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THE SOCIAL COST OF MONOPOLY WITH ASYMMETRIC LOBBYING ABILITIES

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The regulated monopoly price assumes the weighted average value of the monopoly price and the competitive market price. The weights are determined by the relative sizes of resources the monopolist and the consumers expend. The agents differ in their abilities of exerting political influences. We show that the consumers may lose by defending their surplus and that the consumers' surplus-defending efforts lead to either higher or lower social cost of monopoly.

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I. INTRODUCTION

By expending resources, firms compete to win a monopolist position which is often secured by the government. Because of such expenditures, Tullock [1967] and Posner [1975] have defined the social cost of monopoly as the sum of the deadweight loss and the resource expenditures on rent seeking.

The consumers do not passively accept monopoly practice. They often engage in costly surplus-defending activity, such as persuading authorities to regulate the price or quality of the monopolized good. Hence the monopolist seeks to defend its monopoly rent, while the consumers seek to defend their surplus. The social cost of monopoly is the sum of the deadweight loss, the resource expenditures on monopoly-rent seeking, consumer-surplus defending and monopoly-rent defending. Then an interesting question occurs on the consumer participation in regulating

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monopoly whether it increases the social cost of monopoly or not, as compared with that incurred in the case of passive consumers (Wenders(1987), Ellingsen(1991), Schmidt(1992), Baik(1997); Appelbaum and Katz(1986), Fabella (1995)). Wenders(1987) predicts that the consumers' surplus-defending activities lead to higher social cost of monopoly. Ellingsen(1991), Schmidt(1992) and Baik (1997) conclude that the consumers' surplus-defending activities generally lead to lower social cost of monopoly.

We modify the model of Ellingsen(1991) in two aspects: weighted average determination of regulated monopoly price and asymmetric lobbying abilities. In the earlier works the regulated monopoly price is determined either at the monopoly price or at the competitive market price. This means that the stakes of the monopolist and the consumers are fixed. But, we assume that the regulated monopoly price is determined at the weighted average value of the monopoly price and the competitive market price. The weights are determined by the relative sizes of expenditures the monopolist and the consumers expend. This means that the stakes of the monopolist and the consumers are not fixed but vary depending upon the sizes of expenditures the agents expend. The idea is not arbitrary but similar to the conception of the political support function in Peltzman(1976) or the ex-post rule in Ursprung(1990).

In Ellingsen(1991), Schmidt(1992), Fabella(1995) and Baik(1997), the number of firms is one of the important parameters which influence the expected value of the prizes of the firms and the consumers; but some aspects of asymmetries lacks in those works. So we introduce three types of asymmetries: technologies of firms, lobbying abilities of firms over monopoly position, and lobbying abilities of firms against the consumers over monopoly regulation. Unfortunately, the number of firms is fixed for two in order to have explicit solutions.

We show that the consumers may lose by defending their surplus actively. The more efficient firm could be the Nash loser and vice versa. The consumers' surplus-defending efforts lead to either higher or lower social cost of monopoly.

Section Ⅱ develops the basic model. Section Ⅲ solves the subgame-perfect equilibrium and obtains some preliminary results. Section Ⅳ establishes the main results. Section Ⅴ offers the concluding remarks.

Ⅱ. THE MODEL

Consider an industry where the consumers are represented by the inverse demand function given by $p(q)=\bar{p}-b\cdot q$ where $\bar{p}$ is the choke-off price for the industry. There are two potential monopolists, Firm 1 and Firm 2. The firms' technologies are given by $c_i(q)=c_i\cdot q$, $i=1,2$. Suppose that Firm i has been selected as the monopolist. If Firm i is not regulated at all, then the monopoly price is $p_i^m=(\bar{p}+c_i)/2$, the monopoly quantity is $q_i^m=(\bar{p}-c_i)/(2b)$ and the monopoly profit is $\pi_i = (\bar{p} - c_i)^2/(4b)$. The monopoly profit is maximal and the consumer surplus is minimal. On the other hand, if Firm i is regulated at the competitive market price, $p_i^c = c_i$, then the monopoly quantity is $q_i^c = (\bar{p} - c_i)/b$. The monopoly profit is zero and the consumer surplus is maximal. Hence the consumers and the monopolist contend for a degree of monopoly regulation.

