TAKEOVER WAVES

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WP-AD 99-30

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A B S T R A C T

Horizontal takeovers often occur in waves. A sequence of takeovers is obtained in a Cournot setting with cost asymmetries. They are motivated by two different reasons: (i) A low realization of demand increases the profitability of takeovers. (ii) Takeovers raise the profitability of future takeovers. A possible explanantion of merger races is also obtained by showing that firms buying in the first place pay a lower price for their targets.

Keywords: Takeovers; Antitrust; Demand.

1 Introduction.

It has been observed that mergers usually happen in waves (Mueller (1989)). Two different explanations have been used to explain this phenomenon: the non-strategic and the strategic explanation (Caves (1991)). The former defends that takeovers occur when some common exogenous factor makes them profitable. The latter emphasizes the strategic interrelationship among firms and argues that the bunching (or wave-like behavior) stems from the fact that firms find profitable to merge only if competitors also merge.

I illustrate in a simple setting that both explanations are correct and therefore they should be considered together in order to attempt to explain takeover waves. In particular, it holds that low demand increases the profitability of takeovers, which confirms the non-strategic explanation. On the other hand, I find that previous mergers stimulate future mergers in the industry, which confirms the strategic explanation. The merger wave in the oil industry in 1998 and 1999 is a nice illustration of this situation. The process was preceded by a long period of low oil prices aggravated by the fall in demand due to the Asian crisis.

The results are obtained in a setting where firms compete à la Cournot, marginal cost is constant but it may differ among firms. Cost asymmetries stimulate merger profitability. Nevertheless, the differences in cost mean nothing in absolute terms, but they should be related to price. Then it is when the size of the market comes to the picture. Low demand implies low prices, which accentuates the asymmetries between firms. Therefore, low demand will enhance merger profitability.

This result differs from two previous results in the literature. If firms are symmetric and marginal cost is constant, merger profitability does not depend on market size (Salant et al. (1983)). On the other hand, van Wegberg (1994) shows that if firms face capacity constraints, mergers become more profitable when market size increases, because non-participating firms expands their output less after merger. My result agrees with the empirical finding that horizontal mergers occur in declining industries as a device to rationalize capacity (Dutz

(1989) and Odagiri and Hase (1989)).

The intuition behind the strategic explanation is the following. The reason why takeovers are unprofitable in Salant et al. (1983) is that non-participating firms react to it by raising their output. This negative effect will be less acute the lower the number of firms free-ride from the output reduction induced by the merger. Therefore, a takeover by reducing this number can induce new takeovers.

As far as the strategic explanation is concerned, my work is closely related to Nilssen and Sorgard (1998). They provide a full characterization of the possible interrelations between merger decisions. In the first place, mergers may either encourage or discourage future mergers. In the second place, mergers of competitors may either increase or decrease the profits of the other firms. Combining all possibilities they define four different scenarios. They find that all are possible using an example where firms compete à la Cournot and mergers affect the cost structure of the merging entity. My model is a new example of the scenario in which mergers trigger new merger decisions and increase the profits of competitors. This scenario is specially interesting, because it is the only one where the "bandwagon effect" is obtained. Furthermore, the fact that the acquisition stage is explicitly modeled in my case allows me to obtain new results. In particular, I obtain that firms buying in the first place pay a lower price for their targets.

In the second section, the model is set out. Section III analyses some extensions of the basic model and Section IV concludes.

2 The Model.

We have two "efficient" firms (A and B) with constant marginal cost normalized to zero and two "inefficient" firms (1 and 2) with unit cost c. All of them operate in a market with linear demand $P = \alpha - X$, where P is the price, X the sales of the good and $\alpha > 3c$. Before Cournot competition occurs, efficient firms are allowed to sequentially bid for inefficient firms, so that market structure can be altered. After the takeover the merged entity produces at zero cost. The previous situation is modeled as a five stage game involving the following sequence of decisions.

First stage: Firm A offers b_i to buy firm i ($i = 1, 2$).

Second stage: Inefficient firms decide simultaneously whether to accept the bids or not. If firm i ($i = 1, 2$) accepts, it sells the firm to firm A at price b_i.

Third stage: Firm B makes bids to buy the remaining independent inefficient firms.

Fourth stage: Remaining independent inefficient firms decide simultaneously whether to accept the bids or not.

Fifth stage: Remaining independent firms compete à la Cournot.

We will use as a solution concept the subgame-perfect Nash equilibrium, so that we proceed by backward induction. In Stage 5, we have simply a Cournot game. Profits in equilibrium do depend on the number of inefficient firms having been previously bought but not on whom carried out the takeover. The profits in equilibrium of efficient and active inefficient firms are denoted respectively by $\pi(T_A+T_B, \alpha)$ and $\Pi(T_A+T_B, \alpha)$, where T_j stands for the number of takeovers carried out by Firm j. Given that firm profits in the n-firm problem with individual marginal costs c_i are given by (Letho and Tombak (1998))

$$\left(\frac{(\alpha - nc_i + \sum_{j\neq i} c_j}{n+1}\right)^2 \tag{1}$$

the specific form of those functions is the following:

$$\pi(0,\alpha) = \left(\frac{\alpha+2c}{5}\right)^2 \qquad \Pi(0,\alpha) = \left(\frac{\alpha-3c}{5}\right)^2$$

$$\pi(1,\alpha) = \left(\frac{\alpha+c}{4}\right)^2 \qquad \Pi(1,\alpha) = \left(\frac{\alpha-3c}{4}\right)^2$$

$$\pi(2,\alpha) = \left(\frac{\alpha}{3}\right)^2$$

In Stage 4, given the offers received by the firms, we can determine the acceptance decisions in equilibrium. Inefficient firms will accept any offer assuring them, at least, their opportunity cost[1], that is the profits they would obtain if they stayed in the market.

[1]To avoid the open set problem, inefficient firms are assumed to accept offers when they are indifferent between accepting and not accepting.

