

Kim, Sung-min

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## Policy on the media platform industry: The analysis of pricing policies of internet media with two-sided market theory

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# Policy on the Media Platform Industry

## - The Analysis of Pricing Policies of Internet Media with Two-Sided Market Theory-

Sung-min Kim

Electronics and Telecommunications Research Institute

Dajeon Korea

Songmin516@etri.re.kr

### 1. Introduction

#### 1.1 Background

The proliferation of smart devices is changing media industry, based on the fusion of broadcasting and communication. In the past, newspapers, magazines, terrestrial TV, cable TV, satellite TV, and radio contents could be provided only by its own media networks. Nowadays, these contents can be consumed by smart phone, table PC, connected TV and PC connected to the Internet networks. This phenomenon is changing the structure of the media industry into platform-centric structure. TVs, radios, newspapers, magazines provide their programs through their own media networks to their viewers and readers. However, with Internet connected media, whenever people want to find or check any news, information, TV contents and so on, they start with internet portals through PCs, laptops, smartphones, or even connected TVs. Nowadays, internet based media platform services, OTT(Over The Top service) serves, such as Netflix, Youtoub, Hulu, are providing media contents to users in all over the world.

In this research, media platform covers internet portals, VoD(Video on Demand), OTT, and other internet based or network based media platform services connecting two sides of groups, contents providers and users.

Even though several media platform providers are competing in the early stage of market, the tipping effects of

network externality makes some global media platform providers dominate the markets. Google's U.S. search market share was 34.8% in 2003, but accounts for 85% of the end of 2012. Google's market share in the world search engine market is also more than 80% (in November 2013). In Korea, we can see some tipping phenomenon. Naver, the Korean portal site, took only 30.9% of the market in 2004, but it is taking 72% in 2013. Korean OTT market in 2008 was composed of 42% of PandoraTV, 34% of DaumTVpot, 23% of AfricaTV and 2% of YouTube. However, in August 2013, YouTube is taking 74% of the market. We can see more examples of tipping effects of network externalities. Google's Android market share was only 4% in 2009 but it is taking 67% in 2013 in smartphone OS market.

The one huge global network gives people huge positive externalities. Users don't need to hang around many internet sites to find out any information and any contents. Contents providers don't need to contract with many internet sites to deliver their contents. Almost all the users and contents providers in the world can meet each other in a few internet sites with very high probability.

Two-sided media platform has been tried by many operators. However, only a few operators could make success. Most of the cases, they have failed to building two-sided networks and positive feedback loops. In many papers, the pricing structures have been studied as a factor of building two-side networks. However, in the real world, development of technology and business models are also key factors. So we need to focus on the three main factors : development of matching technology, prosumer strategy, and adoption of AD technology.

## 1.2 Literature Review

From early 2000's, there has been an active research on two-sided market and most of the research are mainly discussing a pricing structure on the platform.

Rochet&Tirole (2003)'s research is based on a market such as credit card market, where transaction itself yields utility. On the research, it says setting a model on the platform of two-sided market and imposing a lower price than Marginal Cost (MC) to try to participate as many parties(users, providers) as possible in setting price, which is called cross-subsidization effect, is a strategy to maximizing the profit in determining a price structure and the surplus of users. If multi-homing of users increases, steering of providers is facilitated, and as a result,

the price on suppliers becomes higher and the price on users becomes lower.

Similar to Rochet&Tirole (2003), Armstrong (2006)'s research is based on the market, where transaction itself yields utility. But the difference is that he made a supposition that each utility, which the other participant in the competing two platforms gives to my platform, is the same amount and that the utility, which my platform gives to other participants, is different. By using such model, the research shows that the equilibrium price is determined by (1) the size of externality between groups, (2) whether the charge is lump-sum or is set depending on, (3) whether users participate in a single platform or in multiple platforms

Caillaud&Jullien (2003) analyzed market equilibrium conditions and price strategies of competing platforms in the information intermediary market such as the internet, which is characterized with network externality, non-exclusive service and price discrimination. The analysis shows that in case of a single-homing (exclusive service), the profit of a monopolist is zero, though two platforms compete with each other and customers lean toward the monopolist. On the other hand, in case of a multi-homing (non-exclusive service), every equilibrium becomes profitable, so they concluded that intermediary agents permit multi-homing in equilibrium.

Hagiu (2009)'s research basically starts from Armstrong (2006)'s model, but consideration on the competition of suppliers on the same plane of a platform is added. On Hagiu (2009)'s model, consumer and supplier (or seller) transact through a platform, and the more products consumers encounter on a platform, the bigger the utility of consumers becomes. And for suppliers, the more consumers they meet, the bigger utility they get on a platform. On this model, all the consumers feel that the marginal value of products is same, and suppliers are homogeneous. Also, this model supposes that consumers and suppliers are vertically differentiated only on fixed cost. The model of Hagiu (2009) is determined by 1) Platform providers first set platform subscription fee. 2) Suppliers and consumers consider the fee and decide whether to participate in a platform or not, and as a result, the number of suppliers and consumers participating in the platform is determined. 3) Suppliers set the selling price and users, who are already involved in the platform, consider which product to purchase. After that, suppliers enter the platform until the profit becomes zero and users participate in the platform until their utility is zero. Through these series of stages, the proper price structure is determined by the proper ratio of the profit that suppliers get and that of users. And the ratio is mainly determined by elasticity of demand of each group. In other words, if elasticity of a consumer's demand on platform becomes higher and elasticity of a

supplier's demand becomes lower, platform providers have to get more profit from suppliers. This thesis takes examples of the companies of PC operating systems, PDAs, smart phones, etc., which give much support to App developers but get lower profit and of MS, Apple, Symbian, Palm, Sun, which make a profit through a manufacturer by licensing. Also, by using consumer utility function ( $V(n) = An^{\frac{1}{\alpha}}$ ), this thesis shows that the more consumers prefer varieties, the bigger the power of suppliers become, and as a result, platform providers make a bigger profit from users and a lower profit from suppliers.

Weyl(2010)'s thesis mainly focuses on analyzing The New York Times and it sets a model of valuing membership as users can read contents on a newspaper. Based on this model, Weyl (2010) suggested the general theory on the price determination of exclusive network and analyzed the income level of users based on their differences.

Research on media market based on two-sided market theory is still not enough. Though Gabszewicz, Laussel&Sonnac (2004), Reisinger (2012), Peitz& Valletti (2008), Kind, Nilssen&Sorgard (2006), etc. analyzed a media market but their research is only focusing on the previous broadcasting media and advertising market.

Empirical analysis exists, yet is not enough. Analyses on newspapers and magazines are usually common. For example, Marc Rysman (2004) focused on a phonebook market, Wilbur(2008) on a TV advertisement market and Chandra&Wexler (2009) on a newspaper market of Canada.

There's also a research on a multi-sided market. Boudreau&Hagiu (2009) proved that it's possible for platform providers as 'Private Regulators' in the multi-sided market to yield the result they want by strategically using legal and technical information. And the paper takes practical examples of Facebook, TopCoder, Roppongi Hills, Havard Business School, etc. Choi(2006) proved that when pay-TV operators, who gain a profit depending on ads, and free-TV operators compete with each other, there might be a market failure due to a market structure in the respect of the supply of various programs and advertising volume.

Previous economics literature on advertising competition usually dealt with the model, where a company determines both the price and the advertising volume. Recently, the research on online ads and internet portal companies is being done.

Reiginger(2012) analyzes both markets, of which an advertiser and an user compete on a platform. For users, platforms are differentiated, but for advertisers, platforms are same. This paper shows that platforms compete against advertisers but they gain a profit in an advertising market. To sum up, Reiginger (2012) explains in this

paper that if public competitors are under less regulation against advertisements, that is, if regulation on ads, broadcasted on public televisions, gets relaxed, private TV platforms can make more money.

Ahn Il-tae (2007) explained an advertising competition of Internet portals by using the model, where two Internet portals provide contents including commercial contents to consumers with different proportions. Son Sang-young (2013) developed the competition model about act of unfair competition, that's seen between advertising service providers on the online advertisement markets of Apple and Google. Also, the paper suggested the ground to judge the existence of 'strategic foreclosure' by Whinston (1990). The paper is different from the previous theses focused on advertising, which mainly discussed TV, newspapers, and magazine, in that Son Sang-Young (2013) focused on online advertisements, and adopted pricing system of PPC (pay per click).

Recently, within the country, there have been many trials to analyze media industry based on two-sided market theory. Lee Kwang-hoon (2011) regards a pay broadcasting market as a two-sided market, and analyzes the competition structure and political issues such as retransmission of terrestrial TV issues, terrestrial TV related PP issues in the respect of channel transaction market. Kim Doe-hoon (2009) analyzed the network neutrality in terms of a two-sided market, and also analyzes the platform competition in the two-sided convergence industrial ecosystem by using Evolutionary Game Model. Hwang Chang-sik (2009) analyzed fair trade-related examples about multi-sided platform providers based on a two-sided market theory.

Even though these many researches had been conducted so far, we need more researches to analyze internet connected media platform market to find out the effect of development of technologies and marketing strategies. When we consider the tipping effect of the market, we need to analyze the monopoly market more.

To solve these questions, this study transformed the model of Hagiu(2009), which considers competition among participants in the two-sided market of a media platform. Users and contents providers are differentiated by their own type, and they participate in the platform until their net utility becomes zero, considering the type. A monopolistic platform provider sets an user's platform membership fee and a contents provider's transaction fee in order to maximize its profit, and the number of users and contents providers are determined according to the fee. Based on this model, by analyzing achievements per various kinds of business models, matching technology, smart advertising, and the effect of adopting prosumer policy, this study is trying to explore ways that a monopolistic media platform can get the effect just like that of a Social planner's market.

This paper's contribution can be summarized into following three points. First, we build a two-sided media platform model connected to the internet to analyze the monopolistic internet. Second, we analyze and test the effects of matching technology, internet blog, and the development of advertising technology with this model. Third, we compare social planner's choice and monopoly operator's so that we find out some implications of how to reduce the gap of monopoly's and social planner's choice.