We consider a two-stage game: The positioning stage, in which the firms contend for the monopoly position, is followed by the regulation stage, in which the consumers and the winning firm, monopolist, contend for a degree of monopoly regulation. The players are Firm 1, Firm 2 and the representative consumer. They are risk-neutral.

At the positioning stage, Firm 1 and Firm 2 contend for the monopoly position. Let e_i represent the level of irreversible rent-seeking outlay Firm i expends. The probability that Firm i wins the monopoly position is given by

$$r_1 = \frac{e_1}{e_1 + \sigma e_2} \text{ and } r_2 = \frac{\sigma e_2}{e_1 + \sigma e_2},$$

where $\sigma(>0)$ represents Firm 2's relative ability to Firm 1 in the positioning-stage contest. $\sigma > 1$ means that Firm 2 has more ability than Firm 1. Ellingsen [1991] assumes implicitly that $\sigma = 1$. We allow that $\sigma \neq 1$. The overall payoffs of the firms are given by

$$W_1 = V_1^* \frac{e_1}{e_1 + \sigma e_2} - e_1 \tag{1}$$

$$W_2 = V_2^* \frac{\sigma e_2}{e_1 + \sigma e_2} - e_2, \tag{2}$$

where V_i^* denotes the equilibrium regulation-stage payoff of Firm i.

At the regulation stage, the winner of the positioning stage, say Firm i, contends for monopoly rent and the consumer for surplus. Let x_i represent the level of irreversible outlay Firm i expends in order to defend the monopoly rent and let y_i the level of irreversible outlay the consumer expends in order to defend the consumer surplus against Firm i. The regulated monopoly price is determined by

$$p_i^r(x_i, y_i) = p_i^c \frac{x_i}{x_i + \theta_i y_i} + p_i^m \frac{\theta_i y_i}{x_i + \theta_i y_i}, \tag{3}$$

with $p_i^r(0, 0) = p_i^m$. The regulated monopoly price is the weighted average of the monopoly price and the competitive market price. The weights are determined by the relative sizes of outlays the consumer and the monopolist expend. $\theta_i(>0)$ represents Firm i's relative ability to the consumer in the regulation-stage contest. $\theta_i>1$ means that Firm i has more ability than the consumer. Ellingsen(1991) assumes implicitly that $\theta_1=\theta_2=1$. Schmidt(1992) and Baik(1997) that $\theta_1=\theta_2$. We allow that $\theta_1\neq\theta_2$.

Since the demand is linear, Equation (3) can be expressed in terms of quantity:

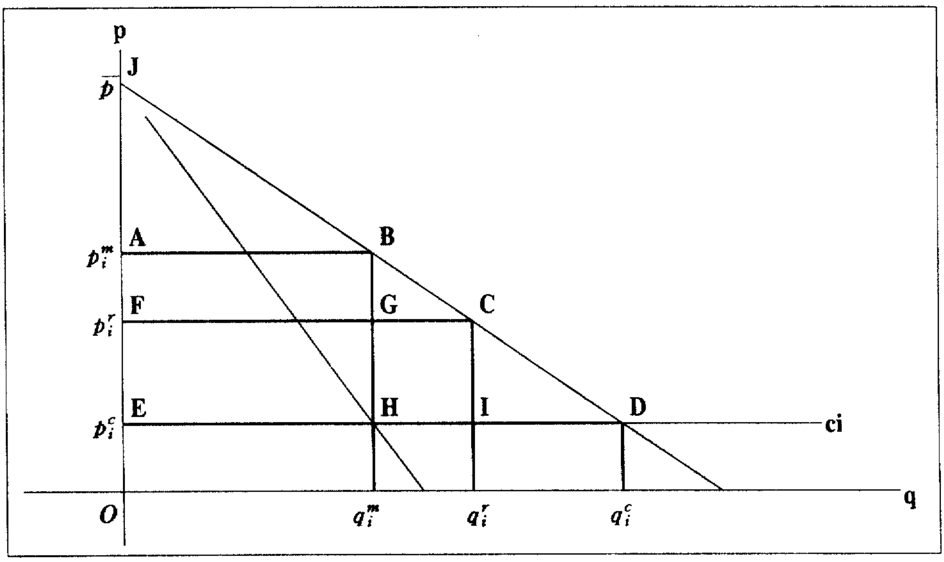
$$q_i^r(x_i,y_i)=q_i^c\frac{x_i}{x_i+\theta_i y_i}+q_i^m\frac{\theta_i y_i}{x_i+\theta_i y_i}=q_i^m\left(1+\frac{x_i}{x_i+\theta_i y_i}\right) \tag{4}$$