If one inefficient firm has been previously bought ($T_A = 1$), the opportunity cost of selling the firm is unambiguously given by $\Pi(1, \alpha)$. Therefore, the remaining inefficient firm only accepts if he receives a bid not lower than $\Pi(1, \alpha)$. If $T_A = 1$, the opportunity cost of an inefficient firm depends on the acceptance decision of the other inefficient firm as it is clear from the following payoff matrix.

		Firm 2	
		Accept	Reject
Firm	A	$b_1 \quad b_2$	$b_1 \quad \Pi(1, \alpha)$
1	R	$\Pi(1, \alpha) \quad b_2$	$\Pi(0, \alpha) \quad \Pi(0, \alpha)$

If the other firm accepts the opportunity cost of accepting is given by $\Pi(1, \alpha)$. If the other firm does not accept the opportunity cost is given by $\Pi(0, \alpha)$. Therefore, in equilibrium, we have that both firms accept if each receives an offer not lower than $\Pi(1, \alpha)$, none accepts if each of them is offered less than $\Pi(0, \alpha)$ and only one accepts otherwise.

In Stage 3, firm B decides how many inefficient firms to buy (T_B)[2]. Given T_B, bids are set such that targets only receive their opportunity cost.

If $T_A = 1$, one takeover gives as much profits as none if the following condition holds:

$$\pi(2, \alpha) - \pi(1, \alpha) - \Pi(1, \alpha) \geq 0 \tag{2}$$

In Appendix A, it is checked that it holds when $3c < \alpha \leq 15c$.

If $T_A = 0$, two takeovers give as much profits as one if:

$$\pi(2, \alpha) - 2\Pi(1, \alpha) - \pi(1, \alpha) + \Pi(0, \alpha) \geq 0 \tag{3}$$

two takeovers give as much profits as none if:

$$\pi(2, \alpha) - 2\Pi(1, \alpha) + \pi(0, \alpha) \geq 0 \tag{4}$$

one takeover gives as much profits as none if:

$$\pi(1, \alpha) - \Pi(0, \alpha) - \pi(0, \alpha) \geq 0 \tag{5}$$

[2]In case of indifference, we will assume that the option with more takeovers is chosen.

In Appendix A it is shown that when (3) holds $T_B = 2$ is the optimal strategy because (3) implies (4). (3) holds when $3c < \alpha \leq \frac{993c}{131}$.

When (5) does not hold $T_B = 0$ is the optimal strategy, because then (4) does not hold either. (5) does not hold when $\alpha > \frac{61c}{7}$.

In the other cases $(\frac{993c}{\alpha} < \alpha \leq \frac{61c}{\alpha})$, $T_B = 1$ is the optimal strategy.

To summarize the equilibrium strategies of firm B, we define 4 different zones depending on the value of α.

Zone 1: $3c < \alpha \leq \frac{993c}{131}$. Firm B buys all remaining independent firms.

Zone 2: $\frac{993c}{131} < \alpha \leq \frac{61c}{7}$. Firm B buys one firm.

Zone 3: $\frac{61c}{7} < \alpha \leq 15c$. Firm B buys one firm only if firm A has previously bought one.

Zone 4: $15c < \alpha$. Firm B buys no firm.

Intuition about the effect of market demand can be obtained by rewriting profits such that their expression is multiplied[3] by α^2. Then, we have:

$$\pi(i,\alpha) = \alpha^2 \left(\frac{1 + \frac{(2-i)c}{\alpha}}{3+i} \right)^2 \quad i = 0,1,2 \tag{6}$$

$$\Pi(i,\alpha) = \alpha^2 \left(\frac{1 - \frac{3c}{\alpha}}{3+i} \right)^2 \quad i = 0,1 \tag{7}$$

In a Cournot setting with symmetric costs takeovers are very rarely profitable. Increases in c increase takeover profitability, because the cost savings obtained from transferring output from the high-cost firm to the low-cost merger partner become greater. From (6), it is clear that reductions in α have the same effect as increases in c. Then it follows that α negatively affects the profitability of takeovers.

The acceptance decisions in equilibrium in Stage 2 are like the ones in stage 4 when no firm had been previously bought, except when costs belong to Zone 1 and 2.

[3]The multiplicative factor does not affect takeover decisions.

In Zone 1, the opportunity cost of selling the firm is $\Pi(1,\alpha)$, independently of the decision taken by the other firm. Therefore, a firm accepts the offer whenever he receives an offer not lower than $\Pi(1,\alpha)$.

In Zone 2, the opportunity cost of one firm accepting when the other does not, depends on whether by deviating he will be bought in Stage 4 or remain independent. In the former case, the opportunity cost is $\Pi(0,\alpha)$ and in the latter $\Pi(1,\alpha)$. In other words, inefficient firms are no more symmetric, because they obtain different payoffs when they refuse both offers. One firm will sell the firm to firm B at $\Pi(0,\alpha)$ and the other will remain independent obtaining profits of $\Pi(1,\alpha)$.

We call Firm k ($i,k = 1,2$ and $i \neq k$) the one that it is going to be bought in Stage 4 by Firm B after Firm A has made offers (b_1, b_2) and they have been rejected by inefficient firms. The payoff matrix is given by:

		Firm k	
		Accept	Reject
Firm	A	$b_i \quad b_k$	$b_i \quad \Pi(1,\alpha)$
i	R	$\Pi(1,\alpha) \quad b_k$	$\Pi(1,\alpha) \quad \Pi(0,\alpha)$

Then, Stage 2 acceptance decisions in equilibrium can be written as:

No firm accepts, if $b_i < \Pi(1,\alpha)$ and $b_k < \Pi(0,\alpha)$.

Only Firm k accepts, if $b_i < \Pi(1,\alpha)$ and $\Pi(0,\alpha) \leq b_k$.

Only Firm i accepts, if $\Pi(1,\alpha) \leq b_i$ and $b_k < \Pi(1,\alpha)$.