## 2. Modelling framework

In this paper, we build two-sided market model for media contents platform market based on Hagiu(2009) model. In this model, there is a monopolistic media platform service provider, who mitigates the trade of users(consumers) and contents providers and makes earns by charging fees for each sides. There are two types of fee, lump-sum fee and transaction fee. We can make various combinations of fee type for each side : (0, lump-sum, transaction, lump-sum+transaction) x (contents providers, users) = 8 types.

However, we will focus on three pricing types only which we can observe more often. We can easily see subscription fee for users (or monthly fee) as a kind of lump-sum fee. And for contents providers, we focus on the transaction fee because internet based platforms can charge fees based on the transactions and even by the number of clicks.

Pricing type1 : if  $\Pi^* - c_c - c_s \geq 0$ , lump-sum fee for users and transaction fee for CPs

Pricing type2 : if  $\Pi^* - c_s \geq 0$ , and  $\Pi^* - c_c < 0$ , lump-sum fee for users and no fee for CPs

Pricing type3 : if  $\Pi - c_s \geq 0$ , and  $\Pi - c_c < 0$  no user fee and transaction fee for CPs

Where  $\Pi^*$  is the profit of platform provider,  $c_s$  is cost building and maintaining charging system for subscribers and ,  $c_c$  is cost for contents providers. For these three pricing types, we analyze the role of three following factors in the model; matching technology( $\delta$ ), contents prosumer effect( $\beta$ ), and development of advertising technology( $\alpha, \gamma$ ).

First, the development of matching technology such as search engine and big data technology, can match better contents to users' needs, which can provide positive feedback loop for each side of platform by raising the probability of finding what they want. In this model, we analyze how the level of matching technology,  $\delta$  can effect on the number of users and CPs.

Second, the contents prosumer effect is the effect of internet blog or Youtube. Platform providers can get lots of free contents by providing users free internet space to create and share their own information, contents, feeling and so on. Platform service providers can make users contents providers by giving users some utility of expressing their thoughts and feelings on the internet. We will call this the prosumer effect and  $U$  denotes the utility of expressing users thoughts and feelings on the internet.

Third, we will analyze the effect of advertising technology. In the most of researches, advertising had been considered to giving negative utilities to viewers. However, platform service providers can make earns by advertising and users can enjoy the service for free or with low fee paying their eyes on ads. However, advertising can give positive utilities to viewers as information and entertainment. We will analyze the effect of advertising technology with our model also.

There are some examples of each types of pricing models.

<Table 2-1> Summary for main results of a basic model

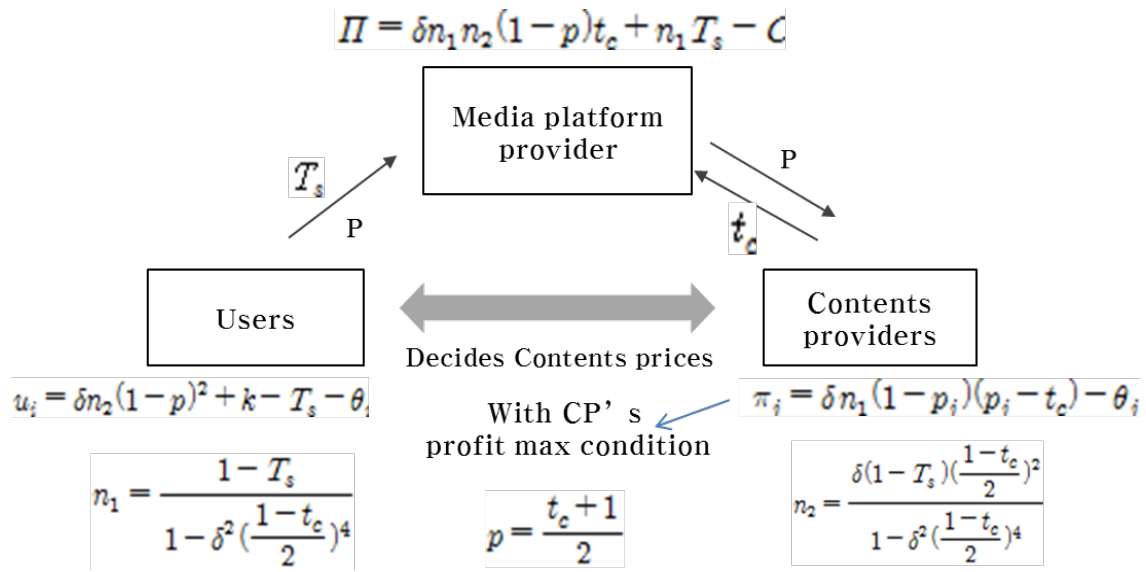
	User membership fee + CPs transaction fee	User membership fee only	transaction fee for CPs only	No fee
Basic model	Apple's app store	Netflix, Hulu plus, pooq, tving	Online shopping mall Online video rental services (iTunes, Amazon, Disney)	
Prosumer model				YouTube, GomTV, PandoraTV Blog of portals (Google, naver)
Ad model	Google's app market	Pooq, tviing,		YouTube, Hulu, GomTV, PandoraTV DaumTV pot

## 2.1. Foundation of Model

### 2.1.1. Pricing type 1 : lump-sum fee for users and transaction fee for CPs

There is a monopolistic media platform service provider. He mediates contents transaction between users and contents providers and make earns. He charges lump-sum fee(such as subscription fee) for users and transaction fee for one unite of contents for CPs. The levels of Lump-sum fee and transaction fee are determined to maximize the platform operator's profit. The contents price level is determined to maximize the content providers' profits.





(Figure 2-1) The structure of contents market with media platform (pricing type1)

In this model, the decision making process of the platform operator, users and contents providers follows these three steps.

- (i) Step1: the platform operator choose its pricing type
- (ii) Step2: the platform operator chooses the price level; lump-sum fee  $T_s$  for users and transaction fee  $t_c$  for CPs.
- (iii) Step3: the level of contents price  $p$  is determined by CPs.
- (iv) Step4: Users and CPs observe the prices and determine whether they participate the platform or not. That determines the number of users and CPs on the media platform  $n_1, n_2$ .

This model is based on Hagiu(2009), which considered the competition of participants in each side in the two sided platform model. In Hagiu(2009), users' and CPs' types are differentiated from 0 to 1. From the users and CPs whose utility is high, to them whose utility is 0(zero), users and CPs decide their participation. For the convenience of development of modeling and calculation, the number of users and CPs will be decided by zero profit condition and then the platform operator will maximize their profit by choosing level of prices. This process followed that of Hagiu(2009).

The platform has a matching technology with a level of  $\delta$ ,  $0 \leq \delta \leq 1$  and matches users and contents. So the users can find out what they want among  $n_2$  kinds of contents with probability of  $\delta$ , pay contents price  $p$  for one unite of content, consume  $1-p$  unite of content, and pay subscription fee  $T_s$ . Users' utility for one unit of content is normalized to 1 and users can also get utility  $k$  by using other services of platform such as email, blog and so on. User 'i' has disutility of  $\theta_i$  when he uses the platform.  $\theta_i$  has normal distribution between

$[0, 1]$ , like a transportation cost of linear city model. So user  $i$ 's net utility function becomes (1-1).

$$u_i = \delta n_2 (1-p)^2 + k - T_s - \theta_i \quad (1-1)$$

Number of users is decided by  $u_i = \delta n_2 (1-p)^2 + k - T_s - \theta_i = 0$ . So the number of users becomes

$$n_1 = \hat{\theta}_i = \delta n_2 (1-p)^2 + k - T_s.$$

On the other side of platform, there are  $n_2$  contents providers. Each CPs produces one kind of contents, which are differentiated. CPs get  $p_i$  for one unit of contents, sell  $(1-p_i)$  units of contents to each users, and pay transaction fee,  $t_c$  to platform operator. The contents can be chosen by users with the probability of  $\delta$ , the level of matching technology. Contents provider 'j' needs fixed cost to produce,  $\theta_j$ .  $\theta_j$  has normal distribution between  $[0, 1]$ . CPs need no marginal cost to copy and distribute their contents because all the contents are digitalized.

So contents provider  $j$  has a net profit function (2)

$$\pi_j = \delta n_1 (1-p_j)(p_j - t_c) - \theta_j \quad (1-2)$$

By zero profit condition, the number of CPs,  $n_2$  can be decided. When  $\pi_j = \delta n_1 (1-p_j)(p_j - t_c) - \theta_j = 0$ ,  $n_2 = \hat{\theta}_j = \delta n_1 (1-p_j)(p_j - t_c)$ .

The monopolistic platform operator takes subscription fees  $T_s$  from all platform users  $n_1$  and takes transaction fees  $t_c$  from CPs for each transaction. With the possibility of  $\delta$ ,  $n_1$  users and  $n_2$  CPs trade  $(1-p)$  units of contents. The platform needs fixed cost  $C$  to develop and manage the matching technology. If  $\delta = 0$ ,  $C = 0$ . So, the profit of monopolistic platform operator becomes (3)

$$\Pi = \delta n_1 n_2 (1-p)t_c + n_1 T_s - C \quad (1-3)$$

The matching technology  $\delta$  is analogous to the matching technology  $\lambda$  in Cailaud&Jullien(2003). The difference is that Cailaud&Jullien(2003) assumed that  $\lambda$  as a marginal cost which takes whenever each agent take part in the platform. In this research,  $\delta$  is a fixed cost. We assumed that once the platform system is developed, the users can put their information and subscribe by themselves on the system.

The level of contents price is decided in accordance with the maximization condition of CPs.

Content provider  $j$  sets price  $p_j$ , maximizing his profit  $\pi_j = \delta n_1 (1-p_j)(p_j - t_c) - \theta_j$ .

From the first differentiation of the CPs' profit function, we can get  $p_j = \frac{t_c + 1}{2}$ ,  $\forall j$ . As the transaction fee  $t_c$  is same for all CPs, the contents price is (1-3) for all  $j$ .

$$p = \frac{t_c + 1}{2} \quad (1-4)$$

With this contents price, we can get the number of users (1-5) and the number of CPs (1-6).

$$n_1 = \frac{1 - T_s}{1 - \delta^2 \left( \frac{1 - t_c}{2} \right)^4} \quad n_2 = \frac{\delta(1 - T_s) \left( \frac{1 - t_c}{2} \right)^2}{1 - \delta^2 \left( \frac{1 - t_c}{2} \right)^4} \quad (1-5) \quad (1-6)$$

Demand for CP j 's contents determined by (1-7) and demand for total content by (1-8)

$$d_j = \delta n_1 (1 - p) = \frac{\delta(1 - T_s) \left( \frac{1 - t_c}{2} \right)}{1 - \delta^2 \left( \frac{1 - t_c}{2} \right)^4} \quad D = \sum_{j=1}^{n_2} d_j = \delta n_1 n_2 (1 - p) = \frac{\delta^2(1 - T_s)^2 \left( \frac{1 - t_c}{2} \right)^3}{\{1 - \delta^2 \left( \frac{1 - t_c}{2} \right)^4\}^2} \quad (1-7) \quad (1-8)$$

PROPOSITION 1.1 Monopolistic platform operator chooses higher level of fees when they do not have matching technology than when they have it.