with $q_i^r(0,0)=q_i^m$. The weighted average determination of the regulated monopoly price is illustrated in Figure 1.

The consumer's surplus, the monopolist profit, and the deadweight loss at $q_i^r(x_i,y_i)$ are given by

$$q_i[q_i^r(x_i,y_i)]=\int_0^{q_i^r}p(q)dq-p(q_i^r)q_i^r=\frac{\pi_i}{2}\left(1+\frac{x_i}{x_i+\theta_i y_i}\right)^2;^{1)}$$

[Figure 1] The Weighted-Average Determination of Regulated Monopoly Price



$\overline{p_i^m p_i^r}:\overline{p_i^r p_i^c}=AF:FE=x_i:y_i$

(For the linear demand case, $\overline{q_i^m q_i^r}:\overline{q_i^r q_i^c}=x_i:y_i$).

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[1] Note that some part of the consumer surplus (ABJ in Figure 1) is always secured. We may define the stake of the consumer at $q_i^r(x_i,y_i)$ as follows:

$$u_i(q_i^r)-u_i(q_i^m)=\frac{\pi_i}{2}\left(1+\frac{x_i}{x_i+\theta_i y_i}\right)^2-\frac{\pi_i}{2}$$

Since the difference is only a constant term, we can safely ignore this term.

$$v_i[q_i^r(x_i, y_i)] = p(q_i^r)q_i^r - c_i(q_i^r) = \pi_i\left[1-\left(\frac{x_i}{x_i+\theta_i y_i}\right)^2\right];$$
$$H_i[q_i^r(x_i, y_i)] = \int_{q_i^r}^{q_i^c}[p(q) - c_i(q)]dq = \frac{\pi_i}{2}\left(1-\frac{x_i}{x_i+\theta_i y_i}\right)^2;$$

with $u_i(0, 0) = \pi_i/2$, $v_i(0,0) = \pi_i$, and $H_i(0,0) = \pi_i/2$. The payoffs of the regulation-stage game of the consumer and Firm i are given by

$$U_i(x_i, y_i) = u_i(x_i, y_i) - x_i \quad (5)$$

[2]

$$V_i(x_i, y_i) = v_i(x_i, y_i) - y_i. \quad (6)$$

In the earlier works, the stakes of the game are usually fixed and the stake of the consumer (ABHE plus BDH in Figure 1) is always larger than that of the monopolist (ABHE in Figure 1). In this paper, however, the stakes of the game are a priori not determined and depend upon effort levels. That the stakes of the contenders are not fixed rather resembles Ursprung(1990) and Chung (1996).

Ⅲ. EQUILIBRIUM REGULATED MONOPOLY PRICE

To obtain a subgame-perfect equilibrium of the whole game, we work backwards. The regulation-stage game between Firm i and the consumer is referred to as the subgame i. Then the subgame i has a unique Nash equilibrium (Hillman and Riley(1989) and Baik(1994)).[3] Let $\Theta_i \equiv \sqrt{1+2\theta_i}$. Note that $\theta_i > 0 \Rightarrow \Theta_i > 1$.