Both firms accept, otherwise.

The optimal acquisition policy of firm A in Stage 1 depends on which Zone the intercept of demand belongs to.

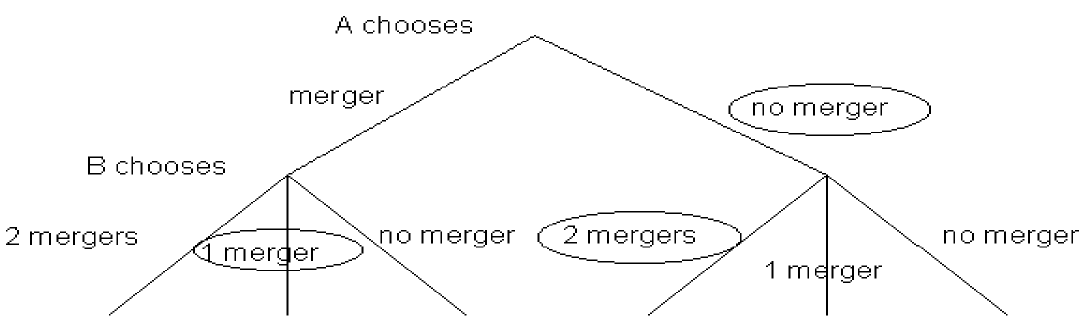
In Zone 1, the obvious decision is letting firm B buy the "inefficient" firms.

In Zone 4, the objective of firm A is like the one of firm B in Stage 3 when $T_A = 0$, so that he does not carry any merger.

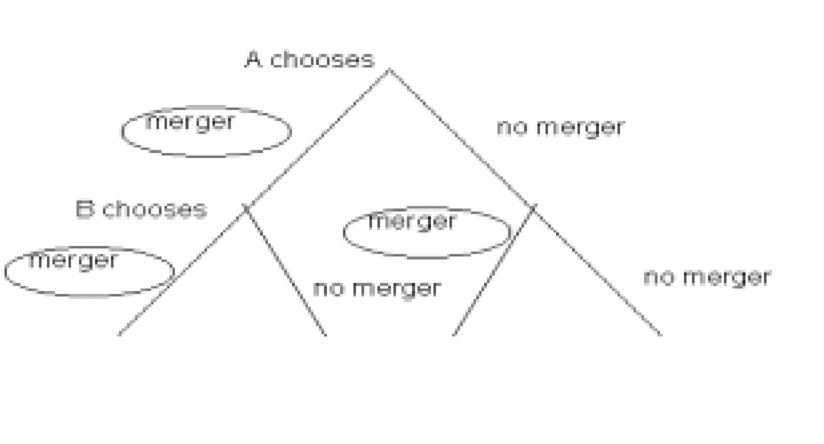
In Zone 2, the cost of buying one firm for firm A is $\Pi(0,\alpha)$. By offering to each firm this amount, one firm will accept it in Stage 2. Then, firm A should compare the profits of carrying one takeover ($\pi(2,\alpha) - \Pi(0,\alpha)$) at this cost with the ones obtained if only firm B buys one firm ($\pi(1,\alpha)$). For the resolution of Stage 3, in Zone 2 we know that $\pi(2,\alpha) - \Pi(1,\alpha) > \pi(1,\alpha)$. Therefore $\pi(2,\alpha) - \Pi(0,\alpha) > \pi(1,\alpha)$ and firm A decides to carry a takeover out.

In Zone 3, firm A has to compare the profits of taking a rival over that is going to induce a new merger in the third stage ($\pi(2,\alpha) - \Pi(0,\alpha)$) with the ones obtained with no alteration in the market structure($\pi(0,\alpha)$). It can be checked that the former decision yields more profits because in Zone 3 it holds that $\pi(2,\alpha) - \Pi(1,\alpha) \geq \pi(1,\alpha)$.

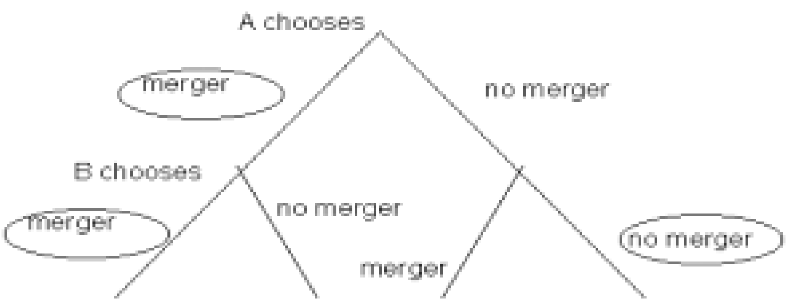
In Figure 1, we summarize the results of the previous five stage game. For the sake of simplicity we have represented our five stage game as a two stage game. The acceptance and market stages have not been drawn, to focus our attention on takeover decisions of firm A and firm B. Equilibrium strategies in each subgame have been encircled. We have four different cases depending on which zone the intercept of demand α belongs to. The first and last cases are extreme. Either both takeovers occur in the last stage or no merger occurs. The former result shows how more profitable takeovers become as the intercept of demand decreases. The latter result should be understood as an extension of the well-known unprofitability of takeovers in a symmetric Cournot setting.



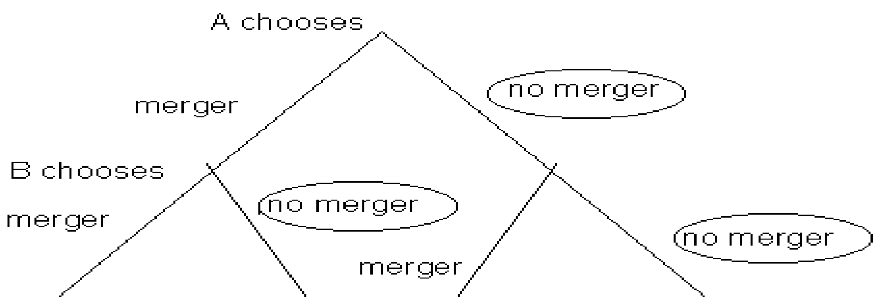
Zone 1



Zone 2: The effect of demand.



