DELEGATION AND MERGERS IN OLIGOPOLY*

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A B S T R A C T

In this paper we analyze the effect strategic delegation on the profitability of mergers in the context of a Cournot oligopoly with linear demand and cost functions. It is assumed that, after the merging process is completed, the owner of every independent firm decides its managerial incentive for his manager. We show that the required fraction of merging firms for a merger to be profitable, in our model with delegation, is substantially smaller than without delegation.

Keywords: Strategic Delegation; Mergers; Cournot Oligopoly.

1. INTRODUCTION

In the current literature about the profitability of mergers, it is usually assumed that the firms arising after the merging process compete directly in the product market. Under this assumption, Salant, Switzer and Reynolds (1983) have shown that merger is privately profitable only if a relatively high fraction of previously existing firms engage in the merging process. Specifically, they show that if demand and cost functions are linear, then an exogenous merger, followed by Cournot competition is only profitable if at least 80 percent of the firms engages in the merger. Nevertheless, some mergers have recently been observed in aeronautical and automobile industries which are not explained by this result[1].

The aim of this paper is to show that the implicit assumption of those authors that delegation by means of incentive contracts with managers is not feasible, is crucial in their results[2]. We analyze a model with linear demand and cost functions where every firm, resulting from the previous merger process, delegates the output decision on its manager by means of a reward scheme which is a linear combination of revenues and profits. Thus, our model extends also the previous analysis of delegation in oligopoly by Fershtman and Judd (1987), Sklivas (1987) and Vickers (1985) to the case in which mergers are allowed.

The basic consequence of our model is that delegation enhances the profitability of merger. In particular, we show that the required proportion of firms involved in an exogenous merger for this to be profitable, is substantially smaller in the model with delegation, relative to the model by Salant et al. (1983). This result agrees with the mergers recently observed in several industries with a small number of firms.

The rest of the paper is organized as follows. In Section 2, we analyze the profitability of mergers in a model with delegation and Section 3 gathers our conclusions.

[1] In the aeronautical industry, McDonell-Douglas and Boeing have merged in a market with basically three firms (the other is Airbus). In the automobile industry, Rolls Roice has been acquired by Wolksvagen, and Chrysler and Daimler-Benz have merged.

[2] Also, Faulí-Oller (1997) has reconsidered the model by Salant et al. (1983) for the case of a general demand function, to show the connections between the degree of concavity of the demand function and the profitability of mergers. Instead, we keep the assumptions of linear demand function, to focus on the effects of delegation in the profitability of mergers.

2. THE ANALYSIS OF MERGERS WITH DELEGATION

We assume that n initial owners of identical firms of a homogeneous good industry can engage in a merger. The inverse demand and cost functions of each firm are given , respectively, by $p(x) = a - x$, and $C(x_i) = cx_i$, where x is the total output, x_i is the output of firm i and $a > c > 0$. We assume that the cost function of the firm resulting of any merger is the same as the cost function of every initial firm.

Let us define z as the total number of active firms, after the merger is completed. The interactions between these z independent owners and their managers is given by the following game:

Stage 1: The owner of every active firm, say i, resulting from the previous stage, decides, simultaneously, the incentive scheme with his unique manager. We assume that this incentive scheme is of the form $R_i = \pi_i + \lambda_i x_i$, where π_i is the profit of firm i and λ_i, the incentive variable decided by owner i. This contract can be shown to be equivalent to $R_i = (1 - \delta_i)\pi_i + \delta_i p x_i$, where δ_i satisfies $\lambda_i = c\delta_i$. Thus, our approach is equivalent to the assumption that the incentive scheme is a weighted average between profits and revenues (see Fershtman and Judd (1987), Vickers (1985) and Sklivas (1987)). We will keep our notation for simplicity.

Stage 2: Every manager decides, simultaneously, his output.

The following auxiliary result characterizes the Subgame Perfect Equilibrium (SPE) of the subgame consisting in the two last stages of the previous delegation game.

Lemma 1. *In the SPE of the of the delegation game, the total production, the operating profits obtained by each active firm and the delegation variable chosen by each firm are, respectively,* $x(z) = \frac{(a-c)z^2}{z^2+1}$, $\pi(z) = \frac{(a-c)^2 z}{(z^2+1)^2}$ *and* $\lambda(z) = \frac{(a-c)(z-1)}{z^2+1}$.