Lemma 1. At the Nash equilibrium of the subgame i, the equilibrium outlay of Firm i is $x_i^* = \pi_i(\Theta_i^2 - 1)/\Theta_i^3$ and that of the consumer is $y_i^* = 2\pi_i(\Theta_i - 1)/\Theta_i^3$; the equilibrium payoff of Firm i is $U_i^* = (\pi_i/2)(\Theta_i^3 + \Theta_i + 2)/\Theta_i^3$ and that of the consumer is $V_i^* = \pi_i(\Theta_i^3 - 3\Theta_i + 2)/\Theta_i^3$.

The proof of Lemma 1 is given in the Appendix. The equilibrium regulated monopoly quantity and the equilibrium regulated monopoly price are $q_i^{r*} = q_i^m + q_i^m/\Theta_i$ and $p_i^{r*} = p_i^m - (p - c_i)/(2\Theta_i)$, respectively.[4] The total

[2] We may include the deadweight loss and define

$$U_i(x_i, y_i) = u_i(x_i, y_i) + H_i(x_i, y_i) - x_i$$

as the consumer's payoff function. But we think that the consumer does not care about the deadweight loss per se. When the consumer defends his surplus, the deadweight loss consequently decreases.

[3] The Jacobian of Equations (5) and (6) is negative definite. So the subgame has a unique Nash equilibrium.

outlay of the subgame i is given by

$$T^*_{R,i} = x^*_i + y^*_i = \pi_i \frac{\theta_i^2 + 2\theta_i - 3}{\theta_i^3},$$

where the subscript 'R' denotes the regulation stage. The deadweight loss of the subgame i is

$$H^*_i = \frac{\pi_i}{2}\left(1 - \frac{1}{\theta_i}\right)^2.$$

Now we consider the positioning stage of the game. The positioning-stage game has a unique Nash equilibrium, which constitutes a unique subgame-perfect equilibrium of the whole game.[5] Let $\Delta = \pi_2/\pi_1$[6] and $\rho = [(\theta_2^3 - 3\theta_2 + 2)/\theta_2^3]/[(\theta_1^3 - 3\theta_1 + 2)/\theta_1^3]$[7]. Thus $V^*_2/V^*_1 = \Delta\rho$, that is, the ratio of the stakes of the positioning-stage game is the product of the efficiency ratio and a function of θ_1 and θ_2.

Lemma 2. At the Nash equilibrium of the positioning-stage game, the equilibrium outlay of Firm i is $e^*_i = \pi_i \frac{\theta_i^3 - 3\theta_i + 2}{\theta_i^3} \frac{\sigma\Delta\rho}{(1+\sigma\Delta\rho)^2}$ for $i = 1, 2$; theequilibrium payoffs of Firm 1 and Firm 2 are $W^*_1 = \pi_1 \frac{\theta_1^3 - 3\theta_1 + 2}{\theta_1^3}\left(\frac{1}{1+\sigma\Delta\rho}\right)^2$ and $W^*_2 = \pi_2 \frac{\theta_2^3 - 3\theta_2 + 2}{\theta_2^3}\left(\frac{\sigma\Delta\rho}{1+\sigma\Delta\rho}\right)^2$.

