Managerial Incentives and Heterogeneous Firms

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ABSTRACT. An industry where managerial firms and entrepreneurial firms coexist is considered. We analyze the effects of increasing competitiveness, defined by the increase in the number of managerial firms, on the equilibrium managerial incentive scheme. Our analysis shows that an increase in the number of managerial firms would induce a managerial firm to tie the incentives more closely to profits. We also compare the equilibrium with the regular Cournot model.

1. Introduction

Considerable attention has been focused on the strategic implications of managerial incentives; see, for example, Vickers (1985), Fershtman (1985), Fershtman and Judd (1987), Sklivas (1987), Reitman (1993), Sen (1993), and Goering (1996). It is noted that the separation of ownership and management provides firms the opportunity to commit to non-profit maximizing behavior. Such "distortion" is a natural outcome of firms' profit-seeking behavior because it induces favorable responses from competing firms. In this literature, it is often assumed that managers are delegated to make output decisions and are motivated by a linear lncentive scheme that combines sales (revenue) and profits.[1] Since in all these studies firms are assumed identical, it remains unclear how the differences in organizational structures among rivals influence firms' strategic choices of managerial incentives. Such concerns form the basis of the present study.

This note analyzes the choice of managerial incentives in an oligopoly consisting of both *managerial* and *entrepreneurial* firms. Our objective is to examine how the number of managerial firms affects the equilibrium choice of managerial incentive scheme. By an entrepreneurial firm, we mean a firm owned and managed by the same person. Consequently an entrepreneurial firm's owner makes the output decision himself and does not engage in strategic delegation. However, the owner of a managerial firm delegates the output decision to a manager and provides the manager with proper incentives. As in the related literature, our analysis completely eschews the potential agency problems, even though they are certainly important. To simply the analysis, we also assume that the managerial incentive contracts are common knowledge and non-renegotiable (see Fershtman and Kalai (1997) for analysis of unobserved delegation).

Since the results from the literature indicate that, when firms compete in quantities the strategic use of managerial delegation allows a firm to play more aggressively, in our model the increase in the number of managerial firms may be referred to as *increasing competitiveness*. Our analysis shows that increasing competitiveness will increase the relative profit incentive offered to the managers. It is also known that a managerial firm's profits exceed the sum of all the entrepreneurial firms' profits. Nevertheless, a managerial firm in some circumstances may earn less than in the regular Cournot equilibrium.

The setting considered is seemingly close to the situations in many emerging markets of Asia, Africa, Eastern Europe and Latin America. In those markets, many small and medium-sized entrepreneurial firms compete with large enterprises and the decision-making of those large enterprises often involves managerial delegation. Our model may also shed some light on the managerial delegation of the new high-tech

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industries composed of a large number of small enterpreneurial firms.[2]

The remainder of the paper is organized as follows. Section 2 describes the model and presents the results. The comparisons with the regular Cournot model and brief concluding remarks are contained in Section 3.

2. The model

Consider an industry consisting of k ($k \geq 1$) managerial firm (indexed by $i = 1, \ldots, k$) (and n-k entrepreneurial firms (indexed by $i = k + 1, \ldots, n$). These firms produce perfectly substitutable commodities at constant marginal cost c. The market demand is assumed to be $p = A - Q$, where p is market price and Q is the industry output. Let q_i denote the output of firm i and define $\overline{Q}_i \equiv Q - q_i$.

The k managerial firms face a two-stage competitive situation. In the first stage, the owners simultaneously and independently design the incentive schemes of their managers. After this first stage, the incentive schemes become common knowledge. Then, in the second stage all n firms simultaneously and independently decide the production levels.

