An Optimal Incentive Tax Policy on Horizontal Mergers

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This paper analyzes an optimal antitrust policy on horizontal mergers under asymmetric information when antitrust agency cannot observe the post-merger private cost of merged firms. By using a discrete mechanism design approach with self-selection, this paper proposes an incentive compatible lump-sum tax scheme to provide an efficient decision on whether the application for merger should be accepted or rejected. Results show that the optimal size of lump-sum tax is not affected by the informational rent of private post-merger cost information of merged firms.

Keywords: Antitrust policy, horizontal merger, Asymmetric information, Lump-sum tax, incentive compatibility, Mechanism design

JEL Classification: L41, D4, K0

I. Introduction

The level of merger activity is an important factor affecting the market structure throughout the last century. Horizontal mergers between large firms can have significant effects on the structure of industries with imperfect competition. In particular, anti-competitive horizontal mergers can increase the market power of monopolistic firms and affect seriously the efficiency of the market. In his seminal paper, Williamson (1968) points out that modest cost savings from horizontal mergers often result

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in increased social welfare. Therefore, a continuing debate exists as to whether mergers generally promote greater efficiency or greater market power.

The United States Department of Justice has issued its first set of merger guidelines in 1968. The guidelines are created to help reduce uncertainties regarding the legality or illegality of mergers. New guidelines have been released in 1982 and revised in 1984. Compared with the 1968 guidelines, the 1982 guidelines have left relatively few mergers open for challenge. Furthermore, the 1984 guidelines explicitly recognize the relevance of efficiency gains in the decision-making process of a department. However, these guidelines are not for the absolute defense of departments, but can only be denoted as a factor to be considered before making the final decision. In 1992, the guidelines have been revised again to emphasize further the influence of mergers on price and entry condition.[1]

Previous theoretical literature on horizontal mergers can be divided into three trends. The first trend involves the traditional approach on the profit and welfare effect of horizontal mergers under complete information. Perry and Porter (1985) propose a model of horizontal mergers between two Cournot duopolies, in which each firm has the same constant average cost, while McAfee and Williams (1992) consider a model in which firms have different costs. Kabiraj and Lee (2003) create a three-firm model with asymmetric costs and portrayed situations where firms fail to merge into grand coalition. Farrell and Shapiro (1990) and Levin (1990) also contribute to the research on merger policy as to whether merger activity under complete information should be prohibited. Andrade *et al.* (2001), Whinston (2006), and Choi (2007) present an analysis on horizontal merger, providing the empirical works and practical sides of the antitrust law.

The second trend includes recent policy intervention on remedies instead of outright prohibition. Merger activity is shaped by self-selection on participating firms that believe their merger can pass scrutiny and can generate sufficient benefits to brave the regulatory process. Leveque and Shelanski (2003) document evidence on remedied mergers in the United States and the European Union since 1990. Verge (2010) considers

[1] The European Union (EU) merger control regulation has adopted an analytic framework similar to the United States (US) merger guidelines. For example, the EU guidelines report that any merger that will significantly impede effective competition in the common market or in a substantial part of it should be blockaded, whereas the US guidelines report that mergers are prohibited if they would result in a substantial lessening of competition.

the structural remedies of divesture of assets under Cournot oligopoly and Vasconcelos (2010) extended Verge's analysis by focusing on endogenous mergers to increase consumer's surplus.

The third trend approaches on the incentive issue of merger policies under incomplete information. Merging firms usually have better information on prospective cost savings than the antitrust authority does. Lagerlof and Heidhues (2005) consider the asymmetric information where two firms that have proposed to merge are privately informed about merger-specific efficiencies, and analyze the strategic behavior of firms when revealing information to an antitrust authority Cosnita and Tropeano (2009) also consider the efficiency gains in the design of structural remedies when antitrust authority does not observe the magnitude of efficiency gains.

