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Competition versus efficiency

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Abstract: It is usually believed that higher competition, implying more active firms, benefits consumers and encourages the antitrust authorities to foster competition. We show that this view can be misleading, and higher competition may actually make the consumers worse-off. We suggest that the antitrust authorities should be interested in reducing inefficiency instead of increasing competition through more firms.

Key Words: Competition; Consumer welfare; Cost asymmetry; Tax

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Competition versus efficiency

1. Introduction

It is usually believed that higher competition, implying more active firms, benefits consumers[1] (Metzenbaum, 1993, Gans, 2005 and Hausman and Leibtag, 2007) and encourages the antitrust authorities to foster competition.[2] We show that this view can be misleading. We show that higher competition can actually reduce consumer welfare in the presence of government tax/subsidy policies. Considering an industry with asymmetric cost firms and strategic tax policy, we show that if the number of more cost inefficient firms increases, it reduces consumer welfare. However, consumer welfare increases if either the number of more cost efficient firms increases or the costs of the more cost inefficient firms reduce. Hence, in the presence of strategic government policies, a rise in the number of more cost inefficient firms makes the consumers worse off, thus showing a conflict between competition and inefficiency. It is therefore safe for the antitrust authorities to consider reducing inefficiency instead of increasing competition through more firms.

To understand the reasons for our results, let us first consider the situation with no tax/subsidy policies of the government. If we consider an oligopoly industry with cost asymmetric firms, we encounter two types of inefficiencies. One type of inefficiency is due to the oligopolistic competition, and the other type of efficiency is due to cost asymmetry. In this situation, if the number of firms increases, irrespective of its marginal cost, it tends to reduce the inefficiency due to oligopolistic

[1] Promotion of consumer welfare is the common goal of consumer protection and competition policies. As mentioned in the document by the U.S. Department of Justice (http://www.justice.gov/atr/public/div_stats/211491.htm), "Consumers benefit from competition through lower prices and better products and services".

[2] Wooton and Zanardi (2004) survey the use of anti-dumping and anti-trust policies in encouraging and maintaining competition in open economies.

competition. If the number of more cost efficient firms increases, it also tends to reduce the effect of inefficiency due to cost asymmetry. However, if the number of more cost inefficient firms increases, it tends to increase the inefficiency due to cost asymmetry by increasing the number of more cost inefficient firms. If there is no government intervention through tax/subsidy policies, the effect of inefficiency due to oligopolistic competition dominates the effect of inefficiency due to cost asymmetry, and the increase in the number of firms increases total output in the industry irrespective of their costs. Even if the number of firms remains the same but the cost of the more cost inefficient firms reduces it tends to reduce the inefficiency due to cost asymmetry and increases total output in the industry. Hence, without government intervention, both more competition, which increases the number of firms in the industry, and the reduction in cost asymmetry make the consumers better off, and the antitrust authority does not need to bother whether more cost efficient or more cost inefficient firms are entering the industry.

However, the situation changes if the government charges a welfare maximizing uniform tax/subsidy depending on the number of firms and the cost asymmetry. The consideration of a uniform tax/subsidy can have the following justification. It is often argued that the uniform tax rates are simpler and easier to implement. As mentioned in Coşgel (2006, pp. 333) "The cost of administering a system with discriminatory rates can be very high when the characteristics of tax payers do not differ systematically or when these differences cannot be easily observed. It is generally easier to identify differences between the sectors of the economy than within each sector, making it harder to implement discriminatory rates within a sector." For example, the government imposes the same tax/subsidy even if the car producers differ in productivities.

If the government charges a uniform tax/subsidy, it can eliminate the effects of inefficiency due to oligopolistic competition, but cannot eliminate the effect of inefficiency due to cost asymmetry.[3] Any change that affects inefficiency due to the cost asymmetry affects the consumers. Hence, with government intervention, a rise in the number of more cost inefficient firms increases inefficiency in the industry and reduces total output in the industry, thus making the consumers worse-off. In this situation, even if competition increases due to the increase in the number of more cost inefficient firms, the consumers are worse off, since it also increases inefficiency in the industry. However, if either the number of more cost efficient firms increases or the cost of the more cost inefficient firms reduces, both of which reduce the effects of the inefficiency due to cost asymmetry and make the consumers better-off.

One should not get confused between our result and Lahiri and Ono (1988) and Klemperer (1988). *In both Lahiri and Ono (1988) and Klemperer (1988), higher competition, either due to lower marginal cost or due to entry of a firm, always makes the consumers better off. In contrast, if the number of more cost inefficient firms increases in our analysis, it makes the consumers worse off.*

The remainder of the paper is organized as follows. Section 2 describes the model and derives the results under a linear demand. Section 3 concludes.