Following the literature, we assume that for each managerial firm, firm i's manager is motivated to maximize:

$$\begin{aligned}\Omega_i &= \alpha_i\pi_i + (1 - \alpha_i)R_i \\ &= (A - q_i - \overline{Q}_i - \alpha_i c)q_i, \end{aligned} \tag{1}$$

where π_i and R_i are firm i's profits and sales, respectively. Clearly, the relative profit incentives acts essentially as a shift parameter of the marginal production cost. It follows that the reaction function of firm i is given by

$$q_i = \frac{A - \overline{Q}_i - \alpha_i c}{2}. \tag{2}$$

Clearly letting $\alpha_i = 1$ yields the reaction function of an entrepreneurial firm. Solving these reaction functions gives us the second stage equilibrium outcome as follows (the second-order conditions are clearly satisfied).

$$q_i = \frac{A + c \sum_{1 \leq j \leq k,\, j \neq i} \alpha_j - nc\alpha_i + (n - k)c}{n + 1}, \quad i = 1, \ldots, k; \tag{3}$$

$$q_i = \frac{A + c \sum_{1 \leq j \leq k} \alpha_j - (k + 1)c}{n + 1}, \quad i = k + 1, \ldots, n; \tag{4}$$

$$p_i = \frac{A + c \sum_{1 \leq i \leq k} \alpha_i + (n + k)c}{n + 1}. \tag{5}$$

In the first stage, the owner of managerial firm i chooses, α_i to maximize profits π_i. Since at the symmetric equilibrium $\alpha_i = \alpha$, it is straightforward to show that

$$\alpha = 1 - \frac{(n - 1)(A - c)}{(nk + n + 1 - k)c}. \tag{6}$$

We are now ready to investigate the implications of the equilibrium managerial incentives. Examining Equation (6), we find that $\alpha < 1$ and α may be negative when A is sufficiently large compared with c. This means that regardless of the composition of the industry, it is not the interest of the owners of the managerial firms to base their managerial incentives on profits alone. Moreover, although it seems absurd and unlikely in practice, "penalizing" for profits does occur theoretically when demand is sufficiently large. Proposition 1 follows directly from the fact that $\alpha < 1$ and $\partial\alpha/\partial k > 0$.

Proposition 1. Managerial firms always choose to base the managerial incentives only partly on profits. But an increase in the number of managerial firms would induce a managerial firm to tie the incentives more closely to profits.

As noted in the literature, given the opportunity of strategic delegation, each managerial firm would give its manager an incentive to be more aggressive than in the regular Cournot equilibrium. The intuition of Proposition 1 is that, as the number of managerial firms increases, firms would like to hold back the aggressiveness to avoid lowering the market price too much. This observation is in general accordance with the result obtained in Fershtman and Judd (1987), who considered an industry consisting of managerial firms only. What is new from our analysis is that the result also prevails in an industry consisting not only of managerial firms but also of entrepreneurial firms.

Combining Equation (6) with Equations (3) and (4) yields the equilibrium output. Let the subscript m denote the managerial firm and the subscript e the entrepreneurial firm. Hence

$$q_m = \frac{n(A - c)}{nk + n + 1 - k} = nq_e, \tag{7}$$

with corresponding equilibrium price given by

$$p = \frac{A + (nk + n - k)c}{nk + n + 1 - k}. \tag{8}$$

It can then be checked that

$$\pi_m = \frac{n(A - c)^2}{(nk + n + 1 - k)^2} = n\pi_e, \tag{9}$$

If all firms but firm one are entrepreneurial firms (i.e., where $k = 1$), it can be seen from Equation (6) that $\alpha = 1 - (n - 1)(A - c)/(2nc)$, and consequently $\pi_i = (A - c)^2/4n$. This result is intuitively clear since under such circumstances our model yields Stackelberg outcome with firm 1 being the Stackelberg leader. Note that clearly a managerial firm earns greater profits than its entrepreneurial rival does. This simply follows from the fact that managerial delegation enables the managerial firms to commit to more aggressive output, thereby shifting profits from the entrepreneurial firms to the managerial firms. Another way of reasoning is that $\alpha = 1$ is an available choice for each managerial firm. What might be interesting is that $q_m = nq_e$ and $\pi_m = n\pi_e$ regardless of how many managerial firms exist in the industry. This rather strong result seems to be driven by the force of the specifications of linear demand and linear cost structure.

