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Preemptive acquisition and downgrading innovation.

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Abstract

Research papers on innovation activity share the view that whenever an invention is made available by a startup innovator, getting its ownership by acquisition is beneficial for incumbent firms. In this note, I show by means of an example that there are some circumstances in which accomodating entry and competing with the innovator in the product market can be substantially more profitable than blocking her entry via acquisition.

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1. Introduction

Research papers on innovation activity share the view that whenever an invention is made available by a startup innovator, getting its ownership by acquisition is beneficial for incumbent firms (Granstrand and Sjölander 1990, Anton and Yao 1994, Bloningen and Taylor 2000, Gans and Stern 2000 and 2002, Grimpe and Hussinger 2008). Even if the above contributions probably describe the most natural circumstances surrounding ownership acquisitions, one may wonder whether sometimes incumbent firms could not use alternative methods to avoid profit erosion resulting from higher quality entry. In this note, I show that there are some circumstances in which accommodating entry and competing with the innovator in the product market can be substantially more profitable than blocking her entry *via* acquisition. Let me put my argument in the simplest possible perspective. Consider a market in which a firm gains a rent from current sales of its top quality variant. Assume then that an innovator can put on sale a *upgrading product innovation,* namely a variant with higher quality than the existing one(s). The commercialization of this novel variant affects the incumbent's profits along two dimensions. First, the incumbent is now selling a variant which is no longer at the top of the quality ladder. Second, it is penalized by the cannibalization effect taking place among two adjacent variants, as some consumers will now be switching from its own variant to the innovator's product[1]. Accordingly, two arguments could justify the acquisition of the rival's product. Indeed, getting the ownership of the innovation blocks rival's entry while preserving the top position in the quality ladder. Furthermore, when acquiring the novel product, the incumbent can also withdraw from the market its own lower quality variant thereby neutralizing the cannibalization effect and the harsher competition such an entry would necessarily entail[2]. Yet, an alternative way can sometimes be available to the incumbent to partially escape from profit erosion resulting from a higher quality entry. It consists for the incumbent to move its own variant apart from the innovator's one by taking the ownership of a *downgrading product innovation,* namely an innovation whose quality is lower than the one(s) on sale. In this alternative scenario, the incumbent firm would admittedly suffer a drop in profits as it would now obtain profits related to a quality which is

[1]More generally, given the finitiness property holding in vertically differentiated markets, in the case of upward innovation on sale in the market, the highest-quality firm can be either no longer active or scaled down along the quality ladder, depending on the upperbound to the number of firms profitably existing at equilibrium.

[2]An interesting analysis of the incentive to innovate by an incumbent firm is provided by Cozzi (2007) in a general framework of endogenous growth.

lower than before. But, at the same time, it would mitigate the effects of entry by increasing the gap in qualities, thereby relaxing competition with the rival. Further, as one would expect the acquisition price to be positively related to the quality of the purchased product innovation, the price for acquiring a downgrading product innovation would be lower than the one paid for the upgrading product innovation. Accordingly, this difference in price could possibly compensate the loss in profits that the incumbent would suffer when privileging to scale down the quality on sale. I show in this paper by means of an example that an incumbent firm can indeed prefer in some circumstances to accommodate innovator's entry through acquiring a downgrading product innovation rather than to block its entry via preemptive acquisition.

To this aim, I describe a very stylized market which is inspired from the traditional model of vertical differentiation. Then, I study in a sequential game whether preemptive acquisition of an upgrading innovation always belongs to the optimal path of the game.

2. The basic framework

Assume that there are two firms, say H and L, providing two different variants of the same good, respectively u_H and u_L. This latter is unanimously ranked of being of a lower quality than that of firm H. Thus, it is defined as a downgrading variant (with respect to u_H). For simplicity, the average cost with respect to quality is assumed to be equal to zero. Consumers are identified by the parameter $\theta \in [a, b]$, $0 \leq a < b$, and uniformly distributed with density equal to 1. Utility $u_i(\theta, p_i)$ of consumer θ for variant $i, i = H, F$, is given by

$$u_i(\theta, p_i) = \theta u_i - p_i, \ i = H, L,$$

where $u_H > u_L$ and p_i is equal to the price of variant i. Furthermore, I assume that

$$\frac{a}{b} \in \left[\frac{1}{4}, \frac{1}{2}\right]. \tag{1}$$

This assumption guarantees that exactly two firms can make strictly positive profits at an interior equilibrium (see Shaked and Sutton, 1981). I proceed now to define the demand functions as if the market would be covered at equilibrium prices. I shall show afterwards that, under the above assumption, the market is indeed covered at equilibrium. Denote by $\bar{\theta}$ the consumer who is indifferent between buying variants H and L at prices p_H and p_L, respectively. Solving in θ the equation $\theta u_H - p_H = \theta u_L - p_L$,one obtains $\bar{\theta} = \frac{p_H - p_L}{u_H - u_L}$. Then, profit functions $\Pi_H(p_H, p_L)$ and