Zone 3: The Bandwagon effect.



Zone 4.

Figure 1: Summary of the game.

The other two cases are more interesting. Although the sequence of takeovers occurring in the equilibrium path is the same, there is a distinguishing feature between both cases: the optimal strategy of firm B in the subgame where no merger has previously occurred. The difference is important, because in one case (α belonging to Zone 3) the merger of firm A causes the merger of firm B while in the other case (α belonging to Zone 2) the decision of firm B is independent of the decision taken by firm A.

The main intuition from these results can be drawn from the fact that equation (5) imply (2) i.e. if it is profitable to go from four to three firms, then it is profitable to go from three to two firms and the fact that α decreases the profitability of takeovers. Then the situation in the different Zones can be explained.

Zone 4: (2) is not satisfied, hence (5) is also not satisfied. Therefore, no takeover occurs.

Zone 3: (2) is satisfied, but (5) is not satisfied. Hence, if firm A does not merge then neither will firm B. If firm A merges then so will firm B. Firm A finds profitable to trigger the takeover wave.

Zone 2: (5) is satisfied, hence (2) is also satisfied. As (4) does not hold, Firm B does not want to carry two takeovers, so that one takeover is carried by each firm.

Zone 1: Same as Zone 2, except that (4) holds. Therefore, all takeovers are carried out by Firm B.

In Zone 2 and 3, although each "efficient" firms buys one "inefficient" firm, Firm A obtains more profits than firm B, because he pays less for his target: while Firm B pays $\Pi(1, \alpha)$, firm A only pays $\Pi(0, \alpha)$. The reason for this is that, by buying first, firm A can exploit at his advantage the competition between "inefficient" firms.

3 Extensions

3.1 Changes in the form of demand.

The two basic results behind the takeover waves in my model are the fact that decreases in demand and previous takeovers stimulate takeover profitability. In this Section, I check the sensitivity of these two results to a relaxation of the linear demand assumption. I use the following demand,

$$\begin{aligned} P(X) &= \alpha - \frac{X^{b+1}}{b+1} \\ b &\geq 0 \end{aligned}$$

where b is a measure of the curvature of demand.

If firms have constant marginal costs the equilibrium variables have the following particularities. Total output only depends on average cost. Firms profits can be written as:

$$\Pi = \frac{(P(X) - c_i)^2}{-P'(X)} \tag{8}$$

The output in equilibrium when i inefficient firms have been bought takes the following form:

$$X(i, \alpha) = (\alpha)^{(\frac{b}{1+b})} \left(\frac{\left(4 - i - (2-i)(\frac{c}{\alpha})\right)(b+1)}{5 - i + b} \right)^{(\frac{1}{1+b})} \tag{9}$$

Using (8) and (9) the profits of efficient and inefficient firms are respectively given by:

$$\pi(i, \frac{c}{\alpha}) = (\alpha)^{(\frac{2+b}{1+b})} \left(\frac{b + 1 + \frac{(2-i)c}{\alpha}}{5 + b - i} \right)^2 \left(\frac{5 + b - i}{\left(4 - i - \frac{(2-i)c}{\alpha}\right)(b+1)} \right)^{(\frac{b}{1+b})}$$

$$\Pi(i, \frac{c}{\alpha}) = (\alpha)^{(\frac{2+b}{1+b})} \left(\frac{b + 1 - \frac{(b+3)c}{\alpha}}{5 + b - i} \right)^2 \left(\frac{5 + b - i}{\left(4 - i - \frac{(2-i)c}{\alpha}\right)(b+1)} \right)^{(\frac{b}{1+b})}$$

For inefficient firms to produce in equilibrium we must have $\frac{c}{\alpha} < \frac{b+1}{b+3}$. As the multiplicative factor does not affect takeover decisions, we have that they are determined by $\frac{c}{\alpha}$. Therefore, increases in c has the same effect as decreases in α.

Firm B wants to buy an inefficient firm if $T_A = 0$ if:

$$\pi(1, \frac{c}{\alpha}) - \pi(0, \frac{c}{\alpha}) - \Pi(0, \frac{c}{\alpha}) \geq 0 \tag{10}$$

Firm B wants to buy an inefficient firm if $T_A = 1$ if:

$$\pi(2, \frac{c}{\alpha}) - \pi(1, \frac{c}{\alpha}) - \Pi(1, \frac{c}{\alpha}) \geq 0 \tag{11}$$

The following Proposition shows that (10) and (11) only hold if α is low enough.

Proposition 1 *Buying one firm is only profitable if α is low.*

Proof. Define

$$f(\frac{c}{\alpha}) = \pi(1, \frac{c}{\alpha}) - \pi(0, \frac{c}{\alpha}) - \Pi(0, \frac{c}{\alpha})$$

$f(\frac{c}{\alpha})$ is concave, $f(0) < 0$, $f(\frac{b+1}{b+3}) = 0$ and $f'(\frac{b+1}{b+3}) < 0$ (See Appendix B). Therefore there exist $a > 0$ such that $f(a) = 0$ and $f(\frac{c}{\alpha}) \geq 0$ iff $a \leq \frac{c}{\alpha} \leq \frac{b+1}{b+3}$. Then $f(\frac{c}{\alpha}) \geq 0$ iff $\frac{c(b+3)}{b+1} \leq \alpha \leq \frac{c}{a}$. The same argument holds for:

$$g(\frac{c}{\alpha}) = \pi(2, \frac{c}{\alpha}) - \pi(1, \frac{c}{\alpha}) - \Pi(1, \frac{c}{\alpha})$$

■

The proof of Proposition 1 shows that there exist positive $a(b)$ and $d(b)$ such that (10) holds if $a(b) \leq \frac{c}{\alpha}$ and (11) holds if $d(b) \leq \frac{c}{\alpha}$. To prove that previous takeovers increase takeover profitability I have to check that $d(b) < a(b)$. I am not able to prove this result analytically. In Figure 2, we plot $a(b)$ and $d(b)$ for specific values of b. The desired inequality holds for these values.

