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Abstract

Kamien and Zang (1990 and 1993) give monopolization conditions for static and dynamic acquisition games. Introducing cost heterogeneity in these games, we find enlarged monopolization conditions. Indeed, we show that every industry can be monopolized if cost heterogeneity is large enough.

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1 Introduction:

The literature on horizontal mergers presents different types of analyses. Williamson (1968) shows that mergers have positive effects on welfare. But, this idea has often been contradicted. Therefore, competition authorities must keep an eye on mergers. Studies have shown that *ex-ante* competition policy is more efficient and less expensive than *ex-post.* Because of this reason, merger conditions analyses have appeared. For exemple, Salant, Switzer, and Reynolds (1983) search incentives to mergers, seen as exogenous phenomenons. Finally, to take account of firms owners'decisions in merger processes, authors have modeled endogenous merger processes.

Following this last way, we try to answer this question: what are merger process conditions? To take account of the renewed interest about monopolization conditions, illustrated by Gowrisankaran and Holmes (2004), we concentrate on these extreme merger processes. Kamien and Zang (1990) give monopolization conditions within the framework of a static acquisition game in which Cournot competition takes place between symetric firms. They show that monopolization is possible for industries made of less than three firms. Kamien and Zang (1993), show, whithin the framework of a dynamic acquisition game with a single owner able to purchase other firms, that monopolization is possible, but only for industries made of less than four firms. Introducing heterogeneity between firms, we show that monopolization conditions are broader.

The second section presents the static game. The third section is dedicated to the dynamic game. At last, we conclude on contributions of the cost heterogeneity assumption.

2 The static game:

We consider a three stages game: in the first stage, owners make bids for the other firms and an asking price for their own firms. In the second stage, every owner decides how many firms he wants to operate. In the third one, Cournot competition takes place in the industry.

We assume that a firm is initially owned by an individual owner and must be sold in one part. Inverse demand function for the unique good is given by $P(Q) = 1 - Q$ and cost function of the firm i is given by $C(q_i) = c_i q_i$ with i $\in \{1, 2, ..., n\}$. $N = \{1, 2, ..., n\}$ is the initial set of firms and we assume that the owner of the firm 1 is the only one who can buy other firms. Q is the global output quantity in this industry, q is the individual firm output. We also assume that c_i can take two values: c_1 for the most efficient firm

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and $c_2 = c_3 = ... = c_n = c$ for the others. To exclude negative profits, let us add that $c_1 < c < 1$. We rule out a too high heterogeneity between firms. Otherwise, natural monopolies could appear. For this reason, we push back cases in which $c > \frac{1}{2}c_1 + \frac{1}{2}$, both for static and dynamic games. It's also assumed that entries in the industry aren't possibles. We must note that firms are totally informed of consequences to buy another firm or to be purchased, and that firms are not affected by non credible threats. Moreover, it is assumed that relevant variables and sets of available strategies are common knowledge. Lastly, we assume that the game is a centralized one: a several firms owner adopt a behaviour corresponding to a single entity.

Let us consider the three stages of the game: In the first one, every owner of N simultaneously announces a set $\mathrm{B}^j = (B^j_1, B^j_2, ..., B^j_n) \in \mathbb{R}^n$ of bids for each firm. The B^j_j bid is the jth owner asking price. Note $B = (B^1, ..., B^n)$ the $n \times n$ matrix of bids. Note that all bids are 0, except for the first owner and for asking prices. According to B, firms $2, ..., n$, can be sold or not. If $B^1_i \geq B^j_i$, $\forall j \in [2, ..., n]$, the first owner purchase the i^{th} firm. Let us note K the number of firms owned by the first owner after this stage. In the second stage, the first owner decides how many firms he is going to operate among his K firms. As cost functions are linear, he always decides to operate only the most efficient. In the third stage, owners simultaneously decide output levels. Let us note $q = q(K, B)$ the output set. Owner's outcome is the sum of his profits and his transaction cash flow. In this game, we are going to characterize monopoly Nash Equilibrium in pure strategies of this game. Strategies are defined, for each owner, by a bid vector and by an output quantity.

