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Pricing of Products and Complementary Services: A Study of the Online Game Industry

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PRICING OF PRODUCTS AND COMPLEMENTARY SERVICES: A STUDY OF THE ONLINE GAME INDUSTRY

Fixation des prix des produits et services complémentaires : une étude de l'industrie du jeu en ligne

Research-in-Progress

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Abstract

We model a monopolist who offers a product and a complementary service, where only the latter exhibits positive network externalities. We focus on the online game industry as a representative case in which the product (the game), unlike the service (access to the interactive online play mode), has zero marginal cost, and consider two-potential pricing strategies: 1) the bundle pricing, in which the vendor charges a single price for the product and the service; and 2) the separate pricing, in which the vendor sets the prices of the product and the service separately. We find that, in contrast to the common result in the bundling literature, bundling may increase consumer surplus, while the monopolist chooses not to offer the bundle. We offer theoretical evidence that this is due to the presence of network externalities.

Keywords: Bundling, price discrimination, network externalities, online game industry

Résumé

Dans cette recherche, nous modélisons un monopoleur qui offre un produit et un service complémentaire, où seul ce dernier possède des externalités de réseau positives. Nous constatons que, contrairement au résultat commun dans la littérature, le lot de produit peut augmenter le surplus du consommateur, alors que le monopoleur choisit de ne pas offrir le lot. Nous prouvons de façon théorique que c'est du à la présence des externalités de réseau.

Abstract in Korean

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Introduction

In many industries, a firm may offer complementary service along with its base product in order to enhance the value created to its customers. For example, Windows OS customers are offered periodic software upgrades; virus protection software vendors such as Symantec Corporation or McAfee Inc. provide their customers with periodic security updates to protect them from newly-found computer viruses or security breaches. Enterprise system software such as SAP R/3 or Oracle ERP is often sold with a variety of service options such as implementation, consulting, training, and technical support. Thus, it is important for firms to correctly decide which services to provide and set the price of the service and product to maximize profit

In this study, we develop an economic model of an industry in which firms provide complementary online services to customers who purchase a base product.. Focusing on services with positive network externalities, so that the value of the service to its users increases with the number of customers that subscribe to the service, we analyze the firm's decision on the provision and pricing of the online service. Our research is motivated by the observation that in some cases, network externalities arise not from the consumption of the base product, but from using the service complementary to the base product, while most models in the literature assume that network externalities arise from the base product. One exemplary industry is the online game industry, a big industry which was estimated at $3.4 billion in 2005 and is expected to grow up to $11 billion in 2011[1].

We assume heterogonous consumers, and consider the following two pricing strategies; 1) the bundle pricing strategy, where the vendor charges a single price for the base product and the service; and 2) the separate pricing strategy, where the vendor sets the price of the base product and the service separately, and a user who wants to get the service has to pay an additional service fee. With this specification, we address the following research questions.

(i) Under what conditions the firm chooses the bundle pricing or the separate pricing?

(ii) How does the firm's bundling decision affect social welfare?

We find that the firm's pricing choice depends on the marginal cost of the service as well as its intrinsic value to customers. We also show that the service may be supplied less than is social optimum. Especially, we find that while bundling might be preferred by consumers and maximizes social surplus, the monopoly chooses to sell the service separately. Further analysis suggests that the service is often under-provided because of the existence of network externalities; the vendor cannot fully capture the benefits generated for consumers from the service with network externalities.

Literature Review

[1] DFC Intelligence http://www.dfcint.com/wp/?p=52

Our work is related to the literature on network externalities and bundling. Network externalities arise when the utility that a user derives from a product increases with the number of other consumers that use the same or compatible product (Katz and Shapiro 1985). Therefore, a customer's utility from the product is a function of the product's inherent value and the total number of customers (Ellison and Fudenberg 2000).