2. The model and the results

Consider an economy with $n \ (\geq 1)$ firms, each with the marginal cost of production 0, and $m \ (\geq 1)$ firms, each with the marginal cost of production $c \ (> 0)$, competing like Cournot oligopolists with a homogeneous product. We assume that the welfare maximizing government of the country imposes a per-unit tax[4], t, on each firm.

[3] It is intuitive that the government could eliminate both types of inefficiencies if it could charge discriminatory tax/subsidies, and the number of firms would not affect the total output of the industry.
[4] If t is negative, it implies that the government is subsidizing the firms.

We assume that the inverse market demand function is

$$P = a - q, \tag{1}$$

where P is price and q is the total output sold. Although we prove our main result in this section under a linear demand function, we show in the *Appendix* that our result holds also under a general demand specification.

We consider the following game. Given the number of firms, at stage 1, the government charges t in order to maximize welfare, which is the sum of total profits of the firms, consumer surplus and tax revenue. At stage 2, the firms compete like Cournot oligopolists. We solve the game through backward induction.

Given the tax rate, each of n firms maximizes $(a-q-t)q_i$ to determine its output, where $i=1,2,...,n$, and each of m firms maximizes $(a-q-c-t)q_j$ to determine its output, where $j=n+1,n+2,...,n+m$. The equilibrium outputs of the ith firm, $i=1,2,...,n$, and the jth firm, $j=n+1,n+2,...,n+m$, can be found respectively as

$$q_i^* = \frac{a-t+mc}{n+m+1} \qquad \text{and} \qquad q_j^* = \frac{a-t-(n+1)c}{n+m+1}. \tag{2}$$

We assume that $a-t+mc>0$ and $a-t-(n+1)c>0$, which ensure positive outputs of all firms.

The total output and the price of the product are respectively

$$q^* = \frac{(a-t)(n+m)-mc}{n+m+1} \tag{3}$$

and

$$P^* = \frac{a+t(n+m)+mc}{n+m+1}. \tag{4}$$

It is clear from (3) that if the tax/subsidy is not adjusted depending on the number of firms and/or cost asymmetry, more firms (regardless of their types) and cost reduction in the more cost inefficient firms increase q^*, thus making the

consumers better off. *Hence, under exogenous tax/subsidy, more firms in the industry make the consumers better-off, irrespective of the type of the firm.*

Now we want to see the effects of strategic tax/subsidy policies. To show this, we solve the first stage of the game, where the government determines t that maximizes welfare. The government maximizes the following expression to determine t:

$$\underset{t}{Max}(P-t)\sum_{i=1}^{n} q_i^* + (P-c-t)\sum_{j=n+1}^{n+m} q_j^* + \frac{(q^*)^2}{2} + t(\sum_{i=1}^{n} q_i^* + \sum_{j=n+1}^{n+m} q_j^*)$$

$$= \underset{t}{Max}\, Pq^* - c\sum_{j=n+1}^{n+m} q_j^* + \frac{(q^*)^2}{2}, \tag{5}$$

where $q^* = \sum_{i=1}^{n} q_i^* + \sum_{j=n+1}^{n+m} q_j^*$.

The equilibrium tax rate can be found as

$$t^* = \frac{-m(a-c)-an}{(n+m)^2} < 0\,. \tag{6}$$

We get from (2) and (6) that the equilibrium outputs of the ith firm, $i = 1,2,...,n$, and the jth firm, $j = n+1, n+2, ..., n+m$, are respectively

$$q_i^* = \frac{a(n+m)+mc(n+m-1)}{(n+m)^2} \tag{7}$$

and $$q_j^* = \frac{a(n+m)(n+m+1)-c[(n+1)(n+m)^2+m]}{(n+m+1)(n+m)^2}\,. \tag{8}$$

It follows from (7) and (8) that the outputs of all firms are positive if

$$a > \frac{c[(n+1)(n+m)^2+m]}{(n+m)(n+m+1)} \equiv \bar{a}, \tag{9}$$

which is assumed to hold.

We get that the total output is

$$q^* = a - \frac{mc}{n+m}\,. \tag{10}$$

Proposition 1: *(a) An increase in n increases* q^**, thus making the consumers better-off.*

(b) An increase in m reduces q^**, thus making the consumers worse-off.*

(c) A reduction in c increases q^**, thus making the consumers better-off*.

Proof: (a) We get that $\frac{\partial q^*}{\partial n} = \frac{mc}{(n+m)^2} > 0$.

(b) We get that $\frac{\partial q^*}{\partial m} = -\frac{nc}{(n+m)^2} < 0$.