Our paper is closely related to the last approach under incomplete information. We take a discrete version of mechanism design when the private information about post-merger cost is present.[2] On the basis of Williamson's argument, we focus on the fact that cost saving can be used to justify anti-competitive horizontal mergers only if the increase in social welfare from the merger exceeds a positive threshold that depends on the quality of the information on cost savings given to the government. Besanko and Spulber (1993) examine the enforcement process of antitrust policy under the guideline for consumer's surplus and indicate that filling fees for pre-merger notification can deter marginally profitable mergers. By using self-selection property in a mechanism design process, this article provides a detailed analysis on efficient lump-sum tax, which can induce welfare-improving horizontal merger under asymmetric information when an antitrust agency cannot observe the post-merger cost of merged firms. The proposed incentive merger tax provides the efficient decisions of antitrust policy, which is not affected by the informational rent of the private cost information of merged firms at the post-merger cost level.

The organizational structure of this paper is as follows: Section II considers the basic model on horizontal merger policy under complete information and provides an optimal decision whether to allow or reject horizontal mergers. Section III analyzes the case of asymmetric infor-

[2] Laffont and Martimort (2002) provide the revelation principle in the general theory of incentives for a continuous decision model. Mitchell and Moro (2006) and Lee (2010) propose an incentive mechanism for a discrete decision model of trade policy and privatization policy, respectively.

mation in which the antitrust agency cannot observe the post-merger private cost of the merged firm. An optimal decision mechanism on horizontal merger is also proposed in this section. Section IV extends the analysis of the basic model into practical discussions on adjusted welfare standard and partial merger in a Cournot oligopoly with more than three firms. Section V provides the conclusion.

II. Optimal Merger Policy with Complete Information

We will consider the simplified version of Williamson's model on horizontal mergers in which the trade-off between market power and production efficiency gains from merger is illustrated. We assume that the pre-merger market consists of a duopoly, of which products are homogeneous, and that two competitors are going to merge to form a monopoly. Without considering the fixed cost, pre-merger marginal production cost is assumed the same and constant at c_0 for both firms, and the post-merger marginal cost is constant at c_1. Cost-savings arises if $c_0 > c_1$ or $\delta \equiv c_0 - c_1 > 0$. Note that keeping the status quo is considered as the optimal antitrust policy when there is the same cost between pre- and post-mergers. Therefore, we assume that a costs saving effect provides interior solutions and reasonable decisions on the optimal policy.

Inverse market demand function is given by $P = P(Q)$, which is an invariant between pre-merger and post-merger. The pre-merger price is assumed $P_0 \geq c_0$, in which two competing firms earn non-negative profit in the market. Let us define pre-merger consumer's surplus as $CS_0 = \int_0^{Q_0} P(v)dv - P_0 Q_0$, where Q_0 is the pre-merger market output level that is produced by two firms. The pre-merger social welfare, which is the sum of consumer's surplus and industry profits, π_0, is $W_0 = CS_0 + \pi_0$. Let us now examine the post-merger market performance. After merger, the monopolist will maximize the merged profit, $\pi(Q_1) = P(Q_1)Q_1 - c_1 Q_1$. The profit-maximizing output level of the monopolist can be defined as $Q_1(c_1)$, that is, the post-merger market output level is the function of post-merger cost c_1. Thus, the resulting post-merger profit can be also defined as a function of c_1, $\pi(C_1)$. The resulting post-merger consumer's surplus and social welfare will be $CS(c_1) = \int_0^{Q(c_1)} P(v)dv - P(Q_1(c_1))Q_1(c_1)$ and $W(c_1) = \int_0^{Q(c_1)} P(v)dv - c_1 Q(c_1)$, respectively. Let us define the changes of industry profit, consumer's surplus, and welfare between pre-merger and post-merger as $\Delta\pi = \pi(c_1) - \pi_0$, $\Delta CS = CS(c_1) - CS_0$, and $\Delta W = W(c_1) - W_0$, respectively.