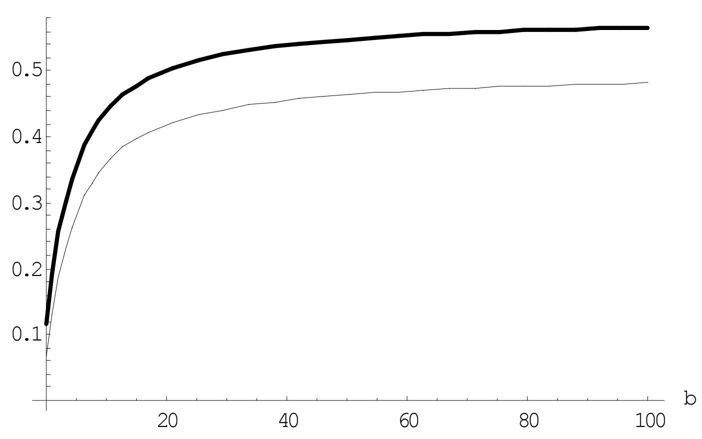


Figure 2. Values of $a(b)$ (bold line) and $d(b)$ (thin line).

3.2 Changes in the extensive form.

3.2.1 Firm B can bid to monopoly.

In this Section we change the model in Section II so that Firm B can also bid for Firm A. The question then is whether the takeover wave falls short of monopoly. The takeover combinations of Firm B increase. However, we will see that in most cases this is not relevant, because the new combinations give less profits[4] that the ones that were already possible in Section II. I recalculate the optimal takeover decisions of Firm B. All calculations are in Appendix C.

If $T_A = 0$, Firm B has 3 new possibilities: buying Firm A, buying Firm A and an inefficient firm and monopolization. The first option is dominated by buying no firm[5]. The second one by buying two inefficient firms. Monopolization is better than buying two firms only if $3c < \alpha \leq (1+2\sqrt{1.1})c$. Only in this region the takeover decisions of Firm B change. In the other cases, he takes the same takeover decisions.

If $T_A = 1$, Firm A has 2 new possibilities: buying Firm A and monopolization. The first option is dominated by buying no firm. The second one is better than

[4]Firm B is allowed to buy its three competitors, but this is very expensive, because it has to pay to each of them their duopoly profits (Kamien and Zang (1990)).

[5]Letho and Tombak (1998) show that the profitability of a merger of two symmetric firms only depends on the number of firms in the industry. Then we can use the result in Salant et al (1983) to show that they are only profitable in a duopoly.

buying only the inefficient firm if $3c < \alpha \leq \frac{c(5+2\sqrt{19})}{3}$. Only in this region the takeover decisions of Firm B change. In the other cases, he takes the same takeover decisions.

If $T_A = 2$, Firm B buys Firm A.

Now we analyse the takeover decisions of Firm A. The only difference with the previous situation is that the industry is monopolized in $3c < \alpha \leq (1+2\sqrt{1.1})c$ if he buys no firm and in $3c < \alpha \leq \frac{c(5+2\sqrt{19})}{3}$ if he buys an inefficient firm. In the first case, the optimal strategy is letting Firm B monopolize the industry. In the second case, he has to compare the profits of triggering the takeover wave leading to monopolization with the ones obtained by simply waiting for Firm B to buy the inefficient firms. When monopolization takes place Firm A will be bought at $\pi(0,\alpha)$ and he will buy the inefficient firm at cost $\Pi(0,\alpha)$. When Firm B buys the inefficient firms he obtains $\pi(0,\alpha)$ and pays no cost, so this is a better strategy. For the other values of α he takes the same decisions as in Section II.

We have the same market structure and sequence of takeovers as in Section II except when $3c < \alpha \leq (1+2\sqrt{1.1})c$ that the industry is monopolized by Firm B.

3.2.2 Firm B can bid sequentially for inefficient firms.

In this Section we change the model in Section II so that Firm B can bid sequentially for inefficient firms. Two new stages are considered. After Stage 4, Firm B can still bid for inefficient firms (Stage 5) and then inefficient firms decide whether they accept the bids (Stage 6). Market competition follows (Stage 7).

The fact that, in the original model, inefficient firms were bid in two different rounds reduced the cost of buying them from $2\Pi(1,\alpha)$ to $\Pi(1,\alpha)+\Pi(0,\alpha)$ in Zone 2 and Zone 3. If firm B is allowed to bid for inefficient firms in two consecutive stages, he can obtain the previous reduction in the cost of buying inefficient firms so that he will be more likely to do it. The question then is whether it will still be possible to generate takeover waves or Firm B will be the only firm to engage in takeover activity.

We study the takeover decisions of Firm B. If $T_A = 1$, nothing changes. If $T_A = 0$, in Zone 1, the optimal decision will still be buying two firms. In Zone 4, buying no firm will still be more profitable than buying one. In Zone 2 and 3, buying two firms gives more profits than buying one, because

$$\pi(2,\alpha) - \Pi(1,\alpha) - \Pi(0,\alpha) \geq \pi(1,\alpha) - \Pi(0,\alpha) \tag{12}$$

holds. (12) is equation (2) that is satisfied in either Zone 2 or 3. Then the relevant comparison is between the profits of buying two firms and the profits of buying none. The former is greater in Zone 2 and 3 if $\frac{993c}{131} < \alpha \leq \frac{1299c}{113}$ (see Appendix D).

Firm A may only be interested in taking a firm over when it triggers a takeover wave ($\frac{1299c}{113} < \alpha \leq 15c$). As those α belong to Zone 3, for the calculations in Section II, we know that it is profitable to do it.