Proof. See Sklivas (1987). ■

According to Lemma 1, the use of managerial contracts makes the equilibrium more competitive, relative to the non-delegation game, if merger is ignored, since $\lambda(z) > 0$. However, we will show that mergers are more attractive, relative to the case in which delegation is not feasible.

To save notation, in the rest of the paper we will assume, without loss of generality, $a - c = 1$.

Let us study the profitability of an exogenous merger that takes place before the Stage 1 of the game. We will compare our results with a similar approach,

undertaken by Salant et al. (1983), in the context of linear Cournot oligopoly, but with no delegation. As we will see, our results differs substantially from those of these authors.

Let us consider an exogenous merger resulting in z final independent firms. We can define $\alpha = \frac{n-z+1}{n}$ as the fraction of insiders, relative to the initial number of firms.

The change in total profits by the insiders as a result of the merger is given by

$$f(n,\alpha) = \pi(n(1-\alpha)+1) - \alpha n \pi(n) \tag{1}$$

These properties and the continuity of $f(n,\alpha)$, imply the following

Lemma 2. *For any $n \geq 3$ there exists a unique $\alpha(n) \in (1/n, 1)$ such that $f(n,\alpha) < 0$ for $0 < \alpha < \alpha(n)$ and $f(n,\alpha) > 0$ for $\alpha > \alpha(n)$.*

Proof. Since $f(n,1/n) = 0$ and $f(n,1) > 0$, the result follows from the continuity of $f(\cdot,\cdot)$ and the facts that $\partial_\alpha f(n,1/n) = -n(\pi'(n)+\pi(n)) < 0$ for $n \geq 3$, and $\partial_{\alpha\alpha} f(n,\alpha) \geq 0$ for $n \geq 2$, $\alpha \in (1/n, 1)$ ■

In other words, for any initial number of firms, the merger is profitable if and only if it contains a sufficiently large fraction of insiders, relative to the total number of firms. Since $z = n(1-\alpha)+1$, the previous result implies the following property of z,

Lemma 3. *Let us define $z(n) = n(1-\alpha(n))+1$. For any $n \geq 3$ there exists a unique $z(n)$ such that $f(n, \frac{n+1-z}{n}) < 0$ for $n > z > z(n)$ and $f(n, \frac{n+1-z}{n}) > 0$ for $z < z(n)$.*

That is, for an initial number of firms, the merger is profitable if and only if it yields a final number of independent firms sufficiently small.

According to Lemma 2, $\alpha(n)$ is a well defined function, given by the condition

$$f(n,\alpha(n)) = \pi(n(1-\alpha(n))+1) - \alpha(n) n \pi(n) = 0 \tag{2}$$

Moreover it satisfies the following

Proposition 1. *$\alpha(n)$ is strictly increasing in n for $n \geq 3$, $n \in N$ and it tends to 1 when n goes to infinity.*

Proof. From expression (2), $\alpha(3) \simeq 0.416; \alpha(4) \simeq 0.434; \alpha(5) \simeq 0.455; \alpha(6) \simeq 0.475$; which shows the proposition for those cases. For $n \geq 6$ the argument is as follows.

Implicit differentiation in (2) gives

$$\alpha'(n) = \frac{(1-\alpha(n))\pi'(z(n)) - \alpha(n)[\pi(n) + n\pi'(n)]}{n[\pi'(z(n) + \pi(n)]}$$