- 1) If  $C \geq \frac{27\delta}{4(256 - 27\delta^2)}$ , the platform operator will not develop the matching technology and will choose  $t_c^* = 1$ ,  $T_s^* = 0.5$ .
- 2) If  $C < \frac{27\delta}{4(256 - 27\delta^2)}$ , the platform operator will develop the matching technology and will choose  $t_c^* = -0.5$ ,  $T_s^* = -\frac{27\delta^2 + 256}{54\delta^2 - 512}$ , Where  $0.5 \leq T_s^* \leq 0.6179$  ( $0 \leq \delta \leq 1$ )

Proof Using (1-4), (1-5), (1-6), we can get new platform operators profit expressions (1-9) and can get optimizing level of fees through the first order conditions of (1-9).

$$\text{Max}_{T_s, t_c} \Pi = \frac{T_s(T_s - 1)}{\delta^2 \left( \frac{t_c - 1}{2} \right)^4 - 1} - \frac{\delta^2 t_c \left( \frac{t_c - 1}{2} \right)^3 (T_s - 1)^2}{\{ \delta^2 \left( \frac{t_c - 1}{2} \right)^4 - 1 \}^2} - C \quad (1-9)$$

Using  $t_c = -0.5$ ,  $T_s = -\frac{27\delta^2 + 256}{54\delta^2 - 512}$ , we can yield the condition of C, with which the platform operator's profit is higher than  $\Pi = 0.25$  ( $\delta = 0$ ).

$$\Pi_{t_c = -0.5, T_s = -\frac{27\delta^2 + 256}{54\delta^2 - 512}} = \frac{T_s(T_s - 1)}{\delta^2 \left( \frac{t_c - 1}{2} \right)^4 - 1} - \frac{\delta^2 t_c \left( \frac{t_c - 1}{2} \right)^3 (T_s - 1)^2}{\{ \delta^2 \left( \frac{t_c - 1}{2} \right)^4 - 1 \}^2} - C > \Pi_{\delta=0} = 0.25 \quad \square$$

PROPOSITION 1.2 If the platform do not have matching technology and charge transaction fee to CPs, the

platform fails to build the network of CPs,  $n_2 = 0$ .

When platform operator chooses not to develop matching technology and decide the level of fees as  $t_c^* = 1$ ,  $T_s^* = 0.5$ , the optimal contents price for one unite would be  $p = 1$ , the number of users would be  $n_1 = 0.5$ , and the number of contents provider would be  $n_2 = 0$ . In this case, platform operator's profit would be  $\Pi = 0.25$ , total utility of user group would be  $U = 0.125$ , total profit of CPs would be  $\Pi_c = 0$ , and social welfare would be  $W = 0.375$ .

Proof. By putting  $t_c^* = 1$ ,  $T_s^* = 0.5$  in to the (4), (5), (6) and (9), we can easily get  $p = 1$ ,  $n_1 = 0.5$ ,  $n_2 = 0$ , and  $\Pi = 0.25$ , where  $c(0) = 0$ . For, social welfare, following expressions yields each groups welfare level.

$$\begin{aligned}
 U &= \int_0^{n_1} u_i d\theta_i = \int_0^{n_1} \delta n_2 (1-p)^2 + 1 - T_s - \theta_i d\theta_i \\
 &= \{ \delta n_2 (1-p)^2 + 1 - T_s \} n_1 - \frac{1}{2} n_1^2 \\
 \Pi_c &= \int_0^{n_2} \pi_c d\theta_j = \int_0^{n_2} \delta n_1 (1-p)(p-t_c) - \theta_j d\theta_j \\
 &= \delta n_1 n_2 (1-p)(p-t_c) - \frac{1}{2} n_2^2 \\
 \Pi &= \delta n_1 n_2 (1-p)t_c + n_1 T_s - c(\delta) \\
 W &= U + \Pi_c + \Pi = \delta n_1 n_2 (1-p) + n_1 - \frac{1}{2} (n_1^2 + n_2^2) - c(\delta) \quad \square
 \end{aligned}$$

**PROPOSITION 1.3** If the platform have matching technology and charge lower transaction fee to CPs, the platform can build two-sides of network and make higher profits.

When platform operator choose to develop matching technology and decide the level of fees as  $t_c^* = -0.5$ ,  $T_s^* = -\frac{27\delta^2 + 256}{54\delta^2 - 512}$ , the optimal contents price for one unite would be  $p = 0.25$ , the number of users and CPs would be increasing function of  $\delta$  like followings.

$$n_1 = -\frac{\frac{27\delta^2 + 256}{54\delta^2 - 512} + 1}{\frac{81\delta^2}{256} - 1}, \quad n_2 = -\frac{9\delta(\frac{27\delta^2 + 256}{54\delta^2 - 512} + 1)}{16(\frac{81\delta^2}{256} - 1)}$$

We can get the ranges,  $0.5 \leq T_s^* \leq 0.61790$ ,  $0.4410 \leq n_1 \leq 0.559$ ,  $0 \leq n_2 \leq 0.3144$  as  $0 \leq \delta \leq 1$ .

**Corollary 1.1.** Even when the matching technology is the lowest level,  $C < \frac{27\delta}{4(256 - 27\delta^2)}$ , total utility of user group, total profit of CPs and profit of platform operator are higher than when there is no matching technology.

Using  $C < \frac{27\delta}{4(256-27\delta^2)}$  and ( $C=0$ ,  $\delta=1$ ), we can get followings and compare the results of proposition 1.2; for users :  $0.125 < U \leq 0.1562$ , CPs  $0 < \Pi_c \leq 0.0494$ , for platform  $0.25 < \Pi \leq 0.3706$ , and social welfare  $0.5 < W \leq 0.5762$ . Membership fee  $T_s \geq 0.5$  is also higher.  $\square$

We can compare the decision of social planner and monopoly platform operator.

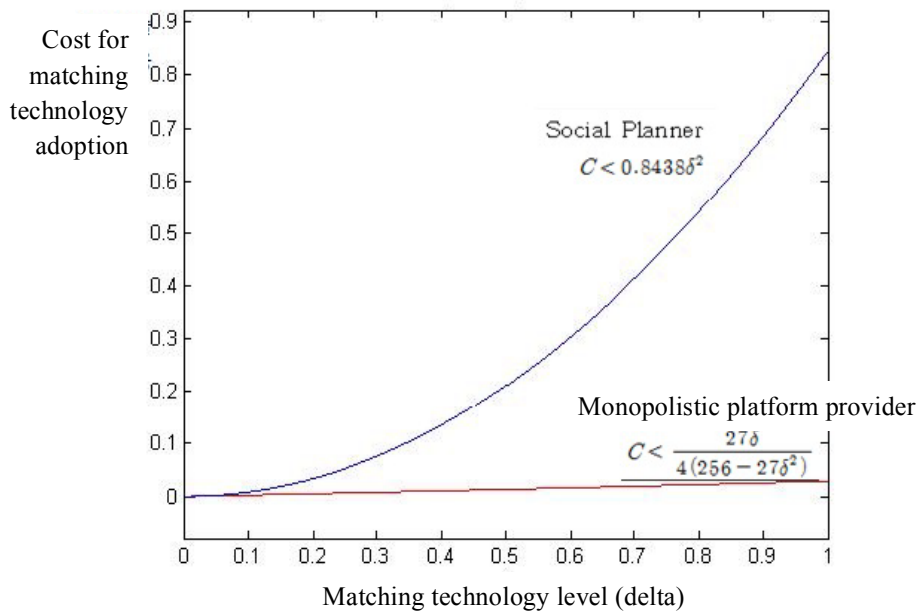
**PROPOSITION 1.4** If a social planner operates the media platform, he would develop matching technology under more relaxed conditions.

The social planner will choose whether develop matching technology or not, depend on the developing cost. After that he will choose the level of fees for each side like following.

$\square$ ) if  $C \geq 0.8438\delta^2$ , he will choose not to develop matching technology and will choose the level of fees  $t_c^* = 1$ ,  $T_s^* = 0$ .

$\square$ ) if  $C < 0.8438\delta^2$ , he will choose to develop matching technology and will choose the level of fees

$$t_c^* = -2, \quad T_s^* = \frac{54\delta^2}{16-27\delta^2}.$$



(Figure 2-2) comparison of developing cost of social planner and monopoly platform operator

As we see Figure1, the cost graph of social planner is higher than that of monopoly operator, which means monopoly operator would not develop the matching technology until the cost becomes low enough.

<Proof> With the first of condition of social welfare function,  $Max_{t_c, T_s} W = U + \Pi_c + \Pi = \delta n_1 n_2 (1-p) + n_1 - \frac{1}{2}(n_1^2 + n_2^2) - C$ , we can get two solutions  $\square$ )

$t_c^* = 1, T_s^* = 0, \square$ )  $t_c^* = -2, T_s^* = \frac{54\delta^2}{16-27\delta^2}$ . With second solutions, we can get  $n_1, n_2$  and the following condition of  $\Pi > \Pi_{\delta=0}, C < 0.8438\delta^2 \square$

**PROPOSITION 1.6** If social planner develop matching technology, transaction fee for CPs and contents price are lower and the network size of each group is bigger than those of monopoly provider.

<Proof> When social planner choose to develop matching technology, the optimal fees to maximizing social

welfare are  $t_c^* = -2, T_s^* = \frac{54\delta^2}{16-27\delta^2}$  and content price is  $p = -0.5$ . In this case, network sizes of each groups are  $n_1 = 1, n_2 = 1.5^2\delta$ .

