Is Social Welfare Increased By Private Firm Entry？

From a coopetition viewpoint

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Introduction

Many studies on a mixed oligopoly mainly deal with competition between public and private firms, the effects of privatization on market performance, and endogenous timing[1].

In reality, however, many firms choose to partake not only in competitive but also in cooperative behaviors. For example, when new communication goods are developed, mobile phone companies first invest in advertising to form a market for the new products, and then they compete with each other in the market. This situation is called coopetition[2].

The objective of this paper is to look into the effects on social welfare of the emergence of private firms in a market monopolized by semi-public firms by using a coopetition model. The following three cases are considered: 1) a semi-public monopoly where the market is monopolized by a semi-public firm, 2) a mixed duopoly with one semi-public firm and one private firm in the market, and 3) a mixed oligopoly with one semi-public firm and two private firms in the market.

Two effects appear from the emergence of private firms; 1) the market size is larger in a semi-public monopoly than in a mixed duopoly if there exists a highly privatized semi-public firm in the market, and 2) the social welfare is greater in a mixed duopoly than in a mixed oligopoly if there exists a highly privatized semi-public firm in the market because the change in the sum of the equilibrium cooperative behavior levels triggered by private firms entering the market has a positive effect (an increase in the sum of the equilibrium output level) rather than a negative effect (an increase in the total cost).

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[1] See De Fraja, G., and Delbono, F. (1989), Pal, D. (1998), White (1996), Fjell, K., Pal, D. (1996), Anderson, S. P., de Palma, A. and Thisse J. -F. (1997), Matsumura (1998), Nishimori and Ogawa (2002), Haruna (2005).

[2] See Brandenburger and Nalebuff (1997), Krishnamurthy (2000), Dearden and Lilien (2001), Ngo and Okura (2008).

Model

We assume homogeneous goods markets and compare the following three cases: 1) a semi-public monopoly where the market is monopolized by a semi-public firm, 2) a mixed duopoly with one semi-public firm and one private firm in the market, and 3) a mixed oligopoly with one semi-public firm and two private firms in the market.

Firms existing in the market play a two-stage game. In the first stage, the firms choose their own cooperative behavior levels. The cooperative behavior level is denoted by k_i for $i \in \{1,2,3\}$, which increases the market size. The overall market inverse demand function is given by

$$P = A - Q, \qquad (1)$$

where Q is the total supply and A represents the market size and is the sum of a (a positive constant number) and K (the total cooperative behavior level). Hence, A is formulated by $A = a + K$.

In the second stage, the firms choose their output levels q_i for $i \in \{1,2,3\}$, representing their competitive behavior. The cost of expending cooperative behavior is denoted by k_i^2. The marginal cost of production denoted by c is assumed to be $a > c$ and is also assumed to be the same for all the firms. Hence, the total cost function is given by

$$C_i = cq_i + k_i^2 \qquad for \qquad i \in \{1,2,3\}. \qquad (2)$$

Firm 2 and firm 3 denote private firms, which maximize their profits. Using (1) and (2), the profit function is given by

$$\pi_i = Pq_i - C_i \qquad for \quad i \in \{2,3\}, \qquad (3)$$

and a semi-public firm is denoted by firm 1. Using (2) and (3), the objective function is

$$U_1 = \alpha W + (1-\alpha)\pi_1, \qquad (4)$$

where W, which is the sum of the consumer surplus CS and the producer surplus PS, represents the social welfare. The social welfare W is thus given by

$$W = CS + PS. \qquad (5)$$

The parameter $\alpha \in [0,1]$ can be interpreted in two ways; it represents the weight of the government's participation in firm 1. It can be regarded as the import level attributed to the government's objective, and the government can control it by regulating the shareholding ratio. Therefore, we can view α as the degree of privatization; i.e. $\alpha = 0$ signifies that firm 1 is solely concerned about its profit while $\alpha = 1$ means that firm 1 aims to maximize social welfare regardless of its profit. Table 1 expresses A, CS, PS, and W in the three cases.

Comparisons

This section scrutinizes the inequality relationships of the three cases to elaborate the effects of the emergence of private firms on social welfare.

Comparison of K

This subsection deals with the inequality relationships of K (the total sum of the equilibrium cooperative behavior levels) in the three cases[3].

Finding 1. *The inequality relationships of K in the three cases.*

$$K^{mo} < K^{md} < k_1^{sm} \quad (0 < \alpha < 0.184), \quad (54)$$

$$K^{mo} < k_1^{sm} < K^{md} \quad (0.184 < \alpha < 0.293), \quad (55)$$

$$k_1^{sm} < K^{mo} < K^{md} \quad (0.293 < \alpha < 0.489), \quad (56)$$

$$k_1^{sm} < K^{md} < K^{mo} \quad (0.489 < \alpha < 1). \quad (57)$$

The intercepts of reaction functions is greater in a mixed duopoly than in a mixed oligopoly and the slop of reaction functions of semi-public firm is smaller in a mixed duopoly than in a mixed oligopoly, when there exists a highly privatized semi-public firm in the market, as shown in (54). On the other hand, the slop of reaction functions of private firm is smaller in a mixed duopoly than in a mixed oligopoly. That is, participation private firm in a mixed duopoly market, reducing the elasticity of the reaction function.