A number of studies examine the effect and implications of network externalities on competition, market equilibrium, and social welfare under a variety of circumstances. Topics studied include the pricing of network goods, the achievement of compatibility and standardization between multiple competing goods (Katz and Shapiro 1985; Farrell and Saloner 1986; Lee and Mendelson 2007), and the upgrade and intertemporal compatibility decision (Choi 1994, Ellison and Fudenberg 2000). Cabral et al. (1999) provide an economic justification for introductory pricing in the presence of network externalities; they show that a monopolist can charge a low price in early periods to attract a sufficient number of customers and take advantage of this customer base in the following periods by charging higher prices. Fudenberg and Tirole (2000) find that, at the presence of network externalities, a large customer base that an incumbent builds with introductory pricing can deter entry of competitors and the monopolist's competitive position can be sustained. Jing (2007) shows that a seller of information goods benefits from second degree price discrimination when network externalities exist, while price discrimination is not optimal when there are no network externalities. Our work examines pricing and bundling decisions in the presence of network externalities.

The literature generally shows that bundling enables the seller to capture more value from consumers and thus reduces consumers' surplus (Adams and Yellen 1976, Schmalensee 1984). Bakos and Brynjolfsson (1999) show that by bundling a large number of information goods a monopolist can capture most of the consumer surplus because the bundling reduces the variance in consumers' valuations and makes the demand more elastic. Their following study (Bakos and Brynjolfsson 2000) considers production costs as well as distribution costs (incurred by the vendor); they show that the two components of costs play a key role in the monopolist's decision whether to bundle or unbundle information goods. The distribution cost in Bakos and Brynjolfsson (2000) is similar to the marginal cost of service in our model (as both costs are increasing in the number of customers). Parker and Van Alstyne (2000) consider bundling in a model of a two-sided market with network effects (Parker and Van Alstyne 2005). When a vendor sells two components, one to each side of the market, he might find bundling of the two components optimal when at least one side of the market is interested in both components and the valuations for the lease valued component are high enough.

Our model differs from previous models in the bundling literature in that one of the bundle's components, the base game, has no marginal cost while the other component, i.e. the service, involves both a positive marginal cost and demand-side network externalities. In addition, the components of the bundle are not symmetric, as the service has no standalone value, while the game does.

The Model

We consider a market with *N* customers who are heterogeneous in terms of their valuations for the product and for the service. We assume that the valuation for the base product, θ, is uniformly distributed in $[\underline{\theta},\overline{\theta}]$, where $\overline{\theta} > 0$ and $\underline{\theta} \le 0$. A consumer's valuation for the service is given by $\alpha(s + n_s^e)$, where n_s^e is the total *expected* number of customers who subscribe to the service, and *s* is the intrinsic value of the service independent on the number of service users. In our analysis, we find the fulfilled expectations equilibrium, that is we find prices (for product and service) such that n_s^*, the *actual* number of service customers, equals n_s^e (Katz and Shapiro 1985).

The heterogeneity in the valuation for the service is modeled as follows. To simplify the analysis, we divide customers into two groups: βN customers (Group 1) have $\alpha = \alpha_1$, while the remaining $(1-\beta)N$ customers (Group 2) have $\alpha = \alpha_2$. We assume that $0 < \beta < 1$ and $\alpha_1 > \alpha_2 \ge 0$, so that the utility of Group 1 customers is affected by the network size to a greater extent. We assume that the vendor cannot identify a customer's valuation for the base product and the service. The vendor has three pricing options as follows[2].

[2] Since the complementary service is available only to the base product customers and has no standalone value, a mixed bundling strategy, in which a vendor sells two products independently as well as the bundle, is not viable.

Case 0: Selling the Product Only

First, we consider the case in which the monopoly offers only the product. The utility function of Group 1 and 2 customers is given in Eq. 1.

$$u_1 = u_2 = \theta - p_0 \qquad \text{(Eq. 1)}$$

p_0 is the price for the product. The profit function of the monopoly in this case is given by

$$\pi_0 = n_0 p_0 \,. \qquad \text{(Eq. 2)}$$

where n_0 is the number of customers who purchase the product. The marginal cost of the base product is zero.