In addition, total utility of user groups, profit of CPs and social welfare are higher than those of monopoly operator. Profit of monopoly operator is smaller.

$$U = 1.5^4\delta^2 - \frac{54\delta^2}{16-27\delta^2} + 0.5 \geq 0.5, 0.5 < U \leq 10.4716$$

$$\Pi_c = 0.5 * 1.5^4\delta^2 = 2.5315\delta^2 \geq 0, 0 < \Pi_c \leq 2.515$$

$$\Pi = (-2) * 1.5^3\delta^2 + \frac{54\delta^2}{16-27\delta^2} = -6.75\delta^2 + \frac{54\delta^2}{16-27\delta^2} \geq 0, -5.5841 < \Pi \leq 0$$

$$W = U + \Pi_c + \Pi = 0.844\delta^2 + 0.5 \geq 0.5, 0.5 < W \leq 0.844$$

## 1.2. Pricing type 2 : lump-sum fee for users and no fee for CPs

In this model, monopoly media platform operator does not charge any transaction fee for CPs and charge only membership fee for users. Except this pricing system, all the assumptions are just the same with pricing type 1 model. So the user  $i$ 's utility function and the number of user group can be expressed the same with the first model.

$$u_i = \delta n_2 (1-p)^2 + k - T_s - \theta_i, (2-1) \quad n_1 = \hat{\theta}_i = \delta n_2 (1-p)^2 + k - T_s (2-2)$$

For CPs, the profit function of contents provider  $j$  and number of CPs can be expressed like following:

$$\pi_j = \delta n_1 (1-p_j) p_j - \theta_j (2-3), \quad n_2 = \hat{\theta}_j = \delta n_1 (1-p_j) p_j (2-4)$$

The contents price that maximizing (2-3) can be yield to be (2-5),  $p^* = \frac{1}{2} (2-5)$

Monopoly platform operator's profit function is  $\Pi = n_1 T_s - C_s$ .

Proposition 1.8. When platform operator charge lump-sum fee for users only, contents price become more expensive than when platform operator charge negative fee(subsidy), so number of CP is smaller, profit of platform provider is smaller and social welfare is also smaller than pricing type 1's.

<Proof> see table 2-2 □

If a platform provider charges only a fixed cost on a user, the fixed cost is  $t_1^* = \frac{k}{2}$ ,

$$\Pi^* = n_1 t_1 = \frac{(\frac{k}{2})^2}{1 - \frac{\delta^2}{16}} = \frac{4k^2}{16 - \delta^2}, \quad n_1^* = \frac{8k}{16 - \delta^2}, \quad n_2^* = \frac{2k\delta}{16 - \delta^2}.$$

Here, if  $k$  value increases,  $t_1^*, n_1^*, n_2^*$  increase in proportion to  $k$ , and  $\Pi^*$  increases in proportion to  $k^2$ .

Depending on the matching technology of  $0 \leq \delta \leq 1$ , user welfare becomes  $0.125 \leq U \leq 0.1422$ , the profit of a contents provider becomes  $0 \leq \Pi_c \leq 0.0089$ , and the profit of a platform provider is determined between the range of  $0.25 \leq \Pi \leq 0.2666$ . Accordingly, aggregate social welfare becomes

### 1.3. Pricing type 3 : No lump-sum fee for users and fee for CPs

In this model, when  $\Pi - c_j \geq 0$ , and  $\Pi - c_j < 0$  monopoly media platform operator does not charge any membership fee for users and charge only transaction fee for CPs. Except this pricing system, all the assumptions are just the same with pricing type 1 model. So the user  $i$ 's utility function and the number of user group can be expressed the same with the first model.

$$u_i = \delta n_2 (1 - p)^2 + k - \theta_i \quad n_1 = \tilde{\theta}_i = \delta n_2 (1 - p)^2 + k \quad (3-2)$$

For CPs, the profit function of contents provider  $j$  and number of CPs can be expressed like following:

$$\pi_i = \delta n_1 (1 - p_i)(p_i - t_c) - \theta_i \quad (3-3) \quad n_2 = \tilde{\theta}_i = \delta n_1 (1 - p_i)(p_i - t_c) \quad (3-4)$$

The contents price that maximizing (3-3) can be yield to be (3-5),  $p = \frac{t_c + 1}{2}$  (3-6)

Monopoly platform operator's profit function is  $\Pi = \delta n_1 n_2 t_c - C_i$ .

To get numerical solution, we assume  $k=1, \delta=0.5$ .

Proposition 1.9 When platform operator charges transaction fee for CPs only, the number of users gets bigger but platform operator's profit gets lower than pricing type 1.

Contents price become more expensive than when platform operator charge negative fee(subsidy), so number of CP is smaller, profit of platform provider is smaller and social welfare is also smaller than pricing type 1's. In this case, the CPs' fee maximizing the profit is

$t_c^* = 0.3306$ , and we can get  $p^* = 0.6653, n_1^* = 1.0031, n_2^* = 0.0562$ . The profit of a platform operator becomes  $\Pi = 0.0093$ . Here, the utility of a user group is  $U = 0.5032$ , the profit of a contents provider group is  $\Pi_c = 0.0016$ , the profit of a platform provider is  $\Pi = 0.0093$ , and as a result, aggregate social welfare becomes  $W = 0.5140$ .

#### 1.4. Comparing the results of a basic model

As we can see in the below table, user flat-rate fee model has higher number of contents provider,  $n_2$  than charge on a contents provider model. The number of users is the highest in charge on a contents provider model, which does not charge any fee on users. But, in terms of the profit of a platform provider and social welfare, among flat-rate fee + charge models, the number was the highest in the model, which adopts matching technology (in other words, when paying subsidy of  $t^* = -0.5$  to a contents provider and receiving positive flat-rate fee from users.

<Table 2-2> Summary for main results of a basic model

Flat-rate fee + charge		User flat-rate fee	Charge on a contents provider ( $\delta = 0.5$ )
$\Pi^* - c_c - c_s \geq 0$		$\Pi^* - c_s \geq 0,$ $\Pi^* - c_c < 0$	$\Pi^* - c_c \geq 0,$ $\Pi^* - c_s < 0$
$\Pi^* - c_j \geq 0$	$\Pi^* - c_j < 0$		
$t^* = -0.5,$ $0.5 \leq t_1^* \leq 0.6179$ ( $0 \leq \delta \leq 1$ )	$t^* = 1$ $t_1^* = 0.5$	$t_1^* = 0.5$ $t^* = 0$	$t_1^* = 0$ $t^* = 0.3306$



$p = 0.25$ $0.4410 \leq n_1 \leq 0.559$ $0 \leq n_2 \leq 0.3144$ $(0 \leq \delta \leq 1)$	$p = 1$ $n_1 = 0.5$ $n_2 = 0$	$p = \frac{1}{2}$ $0.5 \leq n_1 \leq 0.5333$ $0 \leq n_2 \leq 0.1333$ $(0 \leq \delta \leq 1)$	$p = 0.6653$ $n_1^* = 1.0031$ $n_2^* = 0.0562$
$0.125 < U \leq 0.1562$ $0 < \Pi_c \leq 0.0494$ $0.25 < \Pi \leq 0.3706$ $0.375 < W \leq 0.5762$ $(\delta = 1, c = 0; W \text{ is maximized})$	$U = 0.125$ $\Pi_c = 0$ $\Pi = 0.25$ $W = 0.375$	$0.125 \leq U \leq 0.1422$ $0 \leq \Pi_c \leq 0.0089$ $0.25 \leq \Pi \leq 0.2666$ $0.3750 \leq W \leq 0.4177$	$U = 0.5032$ $\Pi_c = 0.0016$ $\Pi = 0.0093$ $W = 0.5140$

## 2.2. Model of adopting prosumer effect

### 2.2.1. Adopt prosumer effect on Pricing structure type 1

The utility of a user and the number of a user is same with the previous model. Here, a platform provider gets flat-rate fee and utility function and the number of participants are like the below.

$$u_i = \delta n_2 (1-p)^2 + k - t_1 - \theta_i \quad (2-1) \quad n_1 = \hat{\theta}_i = \delta n_2 (1-p)^2 + k - t_1 \quad (2-2)$$

The condition of a contents provider is same with the previous model, but here, we suppose that there are utility from a contents company's promotion effect on its own contents, utility that an individual blogger gets from self-expression, and so, that there is the utility of  $l$  per one user. The contents provider pays charging fee of  $t$  per transaction to a platform provider.

$$\pi_i = \delta n_1 (1-p_i)(p_i - t) + l n_1 - \theta_i \quad (2-3)$$

$l$ : Prosumer effect. Utility from j company's promotion effect on its own contents, utility that an individual blogger gets from self-expression, same on every j company

Accordingly, the number of contents providers are as follows.  $n_2 = \hat{\theta}_i = \delta n_1 (1-p_i)(p_i - t) + l n_1 \quad (2-4)$

Like the previous model, a platform provider makes a profit from user flat-rate fee and transaction fee on a contents provider.  $\Pi = \delta n_1 n_2 (1-p)t + n_1 t_1$  (2-5)

Also, like the previous model, the price of contents is determined as follows.  $p = \frac{t+1}{2}$  (2-6)

Accordingly, the price of a contents market is  $p = \frac{t+1}{2}$ , and here, the number of a contents user,  $n_1$  and the number of a contents provider is determined as follows.

By using formula (2-6) and substituting the value to (2-2) and (2-4), like the following, we can find that demand function of a platform user is determined by user's membership fee,  $t_1$ , transaction fee of a contents provider,  $t$  and matching technology level,  $\delta$ .

$$n_1 = \frac{k - t_1}{1 - \delta(1-p)^2 \{ \delta(1-p)(p-t) + l \}} \quad n_2 = \frac{(k - t_1) \{ \delta(1-p)(p-t) + l \}}{1 - \delta(1-p)^2 \{ \delta(1-p)(p-t) + l \}} \quad (2-7) \quad (2-8)$$

Like the following, a platform provider determines  $t, t_1$  maximizing its own profit by charging a flat-rate fee on a user and a fee per transaction on a contents provider.

$$\text{Max}_{t, t_1} \Pi = \delta n_1 n_2 (1-p)t + n_1 t_1 - C(c_\delta + c_s) \quad (2-9)$$

Here, a platform provider can change matching technology level,  $\delta$  from investment, but the change might occur in the medium to longer term. We suppose  $k, l$  are given externally. Accordingly, the selectable variables for a platform provider are  $t$  and  $t_1$ .