Hence, k_1^{sm} is the greatest of the three cases and K^{md} is greater than K^{mo} when a highly privatized semi-public firm exists in the market.

Comparison of consumer surplus

This subsection considers the inequality relationships of the consumer surpluses.

Finding 2. *The inequality relationships of the consumer surpluses.*

$$CS^{sm} < CS^{md} < CS^{mo} \quad . \quad (58)$$

The emergence of private firms increases the total supply, thus boosting the consumer surplus.

Comparison of producer surplus

This subsection concerns the inequality relationships of the producer surpluses[4]

Finding 3. *The inequality relationships of the producer surpluses.*

$$PS^{mo} < PS^{md} < PS^{sm} \quad (0 < \alpha < 0.114), \quad (59)$$

$$PS^{mo} < PS^{sm} < PS^{md} \quad (0.114 < \alpha < 0.301), \quad (60)$$

$$PS^{mo} < PS^{md} < PS^{sm} \quad (0.301 < \alpha < 1). \quad (61)$$

[3] Rounded to three decimal places.

[4] Rounded to three decimal places.

The inequality relationship of the total sum of the equilibrium cooperative behavior level is $K^{mo} < K^{md}$ when there exists a highly privatized semi-public firm in the market, as shown by (59). In a mixed duopoly the positive effects, such as the increase in the market size are smaller than the negative effects, such as the increase in the sum of the firm's total costs. On the other hand, in a mixed oligopoly the positive effects are smaller than the negative effects.

Hence, we conclude that the emergence of private firms has two effects on the producer surplus. 1) The entrance of two private firms always decreases the producer surplus, and 2) if there exists a highly privatized semi-public firm in the market, the producer surplus is smaller in a semi-public monopoly than in a mixed duopoly.

Comparison of social welfare

This subsection considers the inequality relationships of the social welfare. Figure 4, which shows the relationships of W^{sm}, W^{md} and W^{mo} to α, yields Finding 4[5].

Finding 4. *The inequality relationships of the social welfare.*

$$W^{sm} < W^{mo} < W^{md} (0 < \alpha < 0.014), \quad (62)$$

$$W^{sm} < W^{md} < W^{mo} (0.014 < \alpha < 1). \quad (63)$$

[Figure 4 insertions]

When there exists a highly privatized semi-public firm in the market, as shown in (62), the inequality relationship of the consumer surplus is $CS^{sm} < CS^{md} < CS^{mo}$ and the inequality relationship of the producer surplus is $PS^{mo} < PS^{md} < PS^{sm}$, and the inequality relationship of the total sum of the equilibrium cooperative behavior levels is $K^{mo} < K^{md} < k_1^{sm}$. We can thus say that the change in the sum of the equilibrium cooperative behavior levels caused by the entrance of private firms has a positive effect (an increase in the equilibrium output level) rather than a negative effect (an increase in the total cost) if there exists a highly privatized semi-public firm in the market.

Therefore, the social welfare is smaller in a mixed oligopoly market made up of two private firms and a highly privatized semi-public firm than in a mixed duopoly market composed of a private firm and a highly privatized semi-public firm. If a less privatized rather than highly privatized semi-public firm exists in the market, the social welfare will increase in either case.

We conclude that deregulation results in diminishing the social welfare when a highly privatized semi-public firm exists in the market, as in the case of a private firm entering a mixed duopoly market. However, it should be noted that deregulation increases the social welfare when a less privatized semi-public firm exists in the market.

[5] Rounded to three decimal places.

Conclusions

Using a coopetition model, we have shown two effects of the emergence of private firms: 1) the market size is larger in a semi-public monopoly than in a mixed duopoly if a highly privatized semi-public firm is in the market, and 2) the social welfare is greater in a mixed duopoly than in a mixed oligopoly if a highly privatized semi-public firm is in the market, because the change in the sum of the equilibrium cooperative behavior levels triggered by private firms entering the market has a positive effect (an increase in the sum of the equilibrium output level) rather than a negative effect (an increase in the total cost).

We conclude that deregulation results in diminishing the social welfare when a highly privatized semi-public firm exists in the market, as in the case of two private firms entering a semi-public monopoly market.

We don't refer the relationship of the optimal value of α to the number of private firms existing in the market. Extending our model to this direction remains for future research.

Figure 4

The relation of W to α in the three cases