$\Pi_L(p_H, p_L)$ write as

$$\Pi_H(p_H, p_L) = \left(b - \frac{p_H - p_L}{u_H - u_L}\right) p_H \tag{2}$$

$$\Pi_L(p_H, p_L) = \left(\frac{p_H - p_L}{u_H - u_L} - a\right) p_L. \tag{3}$$

Maximization of (2) and (3) with respect to p_H and p_L, respectively, gives the equilibrium prices $\overset{\circ}{p}_H$ and $\overset{\circ}{p}_L$, namely,

$$\overset{\circ}{p}_H = \frac{(2b - a)(u_H - u_L)}{3}.$$
$$\overset{\circ}{p}_L = \frac{(b - 2a)(u_H - u_L)}{3}.$$

Now, one can easily check that, at these equilibrium prices (1), profits are strictly positive and the market is indeed covered. Substituting these prices in (2) and (3), respectively, one obtains profits $\overset{\circ}{\Pi}_H$ and $\overset{\circ}{\Pi}_L$ at equilibrium

$$\overset{\circ}{\Pi}_H\left(\overset{\circ}{p}_H, \overset{\circ}{p}_L\right) = \frac{(u_H - u_L)(2b - a)^2}{9(b - a)}$$
$$\overset{\circ}{\Pi}_L\left(\overset{\circ}{p}_H, \overset{\circ}{p}_L\right) = \frac{(u_H - u_L)(b - 2a)^2}{9(b - a)}.$$

3. The innovation game

I assume now that a potential entrant, firm F, contemplates to enter the market with an *upgrading product innovation*, namely a novel variant u_F which is at the top of the quality ladder. Thus $u_F > u_H > u_L$. In order to analyze how competition can take place among firms, I study a non cooperative sequential innovation game which develops as follows. At the first stage, the incumbent firm H can realize a preemptive acquisition of the potential entrant at some acquisition price P_H. In the case of preemptive acquisition, the high quality incumbent avoids to openly compete against the potential rival and takes the ownership of the upgrading innovation. If preemptive acquisition does not take place, then at the second stage, the entrant enters the market if there is room for it. Finally, in the case of *de novo* entry, in order to compete against the innovator, the incumbents H can either acquire the low quality rival L at some acquisition price P_L as to offer the downgrading variant u_L or keep on sale its own variant u_H. As usual, the game is solved by backward induction.

3.1 Downgrading innovation under low quality firm's acquisition

Under the assumption that an acquisition agreement has not been reached by firms H and F, and thus that the upgrading innovation has been marketed by the innovator, th high quality incumbent can compete by either *(i)* keeping its own variant u_H for sale or *(ii)* acquiring at some acquisition price the incumbent L and selling the downgrading variant u_L . Of course, firms' profits arising at the equilibrium in the market when *de novo* entry takes place depends on which of the above strategies is adopted by the high quality incumbent.

First of all, let me write profits Π_F^{entry}, Π_H^{entry}, and Π_L^{entry} accruing to the three firms F, H and L under innovator's entry when the two incumbents H and L do not reach an acquisition agreement and thus the high quality incumbent keeps its own variant for sale:

$$\Pi_F^{entry} = \frac{4b^2 (u_F - u_H)(u_F - u_L)^2}{(b-a)(4u_F - u_H - 3u_L)^2};$$
$$\Pi_H^{entry} = \frac{b^2 (u_F - u_H)(u_H - u_L)(u_F - u_L)}{(b-a)(4u_F - u_H - 3u_L)^2};$$
$$\Pi_L^{entry} = 0$$

On the contrary, whenever the high quality incumbent H reaches an acquisition agreement with L, thereby putting on sale the downward variant u_L, firms F and H at equilibrium get respectively

$$\Pi_F^{\circ\circ}\left(p_F^{\circ\circ}, p_L^{\circ\circ}\right) = \frac{(u_F - u_L)(2b-a)^2}{9(b-a)}$$
$$\Pi_H^{\circ\circ}\left(p_F^{\circ\circ}, p_L^{\circ\circ}\right) = \frac{(u_F - u_L)(b-2a)^2}{9(b-a)}).$$

It is easy to prove that

Proposition 1 *In the case when theupgrading innovation is commercialized by the innovator, the high quality incumbent prefers to acquire the low quality rival and scale down the quality of the good it offers for sale only if the market is small and/or its own product is not so different from one of the existing variants.*

Proof: See Appendix

The economic rationale is very intuitive. Indeed, in the two above described circumstances, keeping the existing variant u_H in the market would make the price competition very fierce thereby reinforcing the incentive to isolate itself from the other firm's product u_F *via* the downgrading innovation u_L.