By substituting  $n$  of (1-6) and  $n_1, n_2$  from (1-7), (1-8) to formula (1-11), we can get the formula as follows.

$$\Pi = \frac{(k - t_1)^2 \{ \delta(\frac{1-t}{2})^2 + l \} \frac{\delta(1-t)t}{2}}{[1 - l\delta(\frac{1-t}{2})^2 - \delta^2(\frac{1-t}{2})^4]^2} + \frac{(k - t_1)t_1}{1 - l\delta(\frac{1-t}{2})^2 - \delta^2(\frac{1-t}{2})^4} \quad (2-9)$$

By solving the first degree differential equation for  $t_1$ , we can find the value as follows.

$$t_1 = \frac{2k\delta^2(\frac{1-t}{2})^3t + 2kl\delta(\frac{1-t}{2})t + kl\delta(\frac{1-t}{2})^2 + k\delta^2(\frac{1-t}{2})^4 - k}{2\{\delta^2(\frac{1-t}{2})^3t + l\delta(\frac{1-t}{2})t + l\delta(\frac{1-t}{2})^2 + \delta^2(\frac{1-t}{2})^4 - 1\}} \quad (2-10)$$

If we substitute the value to (1-11) and differentiate for  $t$ , the value is as follows.

$$t^* = A - \frac{\frac{2l}{3\delta} - \frac{1}{4}}{A} + \frac{1}{2} \quad \text{where } A = [\{(\frac{2l}{3\delta} - \frac{1}{4})^3 + (\frac{l}{2\delta} + \frac{1}{8})^2\}^{\frac{1}{2}} - \frac{l}{2\delta} - \frac{1}{8}]^{\frac{1}{3}} \quad (2-11)$$

But, if  $l = \frac{3}{8}\delta$ ;  $t = \frac{1}{2}$ . If we substitute  $t^*$  of formula (2-11) to a formula for  $t_1$ , the result is as follows.

$$t_1^* = \frac{k(16 - \delta^2 - 4\delta l + 6\delta k B + 12\delta k l B^2 - 8\delta^2 B^3 + 3\delta^2 B^4 - 8\delta k l B)}{-2\delta^2 + 32 - 8\delta l - 4\delta^2 B^3 + 4\delta^2 B + 8\delta l B^2 + 2\delta^2 B^4} \quad (2-12)$$

$$\text{where } B = C - \frac{\frac{2l}{3\delta} - \frac{1}{4}}{C} + \frac{1}{2}, \quad C = [\{(\frac{2l}{3\delta} - \frac{1}{4})^3 + (\frac{l}{2\delta} + \frac{1}{8})^2\}^{\frac{1}{2}} - (\frac{l}{2\delta} + \frac{1}{8})]^{\frac{1}{3}}$$

However, as formula (2-11) and (2-12) are so complicated to compare the values, we'll simplify the formula by substituting  $l = 0.1, k = 1$  and  $l = 1, k = 1$ .

First, we'll look at the optimum cost of a platform provider, the number of a user and a contents provider, profit and social welfare in case of  $l = 0.1, k = 1$ .

**PROPOSITION 2.1.** ( $l = 0.1, k = 1$ ;) A platform provider sets the fixed cost on user in the range of  $0.5 < t_1^* < 0.5072$  depending on matching technology level in order to maximize the profit. Also, a fee on a contents provider is determined within the range of  $-0.355 < t^* < 0$  depending on matching technology. Here, if matching technology level increases,  $t^*$  value decreases.

**Lemma 2.1.** Depending on pricing policy of a platform provider, a user and a contents provider determines whether to participate in a platform or not, and here, the number of a user is set within the

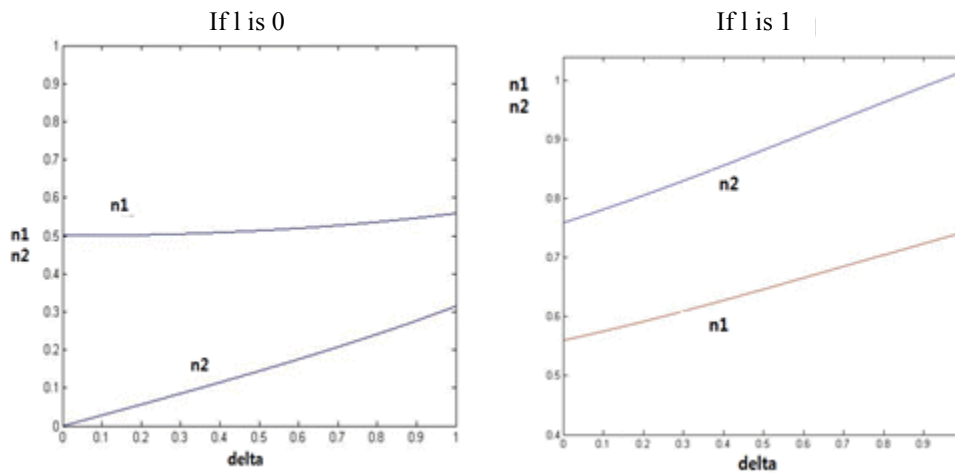
range of  $0.5 < n_1 < 0.5066$  and the number of a contents provider within the range of  $0.05 < n_2 < 0.1126$ . The price of contents is as  $0.3225 < p < 0.5$  and the profit of a platform provider is as  $0.25 < \Pi < 0.2533$ .

**Lemma 2.2.** User group welfare, contents provider group profit and platform provider profit becomes  $U = 0.125$ ,  $\Pi_c = 0.0013$ ,  $\Pi = 0.25$  each. So, here, we can see that a platform provider gets the highest profit, and aggregate social welfare is  $W = 0.3763$ .

Now, we'll see how it changes if  $k = 1, l = 1$ .

**PROPOSITION 2.2.** ( $l = 1, k = 1$ ;) If cross network effect increases ( $l$  increase) from contents provider's platform use, user fixed cost and charge on a contents provider can be higher as  $0.5 < t_1^* < 0.6301$  and  $-0.2117 < t^* < 0$  each. Also, the number of a user and the number of a contents provider increase as  $0.5595 < n_1 \leq 0.7423$  and  $0.7586 < n_2 \leq 1.0148$  each.

On (Figure 4-5), the right graph has the higher number of a user and a contents provider by adopting prosumer effect ( $l = 1$ ) than the left graph, and in particular, we can see that the number of a contents provider increased.



(Figure 4-5) Change in the number of a user ( $n_1$ ) and the number of a contents provider ( $n_2$ ) from prosumer effect

**Lemma 2.3.** As there is the increase ( $l=1$ ), user group welfare, the profit of a contents provider group and the profit of a platform provider group are  $0.125 < U < 0.1413$ ,  $0.125 < \Pi_c < 0.1612$   $0.25 < \Pi < 0.2568$  each. So, we can see that the profit of a contents provider, in particular, increased highly and social welfare increased highly as in  $0.5 < W < 0.5593$ .

### 2.2.2. Adopt contents promotion effect on Pricing structure type 2

A user has the same property as in the previous model, but pays to a flat-rate fee a platform provider. Accordingly, a user utility function and the number of a user are as follows.

$$u_i = \delta n_2 (1-p)^2 + k - t_1 - \theta_{(2-1)} \quad n_1 = \hat{\theta}_i = \delta n_2 (1-p)^2 + k - t_1 (2-2)$$

A contents provider is under the same condition with the previous 2.1 model, but as he/she does not pay a transaction fee,  $t$ , to a platform provider, utility function and the number of platform participants are determined as follows.

$$\pi_i = \delta n_1 (1-p_i) p_i + l n_1 - \theta_i (2-3) \quad n_2 = \hat{\theta}_i = \delta n_1 (1-p_i) p_i + l n_1 (2-4)$$

$l$ : utility from j company's promotion effect on its own contents, utility that an individual blogger gets from self-expression, all same

And the contents supply price of a contents provider can be determined from profit maximizing condition of j

company in formula (3-5) and is as (3-7).  $p = \frac{1}{2}$  (2-6)

A monopolistic platform provider intermediates contents that a user want with the possibility of  $\delta$ . If the platform provider makes a profit by not charging a fee on a contents provider but by charging fixed-cost on a user, the profit function is determined as follows.

$$\Pi = n_1 t_1 - C_s (2-5)$$

**PROPOSITION 2.3.** In case that a platform provider charges only a flat-rate fee on a user, flat-rate fee is

$$t_1^* = \frac{k}{2}, \quad \Pi^* = n_1 t_1 = \frac{(\frac{k}{2})^2}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} = \frac{4k^2}{16 - \delta^2 - 4l\delta} \quad . \text{ So, accordingly, if } l=1, k=1, \quad t_1^* = \frac{1}{2},$$

$$\Pi^* = \frac{4}{16 - \delta^2 - 4\delta}.$$

<Proof>

After finding  $n_2 = (\frac{\delta}{4} + l)n_1$  from formula (2-2), (2-4), and (2-6), we substitute the value to formula (2-2),

$$n_1 = \frac{k - t_1}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} \quad (2-7)$$

and the result is as follows. If we substitute the value again to formula (2-4), we can

$$n_2 = \frac{(k - t_1)(\frac{\delta}{4} + l)}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} \quad (2-8)$$

get the following result. If we substitute (2-7) and (2-8) to (2-5)', we can get the

$$\text{Max}_{t_1} \Pi = \frac{(k - t_1)t_1}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} - C_s \quad (2-9)$$

profit maximizing formula of a platform provider as follows. From first

degree differential formula for  $t_1$  in (2-9), we can draw  $t_1^* = \frac{k}{2}$ , and if we substitute the value again to (2-9),

$$\Pi^* = n_1 t_1 = \frac{(\frac{k}{2})^2}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} = \frac{4k^2}{16 - \delta^2 - 4l\delta} \quad (2-11)$$

formula (2-11) is deduced.  $l=1, k=1; \quad t_1^* = \frac{1}{2},$

$$\Pi^* = \frac{(\frac{1}{2})^2}{1 - \frac{\delta^2}{16} - \frac{\delta}{4}} = \frac{4}{16 - \delta^2 - 4\delta} \quad \square$$

**Lemma 2.4** With matching technology level of  $0 \leq \delta \leq 1$ , user welfare is  $0.125 \leq U \leq 0.2645$ , the profit of a contents provider is  $0.1875 \leq \Pi_c \leq 0.4131$ , and the profit of a platform provider is determined within the range of  $0.25 \leq \Pi \leq 0.3636$ . Accordingly, aggregate social welfare is

$$0.5625 \leq W \leq 1.0412.$$

<Proof>

By substituting the values to the following formula, we can find user group value, contents provider group value, and aggregate social welfare.