The following are the properties of the post-merger market performance, which include industry profit, consumer's surplus, and welfare. First, the outputs and profits of the merged firm are decreasing functions of post-merger cost,[3] that is, $(\partial Q_1/\partial c_1)<0$ and $(\partial \pi/\partial c_1)<0$. Therefore, if the post-merger cost increases, then the merged firm reduces its output, which results in reduced profit. Second, consumer's surplus and welfare after merger are decreasing functions of the post-merger cost, that is, $(\partial CS(c_1)/\partial c_1)<0$ and $(\partial W(c_1)/\partial c_1)<0$. Therefore, if the post-merger cost increases, then the output of the merged firm decreases, which results in decreased consumer's surplus. Aside from the decrease in profit of the merged firm if the post-merger cost increases, social welfare also decreases. Changes in consumer's surplus and welfare between pre-merger and post-merger are decreasing functions of post-merger cost, that is, $(\partial \Delta CS/\partial c_1)<0$ and $(\partial \Delta W/\partial c_1)<0$. Given that consumer's surplus and welfare after merger is a decreasing function of post-merger cost and it does not affect the performance of pre-merger, consumer's surplus and the welfare between pre-merger and post-merger decrease as post-merger cost increases.

By using the abovementioned properties, we can determine the useful relations between cost level and changes in welfare, thus providing an optimal decision on antitrust policy (Figure 1). Let c^* denote the cost level of c_1, which makes $\Delta W=0$, that is, $W(c^*)=W_0$. Thus, $C^*\leq C_0$.[4] Therefore, the monotonicity of ΔW in terms of c_1 denotes that the merger is welfare-decreasing if $c_1>c^*$, whereas the merger is welfare-increasing if $c_1<c^*$. Specifically, if $c_1<c^*$, the post-merger production efficiency is greater than the increase of post-merger welfare loss.

Let c^{**} denote the cost level of c_1, which makes $\Delta CS=0$, that is, $\Delta Q=\Delta P=0$. We can show that $c^*>c^{**}$. Therefore, the monotonicity of ΔCS in terms of c_1 gives the conclusion that if $c_1<c^{**}$, then the merger increases the consumer's surplus. This condition is Pareto-improving to both consumers and the two firms. However, if $c^{**}\leq 0$, then the merger always reduces the consumer's surplus.

Consider the optimal decision on horizontal merger, which either allows or rejects the horizontal merger. Let $P(c^*)=P^*$, $Q(c^*)=Q^*$, and $\pi(c^*)=\pi^*$. Then, the optimal antitrust policy under complete information determines that $R_0=\{0\leq c_1\leq c^*\}$ is for the "allowing" region and $R_1=\{c^*\leq c_1\leq c_0\}$ is for the "rejection" region. Therefore, the post-merger welfare increases only

[3] Proofs are provided in Appendix I.

[4] If not, $Q_1(c^*)<Q_0$. Thus, $W(c^*)<W_0$ always holds, which is a contradiction.

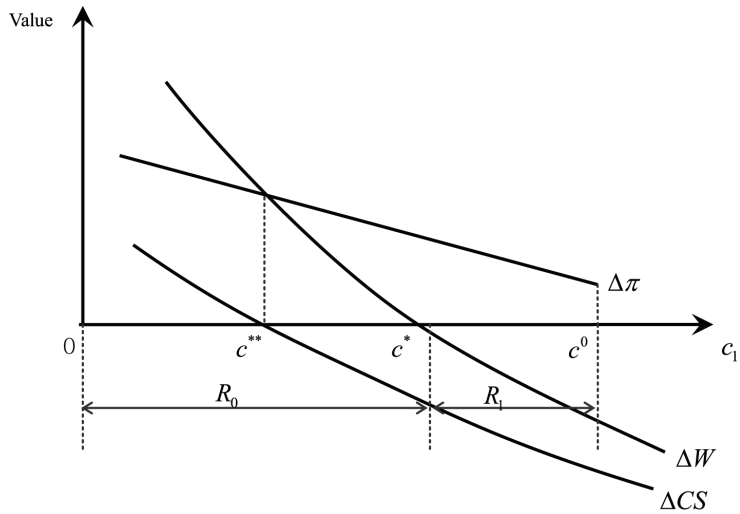

FIGURE 1
OPTIMAL MERGER POLICY WITH COMPLETE INFORMATION

if a cost savings effect is sufficiently high.