3.2 De novo entry

Given the natural duopoly structure of the market, whenever acquisition of the innovator is not observed at the first stage, this latter can always enter the market via de novo entry. Indeed, whatever the strategy which is adopted by the high quality incumbent to compete against the innovator under *de novo* entry, this always gains positive profits at equilibrium when marketing on its behalf the innovation u_F. Nevertheless, in the case of *de novo* entry, the low quality incumbent is no longer active whenever it does not reach an acquisition agreement with firm H (indeed $\Pi_L^{entry} = 0$)[3].

3.3 Upgrading innovation under entrant's acquisition

I move now to consider in which circumstances the high quality incumbent prefers to block entry thereby taking the ownership of the upward innovation at the first stage of the game. Of course, conditions under which the acquisition agreement, if any, is defined at this stage depend on whether the high quality incumbent finds it profitable to move from its own variant to the downgrading product innovation u_L in the case of *de novo* entry. Let us assume first that in the case of *de novo* entry, the incumbent H competes against the innovator while keeping for sale its own variant u_H (scenario A). Then, let us move to the alternative assumption, namely that in the case of innovator's entry, firm H acquires firm L thereby selling u_L (scenario B). Under these two assumptions,we analyze the first stage of the game.

Scenario A On the one hand, in order to be accepted, the acquisition proposal from the high quality incumbent to the potential entrant should yield this latter profits R_H at least equal to those obtained when marketing the innovation via *de novo* entry, namely Π_F^{entry}. On the other hand, it is convenient for the incumbent H to make the acquisition proposal if, and only if, the duopoly profits $\Pi_H^+\left(p_F^\circ, p_L^\circ\right) = \frac{(u_F - u_L)(2b-a)^2}{9(b-a)}$ obtained when acquiring the innovator are larger than the profits it would get under innovator's entry, namely Π_H^{entry}. From easy computations, it can be proved that:

Proposition 2 *The incentive for the incumbent firm H to block innovator's entry and thereby taking the ownership of the upward innovation u_F is stronger than the incentive to accommodate it while keeping the existing variant u_H on sale.*

[3]This result is discussed in detail in Gabszewicz and Tarola (2011) where the issue of *innovation by acquisition* considered in a different perspective of analysis. Also, we refer the interested reader to Bonisseau and Lahmandi Ayed (2006) for the study of competition among more than two variants in a natural duopoly.

Proof: See Appendix

Scenario B Now, I assume that in the case of *de novo* entry the high quality incumbent acquires the rival L thereby moving to the downgrading product innovation u_L. Thus, the acquisition agreement is evaluated as follows. In order to be accepted by the potential entrant, the acquisition proposal should yield the innovator profits at least equal to those obtained under *de novo* entry, namely $\frac{(u_F-u_L)(2b-a)^2}{9(b-a)}$. On the other hand, it is convenient for the incumbent H to take the ownership of this upgrading product innovation at some acquisition price if, and only if, the resulting duopoly profits $\Pi_F^{\circ\circ}\left(p_F^{\circ\circ}, p_L^{\circ\circ}\right)$ are larger than the profits it would get when competing against the innovator, namely $\Pi_H^{\circ\circ}\left(p_F^{\circ\circ}, p_L^{\circ\circ}\right)$. Notice however, that in this case the acquisition price to be paid coincides with the profits $\Pi_F^{\circ\circ}\left(p_F^{\circ\circ}, p_L^{\circ\circ}\right)$ it would get under this acquisition. Accordingly, the high quality incumbent would earn zero profits from the acquisition of the innovator, whereas it obtains strictly positive profits from acquiring L and marketing the downgrading product. Thus,

Proposition 3 *The incentive for the incumbent firm H to accommodate entry at the second stage of the game while marketing the downgrading product u_L is stronger than the incentive to block innovator's entry thereby taking the ownership of the upward innovation u_F .*

The two above propositions 2 and 3 show that two different equilibria may be observed in the market. Whenever the market is small and/or the high quality incumbent's variant u_H is rather close to one of the existing variants, then the incumbent chooses to accommodate entry thereby taking the ownership of the downgrading innovation u_L. In the alternative case, the incumbent prefers to block innovator's entry and take the ownership of the upgrading innovation u_F while withdrawing its own good u_H from the market. So, one can conclude that:

Proposition 4 *Preemptive acquisition of the upgrading innovation is not always the subgame perfect Nash equilibrium of the game.*