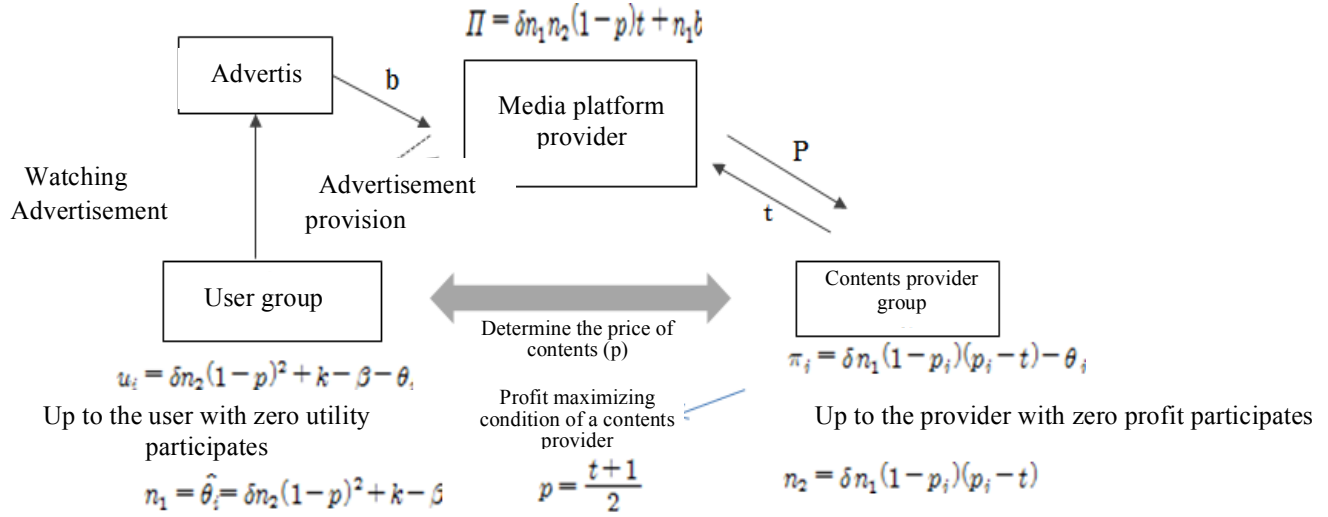
$$\begin{aligned}
U &= \int_0^{n_1} u_i d\theta_i = \int_0^{n_1} \delta n_2 (1-p)^2 + k - t_1 - \theta_i d\theta_i \\
&= \{\delta n_2 (1-p)^2 + k - t_1\} n_1 - \frac{1}{2} n_1^2 \\
&= \delta n_1 n_2 (1-p) - \delta n_1 n_2 (1-p)p + (k - t_1) n_1 - \frac{1}{2} n_1^2 \\
&= \frac{\delta k^2 (\frac{\delta}{4} + 1)}{16 (\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)^2} - \frac{k^2}{8 (\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)^2} - \frac{k^2}{2 (\frac{\delta^2}{8} + \frac{l\delta}{2} - 2)} \\
\Pi_c &= \int_0^{n_2} \pi_c d\theta_j = \int_0^{n_2} \delta n_1 (1-p)p + l n_1 - \theta_j d\theta_j \\
&= \delta n_1 n_2 (1-p)p + l n_1 n_2 - \frac{1}{2} n_2^2 \\
&= \frac{k^2 (\frac{\delta}{4} + 1) (\delta + 4) - 2k^2 (\frac{\delta}{4} + 1)^2}{16 (\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)^2} \\
\Pi^* &= n_1 t_1 = \frac{(\frac{k}{2})^2}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} = \frac{4k^2}{16 - \delta^2 - 4l\delta} \\
W &= U + \Pi_c + \Pi = n_1 n_2 \{\delta(1-p) + l\} + k n_1 - \frac{1}{2} (n_1^2 + n_2^2) - C \quad \square
\end{aligned}$$

## 2.3. Model with adopting ads

### 2.3.1. Adopt ads on pricing structure 1

A platform provider posts advertisements on its own platform, gets advertisement revenue from it, and does not charge any membership fee on a user. But, here, a contents provider does not post additional advertisement.

From this model, we'll discuss the conditions of how a platform provider, who does not charge a membership fee on a user but makes a profit by advertisements, can gain a bigger profit than that of charging a membership fee on a user. Also, we'll discuss how welfare of each party changes depending on those conditions.



(Figure 4-6) Structure of a media platform-based contents market when adopting ads

Though a user has the same property with the previous model, he/she consumes ads of a platform provider instead of paying a membership fee. The user feels the utility of  $\beta$  on ads of the platform provider, and depending on the effect of ads, the utility becomes  $-1 \leq \beta \leq 1$ .

If  $\beta > 0$ , it means that the user feels disutility on ads, and if  $\beta \leq 0$ , the user feels utility. The user pays  $x$  amount of money per one unit of contents, and gains the utility as follows. And As up to the user of  $u_1 = \delta n_2(1-p) + k - \beta - \theta_i = 0$  takes part in a platform, it is determined as follows.

$$u_i = \delta n_2(1-p)^2 + k - \beta - \theta_i \quad (3-1), \quad n_1 = \hat{\theta}_i = \delta n_2(1-p)^2 + k - \beta \quad (3-2)$$

A contents provider is same with the previous model and pays a fee per transaction.

$$\pi_i = \delta n_1(1-p_i)(p_i - t) - \theta_i \quad (3-3), \quad n_2 = \delta n_1(1-p_i)(p_i - t) \quad (3-4)$$

From the condition maximizing the profit of a contents provider, equilibrium price is determined on formula (3-5).

$$p = \frac{t+1}{2} \quad (3-5)$$



A monopolistic platform provider intermediates the contents a user wants with the probability of  $\delta$ . The platform provider sells one unit of contents for the price of  $p$ , gains a fee,  $t$ , and pays  $p-t$  to a contents provider. Advertisement revenue is in proportion to the number of platform users,  $n_1$  and the revenue per user is  $b$ ,  $0 \leq b \leq 1$ . Here, we suppose that the additional fee for posting ads is 0

$$\Pi = \delta n_1 n_2 (1-p)t + n_1 b \quad (3-6)$$

If we substitute (3-5) to formula (3-2) and (3-4), we can find the number of users and the number of contents providers as follows.

$$n_1 = \frac{1-\beta}{1-\delta^2(\frac{1-t}{2})^4} \quad (3-7) \quad n_2 = \delta(\frac{1-t}{2})^2 n_1 = \delta(\frac{1-t}{2})^2 \frac{1-\beta}{1-\delta^2(\frac{1-t}{2})^4} \quad (3-8)$$

If we substitute formula (3-5), (3-7), and (3-8) to formula (3-6), we can find the profit function of a platform provider, who advertises as follows.

$$\begin{aligned} \Pi_{ad} &= \delta n_1 n_2 (1-p)t + n_1 b \\ &= \delta^2 \left[ \frac{(1-\beta)}{1-\delta^2(\frac{1-t}{2})^4} \right]^2 \times (\frac{1-t}{2})^2 + \frac{(1-\beta)}{1-\delta^2(\frac{1-t}{2})^4} b \end{aligned} \quad (3-9)$$

### PROPOSITION 3.1.

In case that a monopolistic provider makes advertisement revenue without charging membership fee on a user, he/she can choose among two pricing policies maximizing the profit.

□) is applicable even if there's no matching technology and advertisement effect. From □) and □), it is determined depending on matching technology level,  $\delta$ , utility that a user gets from an advertisement and advertisement revenue that a platform provider gains, which is  $b$ .

$$\square) \quad t_{ad}^* = 1$$

$$\square) \quad t^* = 1 + 2 \left( A + \frac{B}{A} - \frac{3\delta^2(\beta-1)}{6bd^2} \right)^{\frac{1}{2}}$$

$$t^* = 1 - 2(A + \frac{B}{A} - \frac{3d^2(\beta-1)}{6bd^2})^{\frac{1}{2}}$$

$$\text{where } A = [(\frac{(\beta-1)^3}{8b^3} + \frac{(\beta-1)}{2bd^2})^2 - B^2]^{\frac{1}{2}} - \frac{(\beta-1)^3}{8b^3} + \frac{(\beta-1)}{2bd^2}]^{\frac{1}{3}}$$

$$\square) \quad B = (\frac{1}{3d^2} + \frac{(\beta-1)^2}{4b})$$

<Proof>

We can get the following result by solving the first degree differential formula(3-9) for  $t$  from a profit function of a platform provider.

$$Max_t \Pi_{ad} = \delta^2 [\frac{(1-\beta)}{1-\delta^2(\frac{1-t}{2})^4}]^2 \times (\frac{1-t}{2})^2 + \frac{(1-\beta)}{1-\delta^2(\frac{1-t}{2})^4} b \quad \square$$

**PROPOSITION 3.2.** If a platform provider sets the price as  $t_{ad}^* = 1$ , the price of contents is  $p = 1$ , the number of users is  $n_1 = 1 - \beta$ , the number of contents providers is  $n_2 = 0$ , and the profit of a platform provider becomes  $\Pi_{ad}(t=1) = b(1-\beta)$ . Here, user welfare is  $U_{ad} = \frac{1}{2}(1-\beta)^2$  and welfare of a contents provider is  $\Pi_{c-ad} = 0$ . Accordingly, aggregate social welfare becomes  $W_{ad} = \frac{(1-\beta)^2}{2} + b(1-\beta)$ .