III. Optimal Merger Policy with Incomplete Information

We now examine the problem of asymmetric information when the antitrust agency has certain information on pre-merger, but no information on post-merger. In particular, we assume that the pre-merger market demand and price-cost margin are public information, but the post-merger cost level of the monopolist is private information.[5] The agency can calculate c^*, which is the threshold level of antitrust policy, from public information, such as c_0 and $P(Q)$. After the agency obtains the post-merger cost information on c_1, where c_1 becomes public, then the agency can determine the optimal policy on the basis of the values of c_1 and c^*, as discussed in Section 2.

We model the optimal antitrust policies on horizontal merger under incomplete information. The agency offers the firm whether to apply the

[5] The assumption that the agency has information on pre-merger market demand (market price P_0, price elasticity on demand η, and market share $s_i = q_i/Q_0$) gives the cost information on c_0. Specifically, from the inverse elasticity rule for price-cost margin $P_0\{1-(s_i/\eta)\}=c_0$, we can obtain the cost information from c_0.

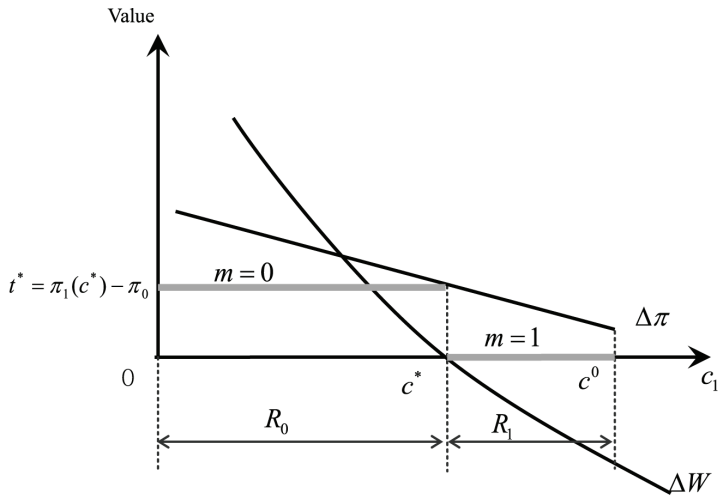

FIGURE 2
OPTIMAL MERGER POLICY WITH INCOMPLETE INFORMATION

merger. Then, the agency chooses $m=0$ (allow merger) or $m=1$ (reject merger). When the agency allow the merger, the merger can impose a lump-sum tax to the firm. This optimal tax policy has decentralized form, which can be formulated as a mechanism design: the firm reports $\hat{c}_1$, which is based on the private information on c_1. As a function of the report, the agency imposes a tax $t(\hat{c}_1)$ and policy $m(\hat{c}_1)$, which is 0 or 1.

Specifically, in the discrete optimal mechanism, the agency chooses the following lump-sum tax and decision on antitrust policy:[6] for any $\hat{c}_1 > c^*$, the merger will be allowed ($m=0$) and a lump-sum tax $t^* = \pi(c^*) - \pi_0$ will be levied. Otherwise, for any $\hat{c}_1 > c^*$, the merger will be rejected ($m=1$).

For a given report of $\hat{c}_1$, the net profit of the merged firm with post-merger cost of c_1 is defined as $\pi(\hat{c}_1, c_1) = \pi(c_1) - \pi(c^*) + \pi_0$ if $\hat{c}_1 \leq c^*$ and $\pi(\hat{c}_1, c_1) = \pi_0$ if $\hat{c}_1 \leq c^*$. In Appendix II, we show that the proposed optimal policy with incomplete information achieves efficient decision with complete information. In Appendix III, we show that the proposed optimal tax is a unique incentive mechanism, which maximizes the tax revenue

[6] Without decision policy on allowing or rejection, m, the single decision on optimal lump-sum tax can be determined as $t=M$ for any $\hat{c}_1 > c^*$, where M is a sufficiently large number that gives negative profit to the merged firm. I appreciate the comments of an anonymous referee regarding these points.

under incomplete information.