4 Conclusion

In this paper, I have proved that when an upward innovation is made available by a potential entrant, it is always offered for sale in the market. However and contrary to what intuitively can be guessed, it is not always profitable for an incumbent to take its ownership as to gain profits deriving from its sale. It is important to remark the aspects of the model that are crucial to my argument. First, the market is assumed to be covered. Second, only two variants can simultaneously compete

in the market. Both of these assumptions are used to define a natural duopoly as reference market and thus keep the analysis as simplest as possible. Of course, if the survival of a larger number of firms at equilibrium would be considered, then the acquisition price for the upward innovation would be no longer equal to zero as the low quality incumbent could be still active under innovator's entry. Notice however that these restrictions do not alter the rationale developed here as the argument underlying my conclusions could be extended with some changes to a more general setting.

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Appendix

Proof of Proposition 1: Notice that in order to be accepted, the acquisition proposal by the high quality incumbent H should yield to the low quality incumbent at the least the profits P_a it would get in the alternative scenario, namely in case of innovator's entry without

acquisition agreement. As in this latter case, the low quality incumbent would be no longer active in the market ($\Pi_L^{entry} = 0$), then $P_a = 0$. As far as the high quality incumbent firm, it finds it profitable this acquisition if the profits in the case it acquires the low quality incumbent and offers u_L, namely $\Pi_H^{\circ\circ}\left(p_F^{\circ\circ}, p_L^{\circ\circ}\right)$ are higher than the profits it would get without an acquiring L, namely Π_H^{entry}. Let me denote by x the value b/a, f the value $u_F - u_H$, and $g = u_F - u_L$. As far as the high quality incumbent H, the sign of the difference between profits under *de novo* entry with acquisition and profits under *de novo* entry without acquisition $\frac{(u_F-u_L)(b-2a)^2}{9(b-a)} - \frac{b^2(u_F-u_H)(u_H-u_L)(u_F-u_L)}{(b-a)(4u_F-u_H-3u_L)^2}$ has the same sign as the second degree polynomial $P(f,x)$ defined by

$$P(f,x) = \frac{(x-2)^2}{9} - \frac{x^2 f(g-f)}{(3g+f)^2},$$

under the assumption that $x \in [2,4]$. Notice that (i) $P(f,x)$ is strictly negative for all f whenever $x = 2$; (ii) $P(f,x)$ has two roots $f^- = \frac{3}{2}\frac{\left(8gx-8g+gx^2-\sqrt{3}\sqrt{64g^2x^3-64g^2x^2-13g^2x^4}\right)}{(10x^2-4x+4)}$ and $f^+ = \frac{3\left(8gx-8g+gx^2+\sqrt{3}\sqrt{64g^2x^3-64g^2x^2-13g^2x^4}\right)}{2(10x^2-4x+4)}$). Thus, (i) whenever $x = 2$ the high quality incumbent prefers to sell its own variant thereby avoiding to acquire the rival L whatever the value of f; (ii) when $x \in (2,4]$, the high quality incumbent chooses to buy firm L whenever $f \in [0, f^-)$ or $f \in (f^+, g]$ and to not buy whenever $f \in (f^-, f^+)$.**Q.E.D**.

Proof of Proposition 2. The incentive to acquisition dominates the incentive to open competition iff the profits that the two firms would get under acquisition are higher than the corresponding profits under *de novo* entry, or

$$\underbrace{\Pi_H^+ - R_H(=\Pi_F^{entry})}_{\text{Acquisition}} \geqslant \underbrace{\Pi_H^{entry}}_{\textit{de novo}\text{ entry}}.$$

Notice that the sign of the difference between profits under acquisition and profits under *de novo* entry $\frac{(u_F-u_L)(2b-a)^2}{9(b-a)} - \frac{4b^2(u_F-u_H)(u_F-u_L)^2}{(b-a)(4u_F-u_H-3u_L)^2} - \frac{b^2(u_F-u_H)(u_H-u_L)(u_F-u_L)}{(b-a)(4u_F-u_H-3u_L)^2}$ has the same sign as the second degree polynomial $P(f,x)$ defined by

$$P(f,x) = \frac{(2x-1)^2}{9} - \frac{4x^2 fg}{(3g+f)^2} - \frac{x^2 f(g-f)}{(3g+f)^2},$$

under the assumption that $x \in [2,4]$. Notice that, $\frac{\partial P(f,x)}{\partial x} > 0$ for any $x \in [2,4]$. As $P(f,2) > 0$, I conclude that, the above difference is positive

in the admissible range of x and thus acquiring the innovator is better at the first stage than openly competing against her at the second one. **Q.E.D**