<Proof>

By substituting  $t_{ad}^* = 1$  to formula (3-5), we can find that  $p = 1$ , and by substituting  $t_{ad}^* = 1$  to formula (3-7) and (3-8), we can see the result of  $n_1 = 1 - \beta$ ,  $n_2 = 0$ . Here, the profit of a platform can be solved out from formula (3-9). User group, the group of contents providers, and aggregate social welfare can be drawn by substituting the above values to the below welfare function of each party.  $\square$

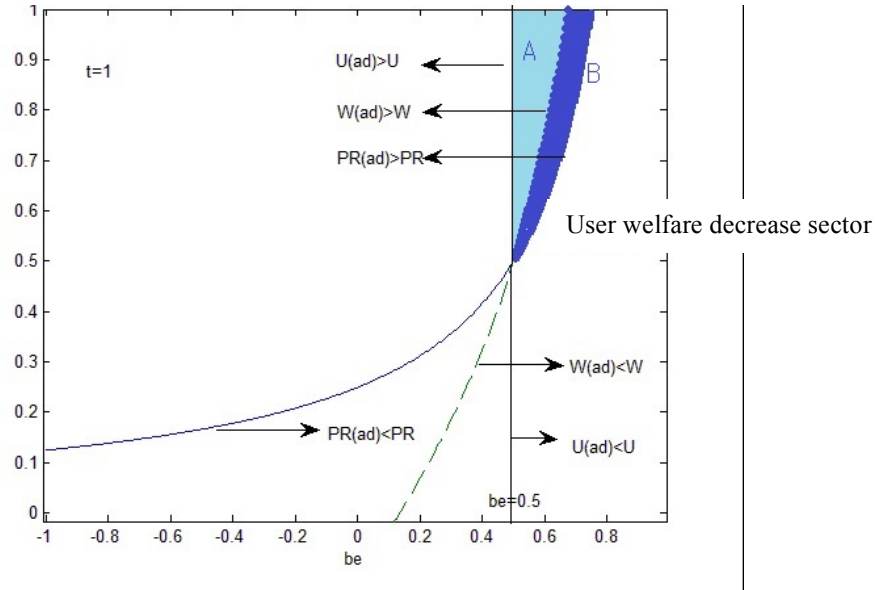
As we can see in Proposition 2.2, the number of users, the profit of a platform provider, welfare level, etc, are all determined depending on advertisement effect,  $\delta$  and the earnings rate of advertisement,  $b$ . In case that a platform provider charges a membership fee on a user and receives a transaction fee of  $t = 1$  from a contents

provider, the result should be like  $\Pi_{ad(t=1)} = b(1-\beta) > 0.25$  in order to satisfy the condition,  $\Pi_{ad} > \Pi = 0.25$  (higher than the profit of a platform provider), and so  $b > \frac{0.25}{(1-\beta)}$  has to be satisfied. The left part of a PR curve in the below graph explains this.

As for user utility,  $U_{ad} = \frac{1}{2}(1-\beta)^2 > U = 0.125$  should be satisfied even when a user does not pay a membership fee and watches an advertisement in order to secure the utility that the user gets when paying a membership fee. For this to be satisfied,  $\beta < 0.5$  and it should be positioned on the left part of a vertical line,  $U_{ad}$  in the graph. The number of contents providers is fixed to 0.

Aggregate social welfare should be  $W_{ad} = \frac{(1-\beta)^2}{2} + b(1-\beta) > W = 0.375$ , and for this to be satisfied, its position should be the left part of a graph.

Comparing advertising rate of return and welfare effect of adopting advertising by disutility ratio (without matching technology)



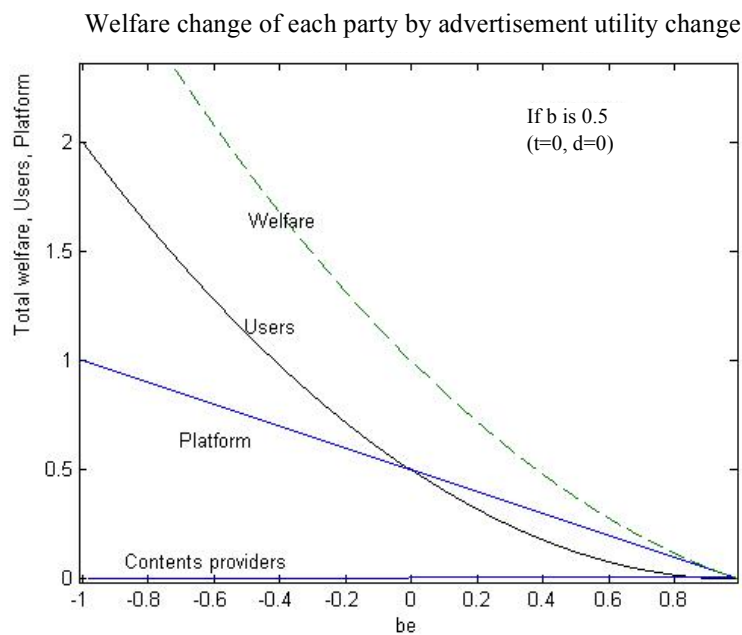
(Figure 4-7) Welfare maximizing condition when adopting ads (in case of  $t = 1, \delta = 0$ )

As a result, a small inverted triangle sector (A) on the upper part of the graph in (Figure 4-7) decreases but aggregate welfare increased in this sector, and for a big inverted triangle sector (A+B) on the upper part of the graph shows decreased user welfare but increased profit of a provider.

That is, a platform provider has the incline to increase the advertising up to the level that a user's disutility on an advertisement increases in order to make a bigger profit, and it can be also explained that the government, which is in the position of Social Planner, has the incline to increase an advertisement explicitly or implicitly up to the level of decreasing user welfare, if the government puts industry activation before user welfare.

Seen from the recent trend, it's possible to apply strong Privacy Act to in-country companies, but applying it to global companies is frequently difficult. In this case, while in-country companies cannot enter the sector of a big triangle (A+B), global companies enter it, might damage user welfare, and take financial profit, so measures to prevent it are necessary.

As disutility of an advertisement increases, welfare of every party decreases but decreasing rate is all different. If  $\beta$  is negative number, user group utility is higher than the profit of a platform provider, but becomes same when  $\beta = 0$ . If  $\beta$  increases to positive number, it becomes lower than the profit of a platform provider.

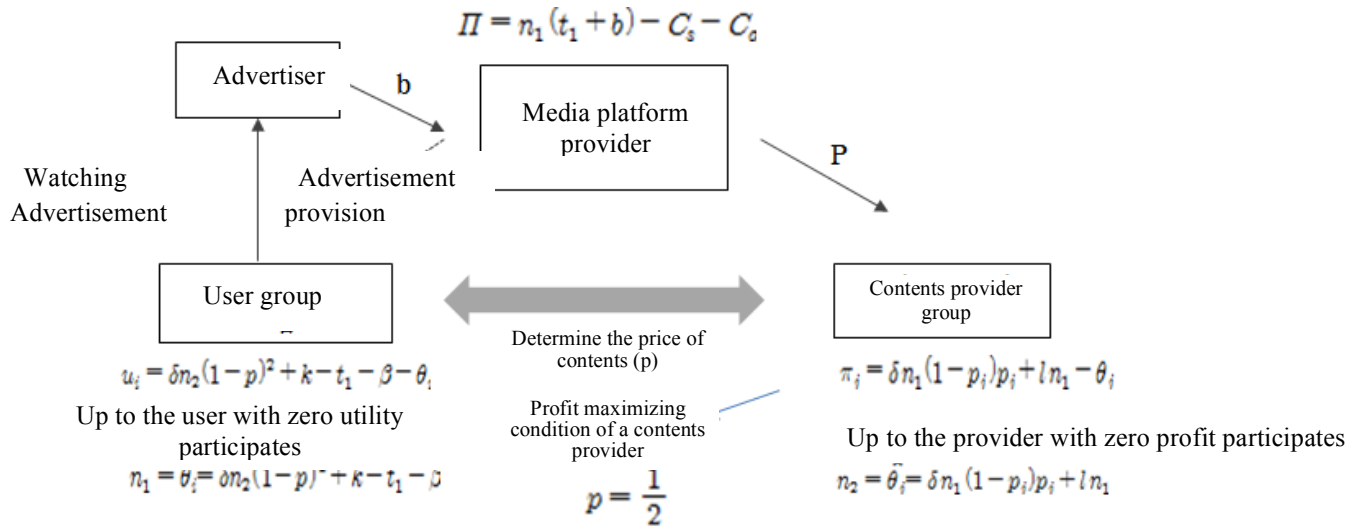


(Figure 4-8) Welfare change of each party by advertisement utility change

### 2.3.2. Adopt ads on Pricing structure 2

In this chapter, we'll discuss the conditions to decrease user flat-rate fee, and to increase the utility and profit of a user, platform provider, and a contents provider in case of adopting an advertisement in a platform, which

charges only a flat-rate fee on a user.



(Figure 4-9) A media platform structure when adopting ads in a user flat-rate fee model

If a platform provider adopts an advertisement and makes a user watch the advertisement, the user feels the utility of  $\beta$  on a platform provider's ad, and the utility becomes  $-1 \leq \beta \leq 1$  depending on advertising effect. If  $\beta > 0$ , it means that a user feels disutility on the ad, and if  $\beta \leq 0$ , a user feels utility on it. Users pay  $p$  per one unit of contents and get the utility as follows. As up to the user of  $u_1 = \delta n_2(1-p) + k - t_1 - \beta - \theta_i = 0$  participates in a platform, we can get the following formula.

$$u_i = \delta n_2(1-p)^2 + k - t_1 - \beta - \theta_i \quad (3-1) \quad n_1 = \tilde{n}_1 = \delta n_2(1-p)^2 + k - t_1 - \beta \quad (3-2)'$$

A contents provider doesn't pay a fee and here we suppose the case that promotion effect of contents exists. As a result, the profit of a platform provider and the number of contents providers are as follows.

$$\pi_i = \delta n_1(1-p_i)p_i + l n_1 - \theta_i \quad (3-3) \quad n_2 = \tilde{n}_2 = \delta n_1(1-p_i)p_i + l n_1 \quad (3-4)'$$

The contents supply price of a contents provider can be drawn from j company's profit maximizing condition in

formula (3-5) and is as follows (formula (3-7)).  $p = \frac{1}{2}$  (3-7)

A monopolistic platform provider intermediates the contents that a user wants with the probability of  $\delta$ . If the platform provider makes a profit by not charging a fee on a contents provider but by receiving a flat-rate fee from a user, a profit function is determined as follows.

$$\Pi = n_1 t_1 - C_s \quad (3-8)$$

If a platform provider posts ads on a platform, he/she gains advertisement revenue from an advertiser. In order to provide ads on a platform, ad-providing system needs to be constructed in the first stage, so the cost,  $C_a$  occurs. Advertisement revenue is in proportion to the number of platform users, which is  $n_1$ , and the revenue per one user becomes  $b$ . Here, the construction fee for ad-posting system is  $C_a$ , and we suppose marginal cost by the increase of advertisement amount as 0.  $\Pi = n_1(t_1 + b) - C_s - C_a \quad (3-9)$

$b$ : Advertisement revenue per one user that a platform provider gets from an advertiser  $0 \leq b \leq 1$

**PROPOSITION 3.2.** In case of making a user watch an advertisement, for a platform provider to make a profit higher than the profit when the provider charges a flat-rate fee on a user, for a user to get higher utility, and for a contents provider to make a higher profit, the condition of

□)  $b > \beta$ , □)  $\beta \leq \frac{k}{2}$  should be satisfied.