The following remarks should be considered. First, for any c_1, $\pi(\hat{c}_1, c_1) \geq \pi_0$, which guarantees that the merged firm is no worse off than the status quo $m=1$; this scenario satisfies the individual rationality (IR) constraint. Second, the firm has no incentive for reporting a false cost, which switches the decision to the other decision region; this scenario satisfies the incentive compatibility (IC) constraint of the truth-telling property. Finally, the proposed mechanism provides the agency with an efficient decision on the merger policy, which increases post-merger social welfare. Therefore, the lump-sum tax mechanism achieves the same efficiency level with complete information. Therefore, information rent does not influence the threshold for the optimal merger decision under incomplete information.

Figure 2 illustrates the optimal merger policy on $m=0$ for R_0 if $c_1 \leq c^*$ and on $m=1$ for R_1 if $c_1 > c^*$. We now review the properties of the optimal incentive tax mechanism with incomplete information. First, for the discrete choice on m, a threshold exists where the optimal choice divides the range of c_1 with the allowing range R_0 and status quo range R_1. In particular, $m=0$ when $c_1 \leq c^*$, and $m=1$ when $c_1 \leq c^*$. The low values of c_1 is the allowing range, whereas the high values of c_1 is the status quo range. Therefore, the optimal policy choice $m(c_1)$ is non-decreasing in c_1.

Second, the optimal tax is lump-sum and is non-discriminatory on the post-merger cost level whenever the policy choice is constant. In particular, the amount of lump-sum tax in R_0 is exactly equal to the increasing profit level when the post-merger cost is at the threshold, that is, $c_1 = c^*$. Therefore, the truth-telling cost information obtains positive profits when $c_1 < c^*$; an informational rent exists for the efficient cost level under asymmetric information.

IV. Extensions and Discussions

A. Consumer's Surplus Standard Versus Welfare Standard

Some of the major antitrust agencies in charge of merger control appear to operate with objectives that differ from that of welfare maximization. According to Neven and Roller (2005), both US and EU merger controls can be interpreted as maximizing consumer's surplus rather than aggregate welfare.[7] The welfare implications of consumer's surplus standard will be welfare-enhancing results rather than welfare standard because

the post-merger profit will be always increasing.

By using the basic framework in the previous section, we can apply the guideline with consumer's surplus, instead of that with social welfare. We will re-define the adjusted welfare with the weights on consumers surplus as $W = CS + \alpha\pi$, where $0 \leq \alpha \leq 1$. Notice that (pure) welfare standard implies $\alpha = 1$, whereas (pure) consumer's surplus standard implies $\alpha = 0$. Let c^s denote the cost level of c_1, which makes $\Delta W = 0$, that is, $W(c^s) = W_0$. From the decreasing properties of welfare and consumer's surplus, we have $c^{**} \leq c^s \leq c^*$.

Similar to the guideline in the previous section, we can formulate the changed set of merger policy with lump-sum tax as follows: for any $\hat{c}_1 \leq c^s$, the merger will be allowed ($m = 0$) and the lump-sum tax $t^s = \pi(c^s) - \pi_0$ will be levied. Otherwise, for any $\hat{c}_1 > c^s$, the merger will be rejected ($m = 1$).

We can apply Appendix II to prove that the proposed policy can achieve an efficient decision with complete information. Welfare will increase under the adjusted welfare standard, compared with the (pure) welfare standard. Lump-sum tax will also increase under the changed set of merger policies.