The proof of Lemma 2 is omitted. The equilibrium probability of Firm 1's

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[4] Rowley and Tollison [1986, p220] argue that once the monopoly is established in the industry, the regulated monopoly price is set slightly above the midpoint of $\overline{p_i^m p_i^c}$ and they argue that this reflects the fact that the monopolist's stake is greater than the consumer's (that is, FCIE exceeds ABCF in Figure 1), when the regulator chooses an equilibrium price along $\overline{p_i^m p_i^c}$ weighing equally the 'dollar votes' of the monopolist and the consumer. Our trouble with their argument is as follows: Both the consumer and the monopolist are not able to figure out how big their stakes are in advance, since they do not know what the regulation price would be. In other words, the consumer and the monopolist do not know which one is bigger, FCIE or ABCF, unless they know how p_i^r is chosen along $\overline{p_i^m p_i^c}$. In this sense, their argument is tautological. In fact, we have $\theta_i = 1 \Rightarrow p_i^{r*} < (p_i^m + p_i^c)/2$. This result shows that the monopolist's stake is not necessarily greater than the consumer's. However, we include some part of the consumer surplus (ABJ in Figure 1) but exclude the deadweight loss (CDI in Figure 1) from the usual consumer's stake (ABDE in Figure 1).

[5] The Jacobian of Equations (1) and (2) is negative definite. So the positioning-stage game has a unique Nash equilibrium.

[6] $\Delta > 1$ means that Firm 2 is more efficient than Firm 1..

[7] $\rho > 1$ if and only if $(\theta_2/\theta_1) > 1$.

winning is $r_1^* = 1/(1+\sigma\Delta\rho)$ and that of Firm 2's is $r_2^* = \sigma\Delta\rho/(1+\sigma\Delta\rho)$. The equilibrium payoff of the consumer is

$$U^* = r_1^* U_1^* + r_2^* U_2^* = \frac{1}{1+\sigma\Delta\rho}\frac{\pi_1}{2}\frac{\Theta_1^3+\Theta_1+2}{\Theta_1^3} + \frac{\sigma\Delta\rho}{1+\sigma\Delta\rho}\frac{\pi_2}{2}\frac{\Theta_2^3+\Theta_2+2}{\Theta_2^3}.$$

When the consumer passively accepts monopoly practice, we can get the payoffs of the players by plugging $\rho=1$ and eliminating expressions involving Θ's. $W_1^O = \pi_1\left(\frac{1}{1+\sigma\Delta}\right)^2$, $W_2^O = \pi_2\left(\frac{\sigma\Delta}{1+\sigma\Delta}\right)^2$, and $U^O = \frac{1}{1+\sigma\Delta}\frac{\pi_1}{2} + \frac{\sigma\Delta}{1+\sigma\Delta}\frac{\pi_2}{2}$, where the superscript 'O' denotes the case of the passive consumer.

The total outlay of the regulation stage, the deadweight loss and the total outlay of the positioning stage are given by

$$\begin{aligned} T_R^* = r_1^* T_{R,1}^* + r_2^* T_{R,2}^* &= \frac{1}{1+\sigma\Delta\rho}\pi_1\frac{\Theta_1^2+2\Theta_1-3}{\Theta_1^3} \\ &+ \frac{\sigma\Delta\rho}{1+\sigma\Delta\rho}\pi_2\frac{\Theta_2^2+2\Theta_2-3}{{\Theta_2}^3}, \\ H^* = r_1^* H_1^* + r_2^* H_2^* &= \frac{1}{1+\sigma\Delta\rho}\frac{\pi_1}{2}\left(1-\frac{1}{\Theta_1}\right)^2 + \frac{\sigma\Delta\rho}{1+\sigma\Delta\rho}\frac{\pi_2}{2}\left(1-\frac{1}{\Theta_2}\right)^2, \\ T_P^* = e_1^* + e_2^* &= \left(\pi_1\frac{\Theta_1^3-3\Theta_1+2}{\Theta_1^3} + \pi_2\frac{\Theta_2^3-3\Theta_2+2}{\Theta_2^3}\right)\frac{\sigma\Delta\rho}{(1+\sigma\Delta\rho)^2}, \end{aligned}$$

where the subscript 'P' denotes the positioning stage. The total outlays of the whole game is $T_P^* + T_R^*$. The social cost of monopoly is $T_P^* + T_R^* + H^*$.