<Proof>

$$\text{From } n_1 = \frac{k - t_1 - \beta}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}}, \quad n_2 = \frac{(k - t_1 - \beta)(\frac{\delta}{4} + l)}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}},$$

$$\text{Max}_{t_1} \Pi = n_1(t_1 + b) - C_s - C_a = \frac{(k - t_1 + \beta)(t_1 + b)}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} - C_s - C_a,$$

$$\text{and we can get } t_1^* = \frac{k + \beta - b}{2}.$$

For a user watching an advertisement to pay the lower fixed cost than the cost they pay when there's no

advertisement,  $t_1^* = \frac{k+\beta-b}{2} < \frac{k}{2}$  should be satisfied. Accordingly,  $b > \beta$ , and advertisement revenue per one user should be bigger than user's disutility on an advertisement.

(□) Condition for conserving profit of a platform provider

If we substitute  $t_1^* = \frac{k+\beta-b}{2}$  to a profit function,

$$\begin{aligned}\Pi^* &= \frac{\{k+\beta - (\frac{k+\beta-b}{2})\} \{(\frac{k+\beta-b}{2}) + b\}}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} \\ &= \frac{(\frac{k+\beta+b}{2})^2}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} - C_s - C_a > \frac{(\frac{k}{2})^2}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} - C_s \\ &\quad \frac{(\frac{\beta+b}{2})^2}{1 - \frac{\delta^2}{16} - \frac{l\delta}{4}} - C_a > 0\end{aligned}$$

And from the above, we can get

Here, if we suppose  $C_a = 0$ , it should be  $\beta + b > 0$ . That is, we can conclude that the sum of advertisement revenue per one user and the cost(user disutility) per user should be higher than 0.

(ii) Condition for conserving user utility

In case of advertising, to make a higher user utility than that of the case without advertising and with paying only fixed cost, the following should be satisfied.

When adopting an advertisement, utility higher than before can be generated if the formula is as follows.

$$\begin{aligned}U^a &= \frac{\delta k^2 (\frac{\delta}{4} + 1)}{16(\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)^2} - \frac{k^2}{8(\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)^2} - \frac{k(\beta - k)}{2(\frac{\delta^2}{8} + \frac{l\delta}{2} - 2)} \\ U^a - U &= \frac{k^2}{4(\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)} + \frac{k(\beta - k)}{2(\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)} > 0\end{aligned}$$

But, the denominator in the above formula is negative number,

$$k^2 + 2k(\beta - k) < 0 - k^2 + 2\beta k < 0, \quad k(k - 2\beta k) > 0$$

□)  $\beta < 0$ ; it should be  $k < 2\beta$ , or  $k > 0$ ,  $k \geq 0$ , so  $k > 0$  is valid only.

□)  $\beta \geq 0$ ; it should be  $k < 0$ , or  $k > 2\beta$ , so  $k \geq 2\beta$  is valid only.

Accordingly,  $\beta \leq \frac{k}{2}$  should be valid.

(iii) Condition for conserving profit of a contents provider

$$\begin{aligned} \Pi_c &= \int_0^{n_2} \pi_c d\theta_j = \int_0^{n_2} \delta n_1 (1-p)p + l n_1 - \theta_j d\theta_j \\ &= \delta n_1 n_2 (1-p)p + l n_1 n_2 - \frac{1}{2} n_2^2 \\ \text{From} \quad \Pi_c^a &= \frac{\delta(\frac{k+b-\beta}{2})^2(\frac{\delta}{4}+1)}{4(\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)^2} - \frac{(\frac{k+b-\beta}{2})^2(\frac{\delta}{4}+1)^2}{2(\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)^2} + \frac{(\frac{k+b-\beta}{2})^2(\frac{\delta}{4}+1)}{(\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)^2} \\ &= \frac{(\frac{k+b-\beta}{2})^2(\frac{\delta}{4}+1)^2}{8(\frac{\delta^2}{16} + \frac{l\delta}{4} - 1)^2} \\ \Pi_c^a - \Pi_c &= \frac{2(b-\beta)(b-\beta+2)(\delta^2+8\delta+16)}{(\delta^2+4\delta-16)^2} > 0, \end{aligned}$$

We can see that the result should be  $b < \beta - 2$  or  $b > \beta$

But here, as  $0 \leq b \leq 1$ ,  $b > \beta$  is valid only.

To gather up (i), (ii), and (iii), we can draw the result of □)  $b > \beta$  and □). □

### 3. Conclusion

When we consider the evolution speed, the innovative industries characteristics and the increasing influence of global operators, the direct regulation of market distortion may reduce the companies' voluntary innovations and



weaken the competitiveness of industry. This analysis suggests some policies for balanced development of media industry with minimizing the regulations of internet based media industry.

First, monopoly platform providers' pricing policy gives the lower users' utility and the lower contents providers' profits than social planner' one. However, the development of matching technology will increase the transactions between two-sided platform participants, users and content providers, and actively enhances the utility and number of the participants. Second, introduction of Prosumer policy, such as internet blog, and provision of more utility of publicity for contents providers can increase the number of content providers and users utility. This policy will ease the distortion of distribution and explains how Internet search engines and YouTube are activated. Third, introduction of advertisement and development of advertising technology can preserve revenue of the platform providers' profit even without charging users entrance fee under certain conditions. Generally, advertising gives dis-utilities to viewers, but with the development of advertising techniques advertising itself can raise the utility and the effectiveness of ads for the viewer, so the user can obtain more utilities by paying less advertising fees. However, there are some incentives for monopoly platform providers to raise the amount of advertisement with reducing users' utility to raise his profits.

This paper's contribution is analysis of internet based internet media industry with modified two-sided market theory starting with monopoly market case only. As many cases such as internet search engine market, internet based multimedia market and smart phone OS, and so on, show that major player takes more than 70% of market shares, this monopoly market analysis provides implications. However when we consider the early stage of internet based media market, competitive market and dynamic market analysis should be studied further.

From the analysis, we can draw the following indications. First, as the pricing policy of a monopolistic provider is to maximize his/her profit, the loss of user welfare and contents provider profit can be generated compared to the decision of Social planner. In other words,

In other words, a monopolistic platform provider is highly inclined to charge a fee higher than the socially desirable flat-rate fee and to give a subsidy lower than the subsidy, which should be given to a contents provider. Here, a platform provider can increase the number of participants and social welfare by improving matching technology.

Second, by making a user share uploaded information with other users on his/her blog or on an internet café, a

platform provider can make users satisfy their needs of self-expression and get utility, and the provider can have the effect of providing a user with a variety of contents at a lower cost. That is, a contents provider can make a profit by selling contents, or even if there's no direct profit from his/her own contents, we can expect the increase of the number of platform participants and the increase of user's utility if a user gets utility by sharing with other users and promoting it.

Third, a platform provider can make a higher profit than the profit, which he gets by charging a user fee, by adopting effective advertisements instead of charging a flat-rate fee on users.

But for this to be successful, the disutility of ads should be low and the rate of return should be high. When a platform provider adopts an advertisement, user utility decreases but the profit of a platform provider increases, and accordingly, the section, where a user utility decreases but social welfare increases, is generated.

Bases on these indications, we'll suggest policy direction on a platform, a contents provider, and a user as follows.

Regarding a platform provider, there's an increasing concern on unfair trade and the abuse of market dominant position, which is utilized by a monopolistic platform provider's supreme status. However, most of the act of unfair trade include distribution of illegal contents, copyright infringement, etc. and they the subject of application of existing regulations. Also, considering technology evolution speed, the property of innovative industry, the increased impact of a global business, etc., strengthening regulations directly causes the distortion of a market, decreases the voluntary innovation of a company, and as a result, it might weaken the competitiveness of industry, which raises concern.

As the result, which was analyzed based on the model of this study, implies that matching technology improvement, prosumer function activation and customized advertisement adoption cause the effect of increasing the profit of a platform provider, user utility, and the profit of a contents provider, establishing policies, which induce balanced development between a company and a contents provider through a company's voluntary innovation, should be carried forward prior to strengthening direct regulation.

Concerning a contents provider, a user gets utility by making his/her own contents, sharing them on OTT like internal and external portals and Youtube, and by expressing himself/herself, and a platform provider provides an environment of supplying various kinds of contents at a lower price to its users. However, the entry of a contents provider, who makes high-quality contents, is difficult under the circumstance, where copyright is not

protected. As a result, even if users prefer high-quality contents, it is difficult to find those contents on an internet, but low-priced substitutional goods, which have lower quality but give similar amount of utility, are easy to find. This current phenomenon has the high possibility of throwing out high-quality contents providers from a market and obstruction growth of the entire contents market. To prevent this vicious cycle, we can think of stopping distribution of illegal contents, strengthening copyright protection system, and support expansion plans for making contents at a low price in a public sector in order to lower contents provider's entry cost.

With regard to a user, as recent ICT and other broadcasting related technologies have been developed toward a direction of user awareness, big data, locational information utilization, etc., they can provide convenient and innovative new service, but, on the other hand, the possibility of privacy invasion and abuse of personal information utilization is increasing. So, we suggest there should be legal remedies so as to effectively response to personal information invasion, and guidelines and institutional strategies in order that providers protect users voluntarily, while not obstructing industry utilization.

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