The denominator is negative, since $\partial_\alpha f(n, \alpha(n)) = -n[\pi'(z(n)) + \pi(n)] > 0$. Therefore,

$$\begin{aligned} \alpha'(n) \quad &> \quad 0 \Longleftrightarrow \alpha(n)[\pi'(n) + n\pi(n)] - (1-\alpha(n))\pi'(z(n)) > 0 \\ &\Longleftrightarrow \quad \alpha(n)(1-\gamma(n)) - \frac{\pi'(z(n))}{\pi(n)}(1-\alpha(n)) > 0, \end{aligned}$$

where $\gamma(n) = -\frac{\pi'(n)}{\pi(n)} = \frac{3n^2-1}{n(1+n^2)}$. By using the definition of $\alpha(n)$ and the fact that $\pi(z(n)) = (n - z(n) + 1)\pi(n)$, we obtain

$$\alpha'(n) > 0 \Longleftrightarrow 1 - n\gamma(n) + \gamma(z(n))(z(n) - 1) > 0,$$

where $1 - n\gamma(n) = \frac{4}{1+n^2} - 2 > -2$ for $n \geq 1$, and $\gamma(z)(z-1) = \frac{(3z^2-1)(z-1)}{z(1+z^2)}$ is strictly increasing and takes the value of 2 for $z = 2 + \sqrt{3}$. Therefore, $\alpha'(n) > 0$ if $z(n) > 2 + \sqrt{3}$, but from (1) and the definition of α it follows

$$f(n, \frac{n + 1 - 2 - \sqrt{3}}{n}) = \frac{1}{32 + 16\sqrt{3}} + \frac{(1 - \sqrt{3} - n)n}{(1+n^2)^2} > 0,$$

if $n \geq 6$. Thus, from Lemma 3, it follows that $z(n) > 2 + \sqrt{3}$ for $n \geq 6$ and $\alpha(\cdot)$ is strictly increasing for $n \geq 6$.

Let

$$R(n, \alpha) = \frac{\pi(n(1-\alpha) + 1)}{\alpha n \pi(n)} = \frac{(1 + n - \alpha n)(1+n^2)^2}{\alpha n^2 (1 + (1 + n - \alpha n)^2)^2}$$

be the ratio of the postmerger profits of the insiders to their premerger profits. Evidently, for any $\alpha < 1$, $R(n, \alpha) \to 0$ when $n \to \infty$ and $R(n, \alpha(n)) = 1$ for each $n \geq 3$. Therefore, by continuity, it follows that $\alpha(n) \to 1$ when $n \to \infty$. ■

3. CONCLUSION

According to the previous section, there is a critical proportion, $\alpha(n)$, such that merger is profitable (unprofitable) if and only if the proportion of merging firms

is greater (lower) than this critical value. Moreover, this critical proportion is increasing in the initial number of firms. This is a similar type of property, that the one obtained by Salant et al. (1983). However, the values summarized in the following table, shows that the required proportion for an exogenous merger to be profitable, is remarkably lower, in our model, compared with the non-delegation model.

n	2	3	4	5	6	7	8	9	10	15	20	30	50	100	140	1000
$\alpha(n)\%$	100	42	43	45	47	49	51	52	54	59	62	67	72	78	80	90
$m(n)$	2	2	2	3	3	4	5	5	6	9	13	21	36	78	112	900
$\beta(n)\%$	100	66	50	60	50	57	62	55	60	60	65	70	72	78	80	90

Here, the integer $m(n)$ is the minimal number of insiders for a merger to be profitable and $\beta(n)$ is the proportion $m(n)$ relative to n.

Compared with the model with no delegation, we have some remarkable facts. First, instead of the 80 percent rule, necessary for a merger to be profitable in the model by Salant et al. (1983), in our model, 50 percent is enough, with 4 or 6 initial firms, 60 per cent is only required for more than 15 firms and 70 per cent for more than 30. Second, in our model, the 80 percent requirement is only necessary for more than 140 initial firms, while in the model by Salant et al. this is a universal requirement.

Thus, our results seem to suggest the conjecture that delegation makes mergers more attractive for the firms, relative to the context where delegation is not considered. In fact, this conjecture is valid in our context of exogenous mergers, as shown in our paper. This implies that, with delegation, the role for antitrust policy might be reinforced since the incentive to collusive behavior by firms is increased. A similar suggestion arises, relative to the use of delegation. Contrary to what happens when merger is not considered, the availability of delegation in the context of Cournot competition does not necessarily increases competition since, on the one hand, for a given number of firms those behave more aggressively, but, on the other hand, the incentive to merge might be greater than without delegation. Therefore, a restrictive policy regarding the use of managerial incentives might enhance competition even under Cournot competition among managers.

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