B. Cournot oligopoly with more than three firms

We will extend the traditional homogeneous product model of Cournot oligopoly with more than three firms. According to Kabiraj and Lee (2003), even though monopolization through merger will maximize industry profits by avoiding competition, firms may not successfully create a grand coalition (such as industrial monopoly) when more than three firms with asymmetric cost are present. As pointed out by Salant *et al.* (1983), however, a partial merger by a specific number of firms causes losses; that is, some exogenous mergers between sub-firms in an industry may reduce the endogenous joint profits of the merged firms because the reduced number of firms in Cournot competition would give an incentive to reduce its production. Therefore, a threshold on whether firms have an incentive to merge when cost savings arise should be available. This threshold might provide under-incentive to merge, even though the merger increases welfare.

[7] Consumer's surplus standard is most plausible to the antitrust agency and consumers in the political economy environment. On the arguments on different standards between consumer's surplus and social welfare, see Besanko and Spulber (1993) and Neven and Roller (2005), among others.

In this subsection, we will consider a partial merger, in which only two firms merge into one firm among oligopolists with more than three firms. When a merger achieves cost-saving, that is, $c_0 > c_1$ or $d \equiv c_0 - c_1 > 0$, we will examine the under-incentive of merged firms and construct a merger policy with lump-sum tax (or subsidy) for this situation.
For the sake of simplicity, we assume a linear demand function in which $P = a - bQ$ and $N(\geq 3)$ firms compete with Cournot fashion in a pre-merger period. From the first-order conditions for profit maximization, we have $q_0 = (a - c_0)/\{b(N+1)\}$ and $Q_0 = Nq_0 = \{N(a - c_0)\}/\{b(N+1)\}$. Here, consumer's surplus is defined as $CS_0 = \int_0^{Q_0} P(v)dv - P_0 Q_0$, the firm profits as $\pi_0 = (a - c_0)^2/\{b(N+1)^2\}$, and social welfare as $W_0 = CS_0 + N\pi_0 = \{N(N+2)(a - c_0)^2\}/\{2b(N+1)^2\}$ in a pre-merger situation.

Next, we consider the change of market concentration after a merger occurs between two firms among N firms. $N-1$ firms exist in the market, in which $N-2$ firms have the same production cost at c_0, and a merged firm m has a cost of c_1, where $c_0 > c_1$. Assuming that second-order conditions are satisfied, the first-order conditions for profit maximization provide the following relations:

$$\frac{P_1 - c_o}{q_1} = b = \frac{P_1 - c_1}{q_m} \quad \text{and} \quad Q_1 = (N-2)q_1 + q_m,$$

where q_1 denotes the individual outputs of $N-2$ firms, and q_m denotes the outputs of the merged firm at equilibrium. Calculations yield

$$q_1 = \frac{a - c_0 - \delta}{bN}, \; q_m = \frac{a - c_0 + (N-1)\delta}{bN}, \text{ and } Q_1 = \frac{(N-1)(a - c_0) + \delta}{bN}.$$

Notice that $q_0 < q_m = q_1 < 2q_0$ if $\delta = 0$. Notice also that $N-1$ Cournot-Nash equilibrium outputs[8] are defined as a function of c_1; $\partial q_1/\partial c_1 > 0$, whereas $\partial q_m/\partial c_1 < 0$ and $\partial Q_1/\partial c_1 < 0$.

The following remarks should be considered. First, the profits of the merged firm is

[8] We assume that $d < a - c_0$ for ensuring $N-1$ positive Cournot-Nash equilibrium outputs, where $N-1$ firms exist at post-merger equilibrium. Otherwise, merged firms will monopolize the entire market because post-merger cost is sufficiently lower than the cost of $N-2$ firms. Thus, the monopoly price of the merged firm is lower than the equilibrium price of $N-1$ firms.

$$\pi_m = \frac{(a - c_o + \delta(N-1))^2}{bN^2}.$$

The profit of the merged firm is a decreasing function of its post-merger cost, $\partial\pi_m/\partial c_1 < 0$ and $\partial\Delta\pi_m/\partial c_1 < 0$, where $\Delta\pi_m = \pi_m - 2\pi_0$. Notice that $\Delta\pi_m \geq 0$ only when

$$\delta \geq \frac{(a - c_0)(\sqrt{2}N - N - 1)}{N^2 - 1} \text{ or } c_1 \leq c^\alpha,$$

$$\text{where} \quad c^\alpha = c_0 - \frac{(a - c_0)(\sqrt{2}N - N - 1)}{N^2 - 1}.$$