This extension shows that takeovers waves occur in the original model not only because bids are done sequentially, but also because they allow bidding firms to coordinate their takeover decisions so that they can share the costs of reducing competition.

3.3 The bandwagon effect with Bertrand competition.

We consider the same model as in Section II but with Bertrand competition. Firms produce four differentiated goods. The demand[6] of good i ($i = 1, 2, 3, 4$) is given by:

$$X_i \;=\; A - p_i + b\sum_{j\neq i} p_j$$

[6]The demand system can be obtained from the optimization problem of a representative consumer with utility linear in income: $U(q)+m$, where q is a vector representing the quantities consumed of the differentiated goods and m income. With n goods, Vives (1985) shows that if $U(q)$ is quadratic and symmetric, demands are linear and they satisfy:

$$\frac{\frac{\partial X_i}{\partial p_j}}{\frac{\partial X_i}{\partial p_i}} < \frac{1}{n-1}$$

This explains the upper bound we impose on b.

$$b \;<\; \frac{1}{3} \quad j = 1, 2, 3, 4$$

Firm 1 (2) produces good 1 (2). Firm A (B) produces good 3 (4). All firms have the same marginal cost normalized to zero. In order to use the same description of the game as in Section II, firm 1 and 2 are still called inefficient firms. Through takeover, a firm increases the range of products it offers, for example, if firm A buys firm 1, it will produce good 1 and 3 after the takeover.

On the other hand, the takeover process is considered to be costly. The (fixed) cost of carrying out one takeover is denoted by K. This hypothesis is introduced to avoid all mergers being profitable. (Deneckere and Davidson (1985) show that all two firm mergers are profitable in our setting if $K = 0$). If all mergers were profitable, we could not have the bandwagon effect. To simplify matters we assume that buying two firms is prohibitively costly.

To show that the bandwagon effect holds in this setting we need to compute (see Appendix D) the profits in three different market configurations:

With 4 independent firms, each firm obtains:

$$\Pi_4 = \frac{A^2}{(2-3b)^2}$$

With 3 independent firms, the merged entity obtains:

$$\Pi_3 = \frac{A^2(1-b)(2+b)^2}{2(2-3b-b^2)^2}$$

and the other two firms:

$$\pi_3 = \frac{A^2}{(2-3b-b^2)^2}$$

With two (equal-sized) firms, each firm obtains:

$$\Pi_2 = \frac{A^2(1-b)}{2(1-2b)^2}$$

The gains of firm A of buying a firm in Stage 2 if the bandwagon effect holds are given by:

$$\Pi_2 - 2\Pi_4 - K \tag{13}$$

The gains of Firm B of buying a firm in Stage 4 (if firm A has not previously bought one) are given by:

$$\Pi_3 - 2\Pi_4 - K \tag{14}$$

The gains of Firm B of buying a firm in Stage 4 (if firm A has previously bought one) are given by:

$$\Pi_2 - 2\pi_3 - K \tag{15}$$

For the bandwagon effect to hold (Zone 3 in the graphical summary of the game) we need that (13) and (15) are positive and (14) is negative. It is easy to see that if (15) is positive (13) is also positive (competition decreases profits). It is possible to find K such that (15) is positive and (14) is negative, because (15) is greater than (14) (see Appendix D).

With Bertrand competition, mergers increase profits (gross of fixed costs), because they allow joint profit maximization of participating firms (insiders) and nonparticipating firms (outsiders) react to the merger by increasing their prices. The bandwagon effect holds in our setting, because this positive reaction of outsiders is greater if they are merged.

To illustrate this point we calculate (see Appendix D) given the (symmetric) prices of insiders (p_i) the (symmetric) profit-maximizing prices of outsiders depending on whether they are merged or not.

If they are merged:

$$P(p_i) = \frac{A + 2bp_i}{2(1-b)}$$

If they are not merged:

$$p(p_i) = \frac{A + 2bp_i}{2-b}$$

As $P'(p_i) > p'(p_i)$, outsiders react more to the increase in the price of outsiders when they are merged. This explains that profits of insiders increase more when outsiders are merged.

4 Concluding remarks.

I obtain a sequence of takeovers in a Cournot setting with cost asymmetries. They are motivated by two different reasons:

(i) A low realization of demand increases the profitability of takeovers.

(ii) A takeover triggers new takeovers in the industry by raising their profitability. This phenomenon is usually called the "bandwagon effect".

Those results can be used in further research to generate takeover waves in the same setting. We have also pointed out to an explanation of merger races by showing that firms buying in the first place pay a lower price for their targets.

A Appendix A

(2) holds if:

$$\left(\frac{\alpha}{3}\right)^2 - \left(\frac{\alpha+c}{4}\right)^2 - \left(\frac{\alpha-3c}{4}\right)^2 \geq 0$$

$$\frac{-\alpha^2 + 18\alpha c - 45c^2}{72} \geq 0$$

This function is strictly concave in α with zeros $\alpha = 3c$ and $\alpha = 15c$. Therefore, (2) holds if $3c < \alpha \leq 15c$. Recall that by assumption $3c < \alpha$.

(3) holds if:

$$\left(\frac{\alpha}{3}\right)^2 - 2\left(\frac{\alpha-3c}{4}\right)^2 - \left(\frac{\alpha+c}{4}\right)^2 + \left(\frac{\alpha-3c}{5}\right)^2 \geq 0$$

$$\frac{-131\alpha^2 + 1386\alpha c - 2979c^2}{3600} \geq 0$$

This function is strictly concave in α with zeros $\alpha = 3c$ and $\alpha = \frac{993c}{131}$. Therefore (3) holds if $3c < \alpha \leq \frac{993c}{131}$.