(c) We get that $\frac{\partial q^*}{\partial c} = -\frac{m}{(n+m)} < 0$. ■

The reason for our interesting result, which is Proposition 1(b), is due to the following reason. We have seen in (3) that, for a given *t*, an increase in *m* increases total output. However, it follows from (6) that if *m* increases it reduces subsidy (i.e., $-t^*$), which tends to reduce total output. Since the government policy internalizes the inefficiency due to oligopolistic competition but not the inefficiency due to the cost asymmetry, an increase in *m* reduces total output by reducing subsidy. We show in the *Appendix* that this interesting result holds also under a general demand function.

We have done the above analysis for a homogeneous product. However, it is intuitive that if the products of the firms are differentiated, more firms, irrespective of their types, create a positive effect on the consumers by increasing the number of varieties. Hence, the variety effect tends to reduce the negative effect of a rise in the number of more cost inefficient firms. Therefore, a rise in the number of more cost inefficient firms makes the consumers worse-off if the products are not very much

differentiated so that the inefficiency due to the cost asymmetry dominates the effect of product differentiation.

3. Conclusion

It is generally believed that higher competition makes the consumers better-off and encourages the antitrust authorities to foster competition. We show that this view can be misleading in the presence of strategic government tax/subsidy policies. If the firms differ in terms of marginal costs, an increase in the number of more cost inefficient firms, which increases competition but also creates more inefficiency in the industry, reduces consumer surplus. Hence, the antitrust authority should consider reducing inefficiency instead of increasing competition.

Appendix

Output reducing entry under a general demand function: Now we show that our interesting result, i.e., a rise in the number of more cost inefficient firms reduces total output, holds also under a general demand function.

Assume that the inverse market demand function is $P(q)$ with $P' < 0$ and $P'' \leq 0$.[5]

Given the tax rate, each of the more cost efficient firms and each of the less cost efficient firms maximize the following expressions respectively to determine their outputs:

$$\underset{q_i}{Max}(P-t)q_i, \qquad i = 1,2,...,n \tag{A1}$$

$$\underset{q_j}{Max}(P-t-c)q_j, \qquad j = n+1, n+2,..., n+m. \tag{A2}$$

The equilibrium outputs are given by the following conditions respectively:

$$P - t + P'q_i^* = 0, \qquad i = 1,2,...,n \tag{A3}$$

$$P - t - c + P'q_j^* = 0, \qquad j = n+1, n+2,..., n+m. \tag{A4}$$

The total outputs of the firms are determined by the following expression:

$$(P-t)(n+m) - mc + P'q^* = 0, \tag{A5}$$

where $q^* = \sum_{i=1}^{n} q_i^* + \sum_{j=n+1}^{n+m} q_j^*$, and it depends on *t*.

The government maximizes the following expression to determine the tax rate:

$$\underset{t}{Max} \int_0^{q^*} P(q)dq - c\sum_{j=n+1}^{n+m} q_j^*. \tag{A6}$$

The equilibrium tax is determined by the following expression:

[5] Our result holds as long as the industry marginal revenue is downward sloping. Our assumption of $P'' \leq 0$ satisfies this requirement.

$$P\frac{\partial q^*}{\partial t} - c\frac{\partial \sum_{j=n+1}^{n+m} q_j^*}{\partial t} = 0. \qquad \text{(A7)}$$

It follows from (A7) that $\frac{\partial t^*}{\partial m} > 0$, i.e., as the number of more cost inefficient firms increases, it increases the equilibrium tax, since $\frac{\partial \sum_{j=n+1}^{n+m} q_j^*}{\partial t} < 0$ from (A4).

Now we want to see the effect of *m* on total output. We get from (A5) that

$$\frac{dq^*}{dm} = \frac{(P^* - t^* - c) - (n+m)\frac{\partial t^*}{\partial m}}{-[P'(n+m+1) + P''q^*]}. \qquad \text{(A8)}$$

Since $-[P'(n+m+1) + P''q^*] > 0$, $\frac{dq^*}{dm} < 0$ if

$$(P^* - t^* - c) - (n+m)\frac{\partial t^*}{\partial m} < 0. \qquad \text{(A9)}$$

It is worth noting that the sign of (A9) does not depend on the curvature of the demand function, which is given by P''. Hence, it is immediate that our *qualitative result* of Proposition 1(b), which is shown with a linear demand function (where $P'' = 0$), also occurs under a general demand function *P(q)*. The non-linear demand function only affects the *quantitative result* by making $P'' \neq 0$.

It is also immediate from (A9) that if the tax rate does not change with the number of firms, i.e., if the tax rate is exogenous, we have $\frac{\partial t^*}{\partial m} = 0$ and (A9) does not hold since $(P^* - t^* - c) > 0$ from (A4). That is, for a given tax, if the number of more cost inefficient firms increases, it increases total output. However, if the government chooses welfare maximizing tax, a rise in the number of more cost inefficient firms reduces total output by making $\frac{\partial t^*}{\partial m} > 0$.

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