Similarly, for the case of the passive consumer, we obtain the total outlay $T^O = (\pi_1+\pi_2)\frac{\sigma\Delta}{(1+\sigma\Delta)^2}$ and the deadweight loss $H^O = \frac{1}{1+\sigma\Delta}\frac{\pi_1}{2} + \frac{\sigma\Delta}{1+\sigma\Delta}\frac{\pi_2}{2}$.

IV. MAIN RESULTS

Suppose that $\Delta\sigma>1$ and $\rho<1$ such that $\Delta\sigma\rho<1$, then $1/(1+\Delta\sigma)<1/2$ and $1/(1+\Delta\sigma\rho)>1/2$. That is, Firm 1 becomes the Nash loser when the consumer behaves passively and the Nash winner when the consumer defends his surplus actively (Baik [1994]). Our results come from recognizing this possibility. We have some interesting results.

Proposition 1. There exists a vector $(\Delta, \sigma, \theta_1, \theta_2)$ such that $\Delta<1$, $\sigma<1$, and $\theta_1>\theta_2$, at which the following hold:

(i) $W_1^* > W_1^O$ and (ii) $U^* < U^O$.

The parameters such that $\Delta = 3$, $\sigma = 1.1$, $\theta_1 = 60$ and $\theta_2 = 0.105$ prove Proposition 1. Since Firm 1 is less able than Firm 2 in the positioning-stage contest ($\sigma = 1.1$) and in cost advantage ($\Delta = 3$), Firm 1 would be the Nash loser if there were not the regulation-stage contest. In other words, if there were not the consumer's surplus-defending efforts, the positioning-stage contest would be a lopsided one and Firm 2 would become the Nash winner. But there is the regulation-stage contest and Firm 1 is more able than Firm 2 in this contest ($\theta_1 = 60$ and $\theta_2 = 0.105$) and could become the Nash winner. Therefore it is possible that the surplus-defending efforts of the consumer may benefit Firm 1, which is less efficient.

The surplus-defending efforts of the consumer may hurt the consumer's payoff.[8] If this is the case, we may ask why the consumer not to choose zero surplus-defending efforts no matter what. But this strategy is an incredible threat to Firm 1 and cannot be a part of the subgame-perfect equilibrium strategy. Proposition 1 provides an exception to the rule that consumers' lobbying tends to increase consumers' welfare.

Due to the consumer's surplus-defending efforts, the positioning-stage contest might become closer to an even contest and, thus, the positioning-stage outlay might increase. So we have the next proposition.

Proposition 2. There exists a vector $(\Delta, \sigma, \theta_1, \theta_2)$ such that $\Delta < 1$, $\sigma < 1$, and $\theta_1 > \theta_2$, at which the following hold:

$$T_P^* > T^O \text{ so that } T_P^* + T_R^* + H^* > T^O + H^O.$$

The parameters such that $\Delta = 1.1$, $\sigma = 4$, $\theta_1 = 60$ and $\theta_2 = 0.105$ prove Proposition 2. The surplus-defending efforts of the consumer could cause the total outlay of the positioning stage to increase. This weakens the presumption that regulated monopoly pricing will reduce the firms' interest in the monopoly and hence lower their outlays. Hence, in general, the net impact of the consumer surplus-defending efforts on the total outlays and the social cost of monopoly is far from obvious.

In the next proposition, we show how strong the assumption that $\theta_1 = \theta_2$ is.

Proposition 3. If $\theta_1 = \theta_2$, then the following hold, for all (Δ, σ):

(i) $W_i^* < W_i^O$ for $i = 1, 2$, (ii) $U^* > U^O$, (iii) $H^* < H^O$ and

[8] The possibility of Proposition 1 disappears when the regulation stage is followed by the positioning stage (Baik [1997]).

(iv) $T_P^* < T^O$.

