A note on the adverse effect of competition on consumers

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Abstract: It is usually believed that higher competition, implying more active firms, benefits consumers. We show that this may not be the case in an industry with asymmetric cost firms. A rise in the number of more cost inefficient firms makes the consumers worse-off in the presence of a welfare maximizing tax/subsidy policy. A rise in the number of more cost inefficient firms also reduces social welfare.

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

JEL Classifications: L40; L13; L11; H25; D43

1. Introduction

It is usually believed that higher product market competition reduces price and benefits the consumers (Metzenbaum, 1993 and Hausman and Leibtag, 2007). However, the evidences do not support this view always. Caves et al. (1991), Grabowski (1992) and Perloff et al. (2005) show that entry triggers price in the US pharmaceutical industry. Using simulations, Thomadsen (2007) shows that price in the fast food industry may be higher under duopoly than under monopoly.

We provide an explanation for the price raising effect of higher competition. Considering an industry with asymmetric cost firms, we show that a rise in the number of more cost inefficient firms makes the consumers worse-off in the presence of a welfare maximizing tax/subsidy policy.[1] However, the consumers are better off if either the number of more cost efficient firms increases or the costs of the more cost inefficient firms reduce.

To understand the reasons for our results, let us first consider the situation with no tax/subsidy policies of the government. We encounter two types of inefficiencies under oligopoly with cost asymmetry. One type of inefficiency is due to the oligopolistic competition, and the other type of inefficiency is due to cost asymmetry. If the number of firms increases, it tends to reduce the inefficiency due to oligopolistic competition, irrespective of the entrant's marginal cost. 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. In the absence of tax/subsidy policies, the effect of inefficiency due to oligopolistic competition dominates the effect of inefficiency due to cost asymmetry, and

[1] The implications of indirect tax in imperfectly competitive markets have been discussed in different contexts. See, Suits and Musgrave (1953), Delipalla and Keen (1992), Seade (1985), Stern (1987), Tam (1991) and Hamilton (1999) for a representative sample.

more firms or lower marginal costs of the more cost inefficient firms increase total output and make the consumers better off.

However, the situation changes in the presence of a welfare maximizing uniform tax/subsidy policy.[2] A uniform tax/subsidy can eliminate the effects of inefficiency due to oligopolistic competition, but it cannot eliminate the effect of inefficiency due to cost asymmetry. Hence, any change that increases the inefficiency due to cost asymmetry affects the consumers adversely. Therefore, a rise in the number of more cost inefficient firms reduces consumer surplus in the presence of a uniform tax/subsidy policy. However, more cost efficient firms or lower marginal costs of the more cost inefficient firms make the consumers better-off.

One should not get confused between our result and Lahiri and Ono (1988) and Klemperer (1988), which suggest that*, higher competition, either due to lower marginal cost or due to entry of a firm, always makes the consumers better off, although entry of a more cost inefficient firm may reduce welfare. Our result does not support the results of Lahiri and Ono (1988) and Klemperer (1988) in the sense that a rise in the number of more cost inefficient firms in our analysis makes the consumers worse off.*

Since the endogenous tax/subsidy policies can be viewed as a way to regulate the equilibrium outcomes, our paper can be related to Gans and Quiggin (2003) and Mukherjee and Wang (2011), which show respectively that higher competition may hurt the consumers in the presence of "regulation with scale economies" and "welfare maximising nationalised firm". Hence, our analysis, along with Gans and Quiggin (2003) and Mukherjee and Wang

[2] 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."

(2011), suggests that the price raising effect of competition can be a more common phenomenon under regulatory mechanism.[3]

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, t,[4] on each firm.

We assume that the inverse market demand function is $P = a - q$, where P is price and q is the total output. We show in the *Appendix* that our result holds under a general demand function.

We consider the following game. Given the number of firms, at stage 1, the government determines t 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 and the profits are realized. We solve the game through backward induction.

Given the tax rate, each of the n firms maximizes $(a-q-t)q_i$ to determine its output, where $i = 1,2,...,n$, and each of the 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 as $q_i^* = \frac{a-t+mc}{n+m+1}$ and

[3] There are some other papers challenging the price reducing effects of competition. The factors responsible for the price raising effects of competition in those papers are consumers' search costs (Janssen and Moraga-González, 2004), the presence of the loyal and switching buyer groups (Rosenthal, 1980) and the consumers' preferences for differentiated products (Chen and Riordan, 2008). See also the references in Chen and Riordan (2008) for the papers showing the price raising effects of competition in the spatial models of product differentiation. In contrast, our result is due to the endogenous tax/subsidy policies, and do not depend on the above-mentioned factors.

[4] If t is negative, it implies that the government is subsidizing the firms.