3. Discussion and conclusion

In contrast to regular Cournot model, clearly the equilibrium industry output is lower in the regular Cournot case. Hence the price is always higher in the regular Cournot competition, i.e. $p < p_c$.[3] The comparison of profits is somehow less straightforward. Note that in the regular Cournot equilibrium, firm i's profit is given by $\pi_c = (A - c)^2/(n + 1)^2 = q_2^c$. From Equation (9), we find that $\pi_e < \pi_c$ and

$$\pi_m \geq \pi_c \text{ if and only if } k \leq \frac{n + 1}{\sqrt{n} + 1}.$$

As noted earlier, if all firms but firm one are entrepreneurial firms, the sole managerial firm's profits is that of a Stackelberg leader. However, if there are too many managerial firms, each managerial firm may earn less than in the regular Cournot equilibrium. This can be clearly seen from the fact that π_m decreases with k. In particular, when $k = n$, the profits of each firm is lower than π_c. Fershtman (1985) has noted this observation for a special case of $k = n = 2$.

Proposition 2. A managerial firm earns more than a regular Cournot firm if and only if $k < (n + 1)/(\sqrt{n} + 1)$. However, an entrepreneurial firm earns less than a regular Cournot firm regardless of k.

Until now, we have assumes that $k \geq 1$. It is noteworthy that the regular Cournot competition is a special case of $k = 0$ (i.e. all firms are entrepreneurial firms). Proposition 2 states that as the share of managerial firms increases (i.e. as k gets larger), compared to the benchmark case of $k = 0$, each managerial firm makes a higher profit, while the other n-k firms make a lower profit. The intuition is that a managerial firm benefits at the expense of the entrepreneurial firms due to its choice of higher output. However when the share of managerial firms gets very large (i.e. k increases further), a managerial firm could no longer makes higher profit than in the benchmark case of $k = 0$. This can be seen by noting that eventually the price reduction from the increase in aggregate quantity gets so large that each firm is worse off compared with the regular Cournot firm.

It is easy to see that the presence of managerial firms leads to a higher consumer surplus because each managerial firm produces more aggressively and the resulting equilibrium price is lower compared with the regular Cournot equilibrium. In the meantime, it is also easy to check that producer surplus is lower than that in the regular Cournot equilibrium. However, the reduction in producer surplus is more than offset by the increase in consumer surplus. Thus, for the oligopoly considered, social welfare is higher than that in the regular Cournot equilibrium.

We have so far focused on the case where the ratio between managerial and entrepreneurial firms is exogenously given. If we allow the owners

to decide whether to engage in managerial delegation or not, and thus endogenize the composition of the industry, our previous analysis implies that all owners would choose to hire managers. To see this, note that the equilibrium number of firms engaged in strategic managerial delegation, k^e, is such that the two conditions must be satisfied: $\pi_m(k^e) \geq \pi_e\ (k^e - 1)$ and $\pi_m(k^e + 1) \leq \pi_e(k^e)$. These conditions correspond to the regular "best response" requirements. It is easy to check that the latter condition never holds in the present setting. Consequently, it would lead to a Prisoner's Dilemma situation in which all firms choose to be managerial firms and are worse off compared to the benchmark case of $k = 0$.[4]

This note is intended only as a preliminary step in the analysis of the impact of differences in organizational structures on managerial incentives. Our analysis has demonstrated that the composition of competitors may have an important influence on the linear incentive employed by the owners of managerial firms. Despite the limitations of our simple model, the insights are useful for managerial efficiency and social welfare.

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Notes

[1] A different setting, studied by Fershtman (1985), Sen (1993) and Sen and Sikdar (1997), is to assume that firms' output decisions are determined via (Nash) bargaining between two managers.

[2] We are indebted to an anonymous referee for providing this observation.

[3] We denote by subscript c the respective values for the regular Cournot outcome.

[4] In a related context, Fershtman (1985) and Basu (1995) have shown similar results for the duopoly case.

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