The proof of Proposition 3 is straightforward and omitted.[9] As far as the firms are equally able in the regulation-stage contest against the consumer, the surplus-defending efforts of the consumer hurt the firms, improve the consumer's payoff, and reduce the deadweight loss and the total outlay of the positioning stage. Based on Proposition 3, we have

Corollary. Let $\Delta = 1$, $\sigma = 1$ and $\theta_1 = \theta_2 (= \theta)$. Then

(i) $T_P^* + T_R^* < T^O \Leftrightarrow \theta < (9 - \sqrt{33})/16 \approx 0.20$;

(ii) $T_P^* + T_R^* + H^* < T^O + H^O \Leftrightarrow \theta < 1.5$.

If we assume that $\theta = 1$, then the total outlays and the social cost of monopoly of the active-consumer case are smaller than those of the passive-consumer case (Ellingsen [1991]). But, for a sufficiently large value of θ, the opposite is true.

V. CONCLUDING REMARKS

The weighted average determination of the regulated monopoly price is based on the idea that the degree of regulation of monopoly could be other than all-or-nothing regulation. One issue missed in this work is whether the regulator is actually optimizing when choosing this weighted average value.

If one choose the number of firms as one of the parameter, one sometimes need to employ symmetry in order to have explicit solutions. In this respect our work complements the earlier ones by introducing various asymmetries.

Then we may ask how relevant this curiosity is to the reality. In South Korea, at the end of President Roh Tae Woo's administration, the authority decided that SK chaebol, whose CEO's daughter having married President Roh's son, would be the 'First Entrepreneur' of mobile telecommunication industry. Public outcry followed and the authority called off the decision. Later, during President Kim Young Sam's administration, SK became the 'First Entrepreneur' of mobile telecommunication industry. In Indonesia, "the government grants special duty-free status for only one carmaker, Kia Motors of South Korea." (Business Week, International Edition, April 8, 1996, 17-18). As we know, the

[9] Rowley and Tollison [1986, p220] argued that, under the full dissipation assumption, the social cost of the established partial monopoly is equal to the social cost of full monopoly without consumer competition (that is, ABCF+FCIE+CID is equal to ABDE in Figure 1). But we have that $\Delta = 1$, $\sigma = 1$ and $\theta_1 = \theta_2$ together imply $T_R^* + H^* < T^O + H^O$ for all θ. That is, under the efficient dissipation assumption the social cost of the established partial monopoly is less than the social cost of full monopoly without consumer competition.

public, including other foreign carmakers, outcry has followed.

These two incidents imply that there lurk two types of costs; one is that a more efficient firm may need to expend additional resources to just get the public's approval. The other is that a less efficient firm may win the special status due to its friendliness to the authorities. This could be, in part, why public relation specialists as well as lobbyists are abundant in real life.

APPENDIX

Proof of Proposition 1.

Since $\frac{\partial u_i}{\partial x_i} > 0$, $\frac{\partial^2 u_i}{\partial x_i^2} < 0$, the best-response function of the consumer is

$$\pi_i \frac{\theta_i y_i^2 + 2x_i\theta_i y_i}{(x_i + \theta_i y_i)^3} - 1 = 0. \tag{A1}$$

Since $\frac{\partial v_i}{\partial y_i} > 0$, $\frac{\partial^2 v_i}{\partial y_i^2} < 0$, the best-response function of Firm i is

$$\pi_i \frac{2x_i^2\theta_i}{(x_i + \theta_i y_i)^3} - 1 = 0. \tag{A2}$$

Equating (A1) and (A2) and adding x_i^2 to both sides, we obtain

$$(1 + 2\theta_i)x_i^2 = (x_i + \theta_i y_i)^2 \Leftrightarrow \Theta_i x_i = x_i + \theta_i y_i, \tag{A3}$$

where $\Theta_i = \sqrt{1 + 2\theta_i}$. Substituting (A3) into (A2), we get

$$x_i^* = \pi_i \frac{\Theta_i^2 - 1}{\Theta_i^3}. \tag{A4}$$

Substituting (A4) into (A3) and rearranging, we get

$$y_i^* = 2\pi_i \frac{\Theta_i - 1}{\Theta_i^3}.$$

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