$q_j^* = \dfrac{a - t - (n+1)c}{n+m+1}$ respectively. 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 price of the product are respectively

$$q^* = \frac{(a-t)(n+m) - mc}{n+m+1} \text{ and } P^* = \frac{a + t(n+m) + mc}{n+m+1}. \quad (1)$$

It is clear from (1) that, for a given tax rate, more firms (regardless of their marginal costs) and lower costs of the more cost inefficient firms increase q^*, thus making the consumers better off. *Hence, higher competition makes the consumers better-off under exogenous tax/subsidy.*

Now we show the effects of the strategic tax/subsidy policy. To show this, we solve the first stage of the game, where the government determines *t* to maximize welfare, which is the sum of total profits (Π), consumer surplus (CS) and tax revenue (TR). Hence, the government maximizes the following expression to determine *t*:

$$\underset{t}{Max} W = \underset{t}{Max} \underbrace{(P^* - t)\sum_{i=1}^{n} q_i^* + (P^* - c - t)\sum_{j=n+1}^{n+m} q_j^*}_{\Pi} + \underbrace{\frac{(q^*)^2}{2}}_{CS} + \underbrace{tq^*}_{TR}, \quad (2)$$

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

We get the equilibrium tax rate as $t^* = \dfrac{-m(a-c) - an}{(n+m)^2} < 0$. Incorporating the equilibrium tax rate, we get the equilibrium outputs of the *i*th firm, $i = 1, 2, ..., n$, and the *j*th firm, $j = n+1, n+2, ..., n+m$, as $q_i^* = \dfrac{a(n+m) + mc(n+m-1)}{(n+m)^2}$ and

$q_j^* = \dfrac{a(n+m)(n+m+1) - c[(n+1)(n+m)^2 + m]}{(n+m+1)(n+m)^2}$ respectively. The equilibrium outputs of all firms are positive if $a > \dfrac{c(m+mn+n^2)}{(m+n)} \equiv \bar{a}$, which is assumed to hold.

The total equilibrium output is $q^* = a - \dfrac{mc}{n+m}$. Since $\dfrac{\partial q^*}{\partial n} = \dfrac{mc}{(n+m)^2} > 0$, $\dfrac{\partial q^*}{\partial m} = -\dfrac{nc}{(n+m)^2} < 0$ and $\dfrac{\partial q^*}{\partial c} = -\dfrac{m}{(n+m)} < 0$, the following proposition is immediate.

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*.

The reason for our interesting result, which is Proposition 1(b), is as follows. We have seen that, for a given *t*, an increase in *m* increases total output. However, if *m* increases, it reduces subsidy (i.e., $-t^*$), which tends to reduce the total output. Since the tax policy internalizes the inefficiency due to oligopolistic competition but not the inefficiency due to the cost asymmetry, an increase in *m* reduces the total output by reducing subsidy.[5] We show in the *Appendix* that this result holds under a general demand function.

It is intuitive that if the products are differentiated in our analysis, more firms, irrespective of their marginal costs, 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

[5] It is also worth mentioning that we get $\dfrac{\partial W^*}{\partial m} = \dfrac{nc[-a(m+n) + c(m+mn+n^2)]}{(m+n)^3} < 0$ for $c > 0$, since $a > \dfrac{c(m+mn+n^2)}{(m+n)}$ due to the requirement for positive equilibrium outputs. Hence, more cost inefficient firms reduces welfare whenever all firms produce positive outputs.

in the number of more cost inefficient firms. Therefore, 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.

It is also worth mentioning that uniform tax/subsidy is important for Proposition 1(b). It is intuitive that the government could eliminate the inefficiencies created by oligopolistic competition as well as cost asymmetry if it could charge discriminatory tax/subsidies. In this situation, the number of firms would not affect the total output and consumer surplus. However, as mentioned in the introduction, institutional reasons or the implementation costs may be responsible for the uniform tax/subsidy policy, and in the presence of which a rise in the number of more cost inefficient firms makes the consumers worse off.

Finally, the presence of more cost efficient firms in our analysis does not prevent the more cost inefficient firms from entering the industry, implying that there is limited number of more cost efficient firms in the industry. However, this may not be the case with free entry of more cost efficient firms, where the entire market can be served by the more cost efficient firms only. Hence, our analysis is applicable in industries where both types of firms co-exist.

3. Conclusion

We show that, in an industry with asymmetric cost firms, a rise in the number of more cost inefficient firms hurts the consumers in the presence of a welfare maximizing tax/subsidy policy. Hence, instead of increasing competition, reducing inefficiency due to cost asymmetry may be more desirable under endogenous tax/subsidy policy.

Appendix

Output reducing competition under a general demand function: Assume that the inverse market demand function is $P(q)$ with $P' < 0$ and $P'' \leq 0$.[6] 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:

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

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

It follows from (A7) that $\frac{\partial t^*}{\partial m} > 0$, i.e., a rise in the number of more cost inefficient firms 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 the total output. We get from (A5) that

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

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

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

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 under 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 immediate from (A9) that 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 rate, a rise in the number of more cost inefficient firms 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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