To monopolize the industry, the first owner's monopoly profit minus acquisition costs and opportunity cost must be positive. If n firms are initially present in the industry, this condition is:

$$\frac{(1-c_1)^2}{4} - \frac{(1 - nc_1 + (n-1)c)^2}{(n+1)^2} - \frac{(n-1)(1-2c+c_1)^2}{9} \geq 0 \tag{1}$$

(1) hold if (2) is checked:

$$\underline{c}(n, c_1) \leq c \tag{2}$$

when $\underline{c}(n, c_1) = \frac{1}{2}\frac{(4c_1n^2+35c_1n+13c_1+4n^2-23-n)}{(4n^2+17n-5)}$.

To exclude negative profits, sustainable industry conditions must also be checked. If $c_1 \in [0; 1]$, if the industry comprises more than one firm, and if (2) holds, these conditions are verified.[1] Hence, we can state the following proposition:

Proposition 1 *n-firm industry monopolization is possible if* $\underline{c}(n, c_1) \leq c$.

This result is intuitive. Indeed, a more efficient firm obtains higher profits after monopolization than an identic firm could obtain. Kamien and Zang (1990) show, if $c_1 = c$, that industries larger than two firms can't be monopolized. In contrast, we show that monopolization is possible for every size of industry, if there is enough cost heterogeneity. Note that $\frac{\partial \underline{c}(n,c_1)}{\partial n} > 0$. Subsequently, the larger the industry is, the stronger the cost heterogeneity must be to have monopolization.

3 The dynamic game:

We have shown that monopolization is possible for large industries according to the cost structure. We are going to see that cost structure conditions are modified if the game takes place in several rounds.

Conjecture 1 *If the discount factor is 1, every monopolization in static game is possible in several rounds.*

We are going to show that dynamic increases the number of monopolization possibilities even if the discount factor is smaller than 1. We start again the same assumptions. We repeat the game several times. Let's pose α the discount factor. When it is not precised, conditions and propositions are established with α and c_1 contained between 0 and 1. Thus, $\alpha = \frac{1}{1+r}$, with r the interst rate.

[1] All propositions of this paper are established in respect of sustainable industry conditions.

Let us begin with a three-firm industry: We exclude the one round case because we have already study the static monopolization. We assume that there are two rounds because it is easy to prove that a path with more than two rounds is not advantagous for the first owner. Thus, one firm is purchased, then, another is bought. Again, we must analyse conditions of these two acquisitions. Hence a backward induction arguing:
Second round:

$$\frac{(1-c_1)^2}{4(1-\alpha)} - \frac{(1-2c+c_1)^2}{9(1-\alpha)} - \frac{(1-2c_1+c)^2}{9(1-\alpha)} \geq 0 \tag{3}$$

(3) holds if (4) is checked:

$$\frac{11}{10}c_1 - \frac{1}{10} \leq c \tag{4}$$

First round:

$$\frac{(1-2c_1+c)^2}{9} - \frac{(1-3c+c+c_1)^2}{16(1-\alpha)}$$
$$+(\alpha)(\frac{(1-c_1)^2}{4(1-\alpha)} - \frac{(1-2c+c_1)^2}{9(1-\alpha)}) - \frac{(1-3c_1+2c)^2}{16(1-\alpha)} \geq 0 \tag{5}$$

(5) holds if (6) is checked:

$$c^*(c_1, \alpha) \leq c \tag{6}$$

when $c^*(c_1,\alpha) = \frac{1}{2}\frac{13c_1+22\alpha c_1+1-2\alpha}{10\alpha+7}$.

As the first round condition is the most restrictive, we can state the following proposition:

Proposition 2 *Three-firm industry monopolization is possible if* $c^*(c_1,\alpha) \leq c$.

Kamien and Zang (1993) show that monopolization of a three-symetric firm industry is possible if $\alpha \in \left[\frac{1}{2};1\right]$. Here, we show that it's possible for every $\alpha \in [0;1]$, provided that there is enough cost heterogeneity. Note that $\frac{\partial c^*(c_1,\alpha)}{\partial \alpha} \leq 0$. This means that, the larger the discount factor is, the larger the monopolization possibilities are.[2] Indeed, future profits are more valued while acquisition payments are spread over the time. Moreover, as the first owner doesn't have to monopolize the industry in an only one round, other owners can't ask him the same value for their firms: nothing shows that competition will decrease to a level as low as it was possible in the static game. We state, for c_1 contained between 0 and 1, and for α contained between 1/2 and 1, that (7) holds:

$$c^*(c_1,\alpha) \leq c_1 \tag{7}$$

Hence, if $c = c_1$, monopolization is possible if and only if α contained between 1/2 and 1. Therefore, we find again the Kamien and Zang (1993) result.