Given that $\partial\Delta\pi_m/\partial c_1 < 0$, c^α represents a threshold of private incentive on whether a merger between two firms will increase their profits. Therefore, contrary to the duopoly case, a small amount of cost saving does not provide any incentive to mergers when more than three firms exist in a Cournot oligopoly.

Second, given that $\partial Q_1/\partial c_1 < 0$, consumer's surplus after merger is a decreasing function of post-merger cost, $\{\partial CS(c_1)/\partial c_1\} < 0$; that is, the cost-saving effect of a horizontal merger is always beneficial to consumer's surplus.

Third, welfare after merger is

$$W(c_1) = \int_0^{Q_1(c_1)} P(v)dv - (N-2)c_0 q_1(c_1) - c_1 q_m(c_1).$$

We have

$$\frac{\partial W(c_1)}{\partial c_1} = (N-2)(P(Q_1) - c_0)\frac{\partial q_1}{\partial c_1} + (P(Q_1) - c_1)\frac{\partial q_m}{\partial c_1} - q_m < 0.$$

Thus, welfare after merger is a decreasing function of post-merger cost, and the change of welfare is also a decreasing function of post-merger cost, $\partial\Delta W/\partial c_1 < 0$. We let c^β denote the cost level of c_1, which makes $\Delta W = 0$, that is, $W(c^\beta) = W_0$. Given that $\partial\Delta W/\partial c_1 < 0$, c^β represents a threshold of public incentive on whether merger between two firms is socially beneficial.

Finally, we have obtained two cases by comparing two different (private and public) incentives between c^{α} and c^{β}.[9] On the one hand, if $c^{\alpha} \geq c^{\beta}$, private incentives for mergers are not socially beneficial. Therefore, we can apply the set of merger policies with lump-sum tax as follows: for any $\hat{c}_1 \leq c^{\beta}$, the merger will be allowed ($m=0$) and lump-sum tax $t^{\beta} = \pi_m(c^{\beta}) - 2\pi_0$ will be levied. Otherwise, the merger will be rejected ($m=1$). On the other hand, if $c^{\alpha} \geq c^{\beta}$, then private incentives for mergers are insufficient to achieve the social optimum, compared with public incentives. Thus, the set of merger policies should be accompanied with lump-sum subsidy as follows: for any $\hat{c}_1 \leq c^{\beta}$, the merger will be allowed ($m=0$) and the lump-sum subsidy $s^{\beta} = 2\pi_0 - \pi_m(c^{\beta})$ will be subsidized. Otherwise, the merger will be rejected ($m=1$).

V. Conclusion

The existing guidelines of antitrust policy on horizontal merger are insufficient and incomplete. In practice, both EU and US guidelines are aware of the importance of efficiency gains in horizontal mergers and denote efficiency gains as a factor to be considered before making final decisions. By using self-selection property in a mechanism design, we have provided an efficient tax scheme for horizontal merger policies under asymmetric information when an agency cannot observe the post-merger private cost of merged firms. Specifically, we have proposed an incentive lump-sum tax, which is not affected by informational rent at the post-merger cost level. We believe that this mechanism provides guideline for the substantial lessening of efficiency gain when competition authorities formulate the policy process on antitrust law.

However, the mechanism design problem analyzed in this paper is static Bayesian approach, in which an agency has the ability to commit to a policy as a function of the cost of the merged firm. Some extensions to more general models featuring dynamics and strategic interactions in oligopolistic competition before and after mergers may be amenable to future analysis. On the one hand, under the suggested taxation mechanism, the antitrust agency must have almost all relevant information about demand, pre-merger cost, and pre-merger price, excluding post-merger cost. Some practical implication on how an agency can collect the pre-information and link this information to post-information (with

[9] Appendix II can be applied to prove that the proposed policy can achieve the efficient decision with complete information.