(4) holds if:

$$\left(\frac{\alpha}{3}\right)^2 - 2\left(\frac{\alpha-3c}{4}\right)^2 - \left(\frac{\alpha+2c}{5}\right)^2 \geq 0$$

$$\frac{-97\alpha^2 + 1062\alpha c - 2313c^2}{1800} \geq 0$$

This function is strictly concave in α with zeros $\alpha = 3c$ and $\alpha = \frac{771c}{97}$. Therefore (4) holds if $3c < \alpha \leq \frac{771c}{97}$.

(5) holds if:

$$\left(\frac{\alpha+c}{4}\right)^2 - \left(\frac{\alpha-3c}{5}\right)^2 - \left(\frac{\alpha+2c}{5}\right)^2 \geq 0$$

$$\frac{-7\alpha^2 + 82\alpha c - 183c^2}{400} \geq 0$$

This function is strictly concave in α with zeros $\alpha = 3c$ and $\alpha = \frac{61c}{7}$. Therefore, (5) holds if $3c < \alpha \leq \frac{61c}{7}$.

As we have that $\frac{993c}{131} < \frac{771c}{97}$, (3) implies (4).

As $\frac{771c}{97} < \frac{61c}{7}$, when (5) does not hold, (4) does not hold either.

B Appendix B

Salant et al. (1983) show that $f(0) < 0$ and $g(0) < 0$ for $b = 0$. Then using Fauli-Oller (1997) we have that it holds for any concave demand.

$f(\frac{b+1}{b+3}) = g(\frac{b+1}{b+3}) = 0$, because then inefficient firms do not produce in any market structure.

$$sign[g'(\frac{b+1}{b+3})] = sign[-(1+b)]$$

$$\begin{aligned} sign[g"(\frac{c}{\alpha})] &= sign[-180 - 446b - 362b^2 - 106b^3 - 10b^4 + (120 + 188b + \\ &\quad 78b^2 + 10b^3)(\frac{c}{\alpha}) - (20 + 22b + 8b^2 + b^3)(\frac{c}{\alpha})^2] \end{aligned}$$

It is negative, because $\frac{c}{\alpha} < 1$.

$$sign[f'(\frac{b+1}{b+3})] = sign[-(3+b)]$$

$$\begin{aligned} f"(\frac{c}{\alpha}) &= \frac{18 + 49b + 46b^2 + 17b^3 + 2b^4 - (12 + 14b + 2b^2)(\frac{c}{\alpha}) + (2+b)(\frac{c}{\alpha})^2}{3^{(\frac{b}{1+b})}(1+b)^{(\frac{2+3b}{1+b})}(4+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{3\alpha})^{(\frac{b}{1+b})}(3-\frac{c}{\alpha})^2} + \\ &\quad \frac{-104 - 250b - 192b^2 - 50b^3 - 4b^4 + (104 + 150b + 52b^2 + 6b^3)(\frac{c}{\alpha})}{4^{(\frac{b}{1+b})}(1+b)^{(\frac{2+3b}{1+b})}(5+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{2\alpha})^{(\frac{b}{1+b})}(2-\frac{c}{\alpha})^2} + \\ &\quad \frac{(-26 - 25b - 8b^2 - b^3)(\frac{c}{\alpha})^2}{4^{(\frac{b}{1+b})}(1+b)^{(\frac{2+3b}{1+b})}(5+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{2\alpha})^{(\frac{b}{1+b})}(2-\frac{c}{\alpha})^2} < \\ &\quad \frac{-86 - 201b - 146b^2 - 33b^3 - 2b^4 + (92 + 136b + 50b^2 + 6b^3)(\frac{c}{\alpha})}{4^{(\frac{b}{1+b})}(1+b)^{(\frac{2+3b}{1+b})}(5+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{2\alpha})^{(\frac{b}{1+b})}(2-\frac{c}{\alpha})^2} - \\ &\quad \frac{(24 + 24b + 8b^2 + b^3)(\frac{c}{\alpha})^2}{4^{(\frac{b}{1+b})}(1+b)^{(\frac{2+3b}{1+b})}(5+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{2\alpha})^{(\frac{b}{1+b})}(2-\frac{c}{\alpha})^2} < \\ &\quad \frac{-86 - 201b - 146b^2 - 33b^3 - 2b^4 + (92 + 136b + 50b^2 + 6b^3)(\frac{c}{\alpha})}{4^{(\frac{b}{1+b})}(1+b)^{(\frac{2+3b}{1+b})}(5+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{2\alpha})^{(\frac{b}{1+b})}(2-\frac{c}{\alpha})^2} \leq \\ &\quad \frac{-86 - 201b - 146b^2 - 33b^3 - 2b^4 + (92 + 136b + 50b^2 + 6b^3)(\frac{b+1}{b+3})}{4^{(\frac{b}{1+b})}(1+b)^{(\frac{2+3b}{1+b})}(5+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{2\alpha})^{(\frac{b}{1+b})}(2-\frac{c}{\alpha})^2} = \end{aligned}$$

$$\frac{-\frac{(1+b)^2}{(3+b)}(16b + 129b + 29b^2 + 2b^3)}{4^{(\frac{b}{1+b})}(1+b)^{(\frac{2+3b}{1+b})}(5+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{2\alpha})^{(\frac{b}{1+b})}(2-\frac{c}{\alpha})^2} < 0$$

The first inequality comes from the fact that

$$\frac{3^{(\frac{b}{1+b})}(4+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{3\alpha})^{(\frac{b}{1+b})}(3-\frac{c}{\alpha})^2}{4^{(\frac{b}{1+b})}(5+b)^{(\frac{2+b}{1+b})}(1-\frac{c}{2\alpha})^{(\frac{b}{1+b})}(2-\frac{c}{\alpha})^2} > (\frac{3}{4})(\frac{4}{5})^2(\frac{3}{2})^2 = \frac{27}{25} > 1$$

The second from the fact that I have eliminated all the terms with $(\frac{c}{\alpha})^2$ that are negative. The third holds, because $\frac{c}{\alpha} < \frac{b+1}{b+3}$.

