given by the first order condition:

$$\frac{\partial \Pi_{g1}^{PT}}{\partial p_g} = \frac{\partial \Pi_{g2}^{PT}}{\partial p_g} = \frac{\partial(\frac{p_b - p_g}{3u}p_g - F)}{\partial p_g} = \frac{1}{3u}\left(p_b - 2p_g\right) = 0. \tag{D.1}$$

The generic firms' profit functions are concave in p_g since the second order condition is checked:

$$\frac{\partial^2 \Pi_{g1}^{PT}}{\partial p_g^2} = \frac{\partial^2 \Pi_{g2}^{PT}}{\partial p_g^2} = \frac{\partial(\frac{1}{3u}\left(p_b - 2p_g\right))}{\partial p_g} = -\frac{2}{3u} < 0. \tag{D.2}$$

Therefore, the generic firms' reaction function is:

$$RF(p_b) : p_g(p_b) = \frac{p_b}{2}. \tag{D.3}$$

Thus, the brand-name firm's profit can be rewritten:

$$\Pi_b^{PT} = s_b p_b + \frac{1}{3}s_g p_g \tag{D.4}$$

$$= (1 - \frac{p_b - \frac{p_b}{2}}{u})p_b + \frac{p_b - \frac{p_b}{2}}{3u}\frac{p_b}{2} = -\frac{1}{12u}p_b\left(5p_b - 12u\right).$$

4

The first order condition of the brand-name firm's profit function determines the branded good equilibrium price:

$$\frac{\partial \Pi_b^{PT}}{\partial p_b} = \frac{\partial(-\frac{1}{12u}p_b\,(5p_b - 12u))}{\partial p_b} = -\frac{1}{6u}\,(5p_b - 6u) = 0. \qquad (D.5)$$

The second order condition holds since:

$$\frac{\partial^2 \Pi_b^{PT}}{\partial p_b^2} = \frac{\partial(-\frac{1}{6u}\,(5p_b - 6u))}{\partial p_b} = -\frac{5}{6u} < 0. \qquad (D.6)$$

Therefore, the price maximizing the profit function is:

$$p_b^{PT*} = \frac{6u}{5}. \qquad (D.7)$$

Condition (2) implies that $p_b^{PT*} \leq u$, so $\frac{6u}{5} > u$. As the profit function is increasing and concave for $p_b^{PT} < \frac{4u}{3}$, we deduce the brand-name good equilibrium price $p_b^{PT*} = u$. We report the following equilibrium prices and market shares:

$$
\begin{aligned}
p_b^{PT*} &= u, \qquad &(D.8)\\
p_g^{PT*} &= \frac{u}{2},\\
s_b^{PT*} &= s_g^{PD*} = \frac{1}{2}.
\end{aligned}
$$

Appendix E

$$\Pi_b^{LPD*} - \Pi_b^{PD*} = 2\sqrt{2Fu} - 2F - 2\sqrt{Fu}. \qquad (E.1)$$

This difference is a trinomial admitting two roots:

$F_3 = \frac{1}{4}\sqrt{2}(2\sqrt{2} - \sqrt{3})u - \frac{5}{16}u \simeq 0.751u$ and $F_4 = \frac{1}{4}\sqrt{2}(2\sqrt{2} + \sqrt{3})u - \frac{5}{16}u \simeq$ 1.300 u

5

The benchmark conditions are between these two roots. Therefore, we obtain:

$$\Pi_b^{LPD*} - \Pi_b^{PD*} > 0. \tag{E.2}$$

Appendix F

We study the sign of the net merger gain. We derive the net merger gain function in δ.

$$\frac{\partial G(F, u, \delta)}{\partial \delta} = \frac{1}{4} \frac{u}{(\delta - 1)^3} (4\delta - 3) \begin{cases} > 0 \text{ pour } \delta < \frac{3}{4}, \\ \\ < 0 \text{ pour } \delta > \frac{3}{4}. \end{cases} \tag{F.1}$$

Therefore, the net merger gain is increasing for $\delta < \frac{3}{4}$ and decreasing for $\delta > \frac{3}{4}$. The net merger gain is equal to zero for $\delta^* = \frac{7}{8} > \frac{3}{4}$. As $\lim_{\delta \to 0^+} G(F, u, \delta) = \frac{7u}{8} > 0$, then $G(F, u, \delta) > 0$ for $\delta < \delta^*$ and $G(F, u, \delta) < 0$ for $\delta > \delta^*$.

Appendix G

We search for $MLI(F, u, \delta)$ sign. This one is the same than the sign the function numerator. Thus, we derive this numerator in δ.

$$\frac{\partial(-16F - 8u + 16\sqrt{2Fu})\delta + 16F + 7u - 16\sqrt{2Fu})}{\partial \delta} = -16F - 8u + 16\sqrt{2Fu}. \tag{G.1}$$

This derivative is a trinomial admitting two roots:

$$F_5 = -\frac{u}{16}\left(4\sqrt{2} - 9\right) \simeq 0.209u, \tag{G.2}$$

$$F_6 = \frac{u}{16}\left(4\sqrt{2} + 9\right) \simeq 0.916u.$$

The benchmark conditions imply the negativity of $MLI(F, u, \delta)$ derivative (in δ). We compute the $MLI(F, u, \delta)$ root in δ:

$$\delta^{**}(F, u) = \frac{16F + 7u - 16\sqrt{2Fu}}{16F + 8u - 16\sqrt{2Fu}}. \tag{G.3}$$

6

Under the benchmark conditions, we study this root:

$$\frac{\partial(\delta^{**}(F,u))}{\partial\delta} \quad = \quad -\frac{1}{8}\frac{(-2\sqrt{Fu}+\sqrt{2}u)u}{2F+u-2\sqrt{2Fu}} < 0 \text{ pour } F \in \left[\frac{u}{12};\frac{u}{8}\right]. \text{(G.4)}$$

$$\delta^{**}(F,u)\Big|_{F=\frac{u}{12}} \quad = \quad \frac{25u-4\sqrt{24u}}{28u-4\sqrt{24u}} = 0.643 \in [0;1].$$

$$\delta^{**}(F,u)\Big|_{F=\frac{u}{8}} \quad = \quad \frac{1}{2} \in [0;1].$$

Under the benchmark conditions, $\delta^{**}(F,u)$ is decreasing in F from 0.643 (approximatively) to $\frac{1}{2}$. As $0 < \frac{1}{2} < 0.643 < 1$, whatever the setup cost level, there are discount factor values lower or higher than $\delta^{**}(F,u)$.

7