Bayesian manner) should be scrutinized to construct efficient taxation policies. On the other hand, considering an extension of asymmetric competition model that includes not only market concentrations among firms but also different types of competition with leadership or differentiated products is challenging. From the perspective of monetary transfer in the tax system, some justification of the use of such transfer, which will go to the government, should also be examined.

Finally, an analysis should be conducted by using more practical and political arguments to obtain general and practical policy implications. The present merger control in Europen Union and United States utilizes different instruments including efficiency defense and remedies.[10] For example, the efficiency defense with behavioral remedies, which enable firms to argue the efficiency gains, should be high enough to ensure a price decrease, as pointed out by Lagerlof and Heidhues (2005), Motta and Vasconcelos (2005), and Banal-Estanol *et al.* (2010). Structural remedies (asset divestitures) should also result in a price decrease, as discussed by Cosnita and Tropeano (2009), Verge (2010), and Vasconcelos (2010).

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Appendix I

The first-order and second-order conditions of profit maximization problem obtain the following results:

$$\frac{\partial \pi}{\partial Q} = P + P'Q - c_1 = 0 \text{ and } \frac{\partial^2 \pi}{\partial Q^2} = P''Q + 2P' < 0.$$

From the first-order condition, by using implicit function theorem, we have

$$\frac{\partial Q}{\partial c} = -\frac{\partial^2 \pi}{\partial Q \partial c} \Big/ \frac{\partial^2 \pi}{\partial Q^2} < 0$$

[10] Merger remedies can be classified into two different groups: behavioral and structural remedies. Behavioral remedies set constraints on the property rights of merged firms to enter into specific contractual arrangement. Structural remedies with divestitures modify the allocation of property rights and create new firms.

when the second-order condition is applied. From the profit-maximization problem, by using envelope theorem, we have

$$\frac{\partial \pi}{\partial c} = \frac{\partial \pi}{\partial Q}\frac{\partial Q}{\partial c} - Q = -Q < 0$$

when the first-order condition is applied.

Appendix II

Under the lump-sum tax policy, the net profit of the merged firm for a given report of $\hat{c}_1$ is described as follows:

$$\pi(\hat{c}_1,\ c_1)=\pi(c_1)-t \ \text{ if } \ \hat{c}_1 \leq c^* \text{ and } \pi(\hat{c}_1,\ c_1)=\pi_0 \ \text{ if } \ \hat{c}_1 \leq c^*.$$

On the one hand, if the firm applies for merger when $c_1 \leq c^*$, then the firm has no incentive to report $\hat{c}_1 \leq c^*$. If the firm reports a false cost, then the agency chooses $m=1$ and the merger will be rejected, which yields π_0. However, the firm can earn more profits by reporting $\hat{c}_1 \leq c^*$. On the other hand, if the firm applies for merger when $c_1 \leq c^*$ and report $\hat{c}_1 \leq c^*$, then the agency chooses $m=0$. Given that tax will be imposed to the firm, the firm has negative profit, that is, $\pi(c_1)-\pi(c^*)<0$.

Appendix III

First, the optimal tax should be considered a constant in each policy range. If not, the firm has an incentive to misreport the cost level, which can lower the tax level under the same decision on m. Therefore, the amount to be taxed must be equal in each policy range. Second, the optimal tax level under $m=1$ should be equal to zero, as long as the two firms earn non-negative profit in the pre-merger market. Otherwise, the optimal tax level cannot satisfy the IR constraint. Finally, the optimal tax level under $m=0$ should be equal to $\pi(c^*)-\pi_0$, which is the maximized tax level when $c_1=c^*$. If the optimal tax level is greater than $\pi(c^*)-\pi_0$, then the optimal tax level will violate the IR constraint. If a tax level is lower than $\pi(c^*)-\pi_0$, then the agency can increase the tax level without violating the IR constraint.

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