C Appendix C

Three new market structures become possible, because Firm A can be bought. Monopoly where Firm B obtains $\pi^M = \left(\frac{\alpha}{3}\right)^2$. Duopoly with Firm B and an inefficient firm where Firm B obtains $\left(\frac{\alpha+c}{3}\right)^2$ and the inefficient firm $\left(\frac{\alpha-2c}{3}\right)^2$. Triopoly with Firm B and two inefficient firms where Firm B obtains $\left(\frac{\alpha+2c}{4}\right)^2$ and inefficient firms $\left(\frac{\alpha-2c}{4}\right)^2$. Profits are obtained using (1).

If $T_A = 0$, buying only Firm A gives less profits than buying no firm because

$$\left(\frac{\alpha+2c}{4}\right)^2 - 2\left(\frac{\alpha+2c}{5}\right)^2 < 0$$

Buying Firm A and one inefficient firm gives less profits than buying two inefficient firms because

$$\left(\frac{\alpha+c}{3}\right)^2 - \left(\frac{\alpha+c}{4}\right)^2 - \left(\frac{\alpha-2c}{4}\right)^2 - \left(\frac{\alpha}{3}\right)^2 + 2\left(\frac{\alpha-3c}{4}\right)^2 =$$

$$\frac{c(-58\alpha+133c)}{144} < 0$$

Monopolizing the industry gives more profits than buying two inefficient firms if:

$$\left(\frac{\alpha}{2}\right)^2 - 2\left(\frac{\alpha-2c}{3}\right)^2 - \left(\frac{\alpha}{3}\right)^2 - \left(\frac{\alpha}{3}\right)^2 + 2\left(\frac{\alpha-3c}{4}\right)^2 =$$

$$\frac{-5\alpha^2+10\alpha c+17c^2}{72} \geq 0 \tag{16}$$

This function is strictly concave in α with zeros $\alpha = c(1 \pm 2\sqrt{1.1})$. Therefore, (16) holds if $3c < \alpha \leq (1 + 2\sqrt{1.1})$. Observe that $c(1 - 2\sqrt{1.1}) < 3c$.

If $T_A = 1$, buying only Firm A gives less profits than buying no firm because

$$\left(\frac{\alpha + c}{3}\right)^2 - 2\left(\frac{\alpha + c}{4}\right)^2 < 0$$

Monopolizing the industry gives more profits than buying one inefficient firm if:

$$\left(\frac{\alpha}{2}\right)^2 - \left(\frac{\alpha - 2c}{3}\right)^2 - \left(\frac{\alpha}{3}\right)^2 - \left(\frac{\alpha}{3}\right)^2 + \left(\frac{\alpha - 3c}{4}\right)^2 =$$

$$\frac{-3\alpha^2 + 10\alpha c + 17c^2}{144} \geq 0 \tag{17}$$

This function is strictly concave in α with zeros $\alpha = \frac{c(5 \pm 2\sqrt{19})}{3}$. Therefore, (17) holds if $3c < \alpha \leq \frac{c(5 + 2\sqrt{19})}{3}$. Observe that $\frac{c(5 - 2\sqrt{19})}{3} < 3c$.

D Appendix D

(12) holds if:

$$\left(\frac{\alpha}{3}\right)^2 - \left(\frac{\alpha - 3c}{4}\right)^2 - \left(\frac{\alpha - 3c}{5}\right)^2 - \left(\frac{\alpha + 2c}{5}\right)^2 =$$

$$\frac{-133\alpha^2 + 1638\alpha c - 3897c^2}{3600} \geq 0 \tag{18}$$

This function is strictly concave in α with zeros $\alpha = 3c$ and $\alpha = \frac{1299c}{113}$. Therefore, (18) holds if $3c < \alpha \leq \frac{1299c}{113}$.

E Appendix E

The profit of firm i if it is independent is given:

$$(A - p_i + b\sum_{j \neq i} p_j) \quad p_i$$

The FOC is given by:

$$A - 2p_i + b\sum_{j \neq i} p_j = 0 \tag{19}$$

The profit of firm i if it is merged with firm k is given:

$$(A - p_i + b\sum_{j\neq i} p_j) \;\; p_i + (A - p_k + b\sum_{j\neq k} p_j) \;\; p_k$$

The FOC is given by:

$$A - 2p_i + bp_k + b\sum_{j\neq i} p_j = 0 \tag{20}$$

The equilibrium prices with 4 independent firms are obtained by imposing symmetry in all prices in (19):

$$\frac{A}{2-3b}$$

This leads to the profits cited in the text.

The equilibrium prices with 2 (equal-sized) independent firms are obtained by imposing symmetry in (20):

$$\frac{A}{2-4b}$$

This leads to the profits cited in the text.

The equilibrium if firm i and j are merged an k an l are independent is obtained the following way. Using (19) we write the (symmetric) profit maximizing prices of k and l ($p_k = p_l = p$) as a function of a symmetric strategy of the merging partners ($p_i = p_j = P$):

$$p = \frac{A + 2bP}{2 - b} \tag{21}$$

Using (20) we write the (symmetric) profit maximizing prices of i and j (P) as a function of a symmetric strategy of the independent firms (p):

$$P = \frac{A + 2bp}{2(1 - b)} \tag{22}$$

Solving (21)and (22) for p and P the equilibrium prices are obtained:

$$\begin{aligned} p &= \frac{A}{2 - 3b - b^2} \\ P &= \frac{A(2+b)}{4 - 6b - 2b^2} \end{aligned}$$

They lead to the profits cited in the text.

Now we check that (15) is greater than (14).

$$\Pi_2 - 2\pi_3 - \Pi_3 + 2\Pi_4 = \frac{A^2 b^4 (12 - 34b + 7b^2 + 27b^3)}{2(1-2b)^2(2-3b)^2(2-3b-b^2)^2} > 0.$$

It is positive because $b < \frac{1}{3}$.

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