Let us continue with a four-firm industry: In this industry configuration, there are several monopolization paths, but we can prove that monopolization is easier with three rounds. Thus, we are going to study this path. Let us solve by the same way:
Third round: the first owner buy the last firm:

$$\frac{(1-c_1)^2}{4(1-\alpha)} - \frac{(1-2c+c_1)^2}{9(1-\alpha)} - \frac{(1-2c_1+c)^2}{9(1-\alpha)} \geq 0 \tag{8}$$

(8) holds if (9) is checked:

$$\frac{11}{10}c_1 - \frac{1}{10} \leq c \tag{9}$$

Second round: the first owner buy another firm:

$$\frac{(1-2c_1+c)^2}{9} - \frac{(1-3c+c+c_1)^2}{16(1-\alpha)}$$

[2] $\underline{c}(3, c_1 \geq c^*(c_1,\alpha)$ if and only if $\alpha \geq 1/22$. Therefore, there are more monopolization possibilities in dynamic games than in static ones if $\alpha \geq 1/22$.

$$+(\alpha)\left[\frac{(1-c_1)^2}{4(1-\alpha)}-\frac{(1-2c+c_1)^2}{9(1-\alpha)}\right]-\frac{(1-3c_1+2c)^2}{16(1-\alpha)}\geq 0 \tag{10}$$

(10) holds if (11) is checked:

$$\frac{1}{2}\frac{13c_1+22\alpha c_1+1-2\alpha}{10\alpha+7}\leq c \tag{11}$$

First round : the first owner buy one firm:

$$\frac{(1-3c_1+2c)^2}{16}-\frac{(1-4c+2c+c_1)^2}{25(1-\alpha)}$$

$$+(\alpha)\left[\frac{(1-2c_1+c)^2}{9}-\frac{(1-3c+c+c_1)^2}{16(1-\alpha)}\right]$$

$$+(\alpha)^2\left[\frac{(1-c_1)^2}{4(1-\alpha)}-\frac{(1-2c+c_1)^2}{9(1-\alpha)}\right]-\frac{(1-4c_1+3c)^2}{25(1-\alpha)}\geq 0 \tag{12}$$

(12) holds if (13) is checked:

$$\widetilde{c}(c_1,\alpha)\leq c \tag{13}$$

when $\widetilde{c}(c_1,\alpha)=\frac{1100\alpha^2c_1+650\alpha c_1+423c_1-100\alpha^2+50\alpha+63}{2(243+500\alpha^2+350\alpha)}$.

As the first repetition condition is the more restrictive, we can state the following proposition:

Proposition 3 *Four-firm industry monopolization is possible if $\widetilde{c}(c_1,\alpha)\leq c$.*

Note that $\frac{\partial\widetilde{c}(c_1,\alpha)}{\partial\alpha}\leq 0$. This implies that, the larger the discount factor is, the larger the monopolization possibilities are. We state the following inequality:

$$\widetilde{c}(c_1,\alpha)\leq c_1 \tag{14}$$

(14) implies that monopolization of a four symetric firms industry isn't possible. We can also say that there are more monopolization possibilities in dynamic games than in static ones. Indeed, $\widetilde{c}(c_1,\alpha)\leq \underline{c}(4,c_1)$. These remarks are in line with the intuitions mentioned for three-firm industries, with the actualization effect and the dynamic effect.

4 Conclusion:

Kamien and Zang (1990 and 1993) show that large industries can't be monopolized. Introducing a large enough cost heterogeneity, we have shown that monopolization is possible for every size of industry. Moreover, monopolization is easier if the game is repeated and especially if the discount factor is high.

Extensions of this line of research could include several purchasers in these games, take into account decentralized games in which firms are individually managed, and lastly, find oligopoly equilibria to these games, especially if collusion is possible.

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