Case 1: The Bundle Pricing

Choosing this option, the vendor sells a bundle of the base product and the subscription to the service with a single price p_1. The expected utility functions of customers from Group 1 and 2 are given in Equations 3 and 4, respectively.

$$u_1 = \theta + \alpha_1(s + n_s^e) - p_1 \qquad \text{(Eq. 3)} \qquad\qquad u_2 = \theta + \alpha_2(s + n_s^e) - p_1 \qquad \text{(Eq. 4)}$$

The first terms in Eqs. 3 and 4 represent the customer's utility from the product; the second terms in Eq. 3 and Eq. 4 are the utility from using the complementary service. Only customers whose overall utility is nonnegative purchase the bundle. The profit function of the monopolist when selling the bundle is given by

$$\pi_1 = n_s^*(p_1 - c) \,. \qquad \text{(Eq. 5)}$$

n_s^* is the actual number of customers who purchase the bundle. We assume that while the marginal cost for the base product is zero, the marginal cost to serve one service subscriber is c.[3]

Case 2: The Separate Pricing

In this pricing, the vendor charges service users a service subscription fee f. This results in a situation that only Group 1 customers, who have higher valuation for the service, subscribe to the service, while Group 2 customers do not subscribe to the service but purchase the base product only. Therefore, the vendor can use this pricing strategy as a means for price discrimination. The utility functions of a customer from Group 1 and Group 2 are as follows.

$$u_1 = \theta + \alpha_1(s + n_s^e) - p_2 - f \qquad \text{(Eq. 6)} \qquad\qquad u_2 = \theta - p_2 \qquad \text{(Eq. 7)}$$

u_1 is the utility function of customers in Group 1, while u_2 is the utility of customers in Group 2.. p_2 and f are the price of the product and the service subscription fee, respectively, and both are determined by the vendor. The profit function of the monopoly under this option is given by

$$\pi_2 = p_2 n_0 + n_s^*(f - c) \,, \qquad \text{(Eq. 8)}$$

where n_0 is the total number of customers that purchase the product (from both groups) and n_s^* is the number of Group 1 customers that purchase the product (and thus subscribe to the service).

Results

Before embarking the analysis, we make a parameter assumption as follows. This assumption guarantees the second-order condition to hold for all the following derivations.

Assumption 1. $\bar{\theta} - \underline{\theta} > N\left(\beta\alpha_1 + (1-\beta)\alpha_2\right)$, where $\alpha_0 = \beta\alpha_1 + (1-\beta)\alpha_2$

We derived optimal prices and resulting profits under each of the above three cases, using the concept of Fulfilled

[3] For instance, an online-game service provider should operate a larger-scale service system (e.g. servers, network facilities, and so forth) to serve a larger number of users.

Expectations Equilibrium (Katz and Shapiro 1985), and then compared the profit functions in order to determine the profit maximizing strategy – bundling of product and service, separate pricing or selling only product. The monopolist's pricing choice is summarized in Lemma 1.

Lemma 1. *(The Monopoly's Pricing Strategy). We denote* $\Delta = \bar{\theta} - \underline{\theta}$ *and* $s_0 = \dfrac{\bar{\theta}\left(\sqrt{\Delta - \alpha_1 \beta N} - \sqrt{\Delta - \alpha_0 N}\right)}{(\alpha_1 - \alpha_2)(1-\beta)\sqrt{\Delta}}$. *The monopoly chooses its pricing strategy as follows*

When $s \le s_0$ *holds*

i) The vendor chooses the bundle pricing iff $c < c_{10}$ *and does not operate the service otherwise, where*

$$c_{10} = \bar{\theta}\left(1 - \sqrt{\Delta - \alpha_0 N}\,/\sqrt{\Delta}\right) + \alpha_0 s\,.$$

When $s > s_0$ *holds,*

ii) The vendor chooses the bundle pricing, if and only if $c < c_{12}$, *where*

$$c_{12} = \bar{\theta} - \frac{\alpha_2 s \Delta}{\Delta - \beta N(\alpha_1 - \alpha_2)} + \frac{\sqrt{(\Delta - \alpha_1\beta N)(\Delta - \alpha_0 N)\left(\beta s^2 \Delta(\alpha_1 - \alpha_2)^2 + \bar{\theta}^2\left(\Delta - \beta N(\alpha_1 - \alpha_2)\right)\right)}}{\sqrt{\Delta}\left(\Delta - \beta N(\alpha_1 - \alpha_2)\right)}.$$

iii) The vendor chooses the separate pricing, if and only if $c_{12} < c < c_{20}$, *where*

$$c_{20} = \bar{\theta}\left(1 - \sqrt{\Delta - \alpha_1 \beta N}\,/\sqrt{\Delta}\right) + \alpha_1 s\,.$$

iv) The vendor does not operate the service at all, if and only if $c > c_{20}$.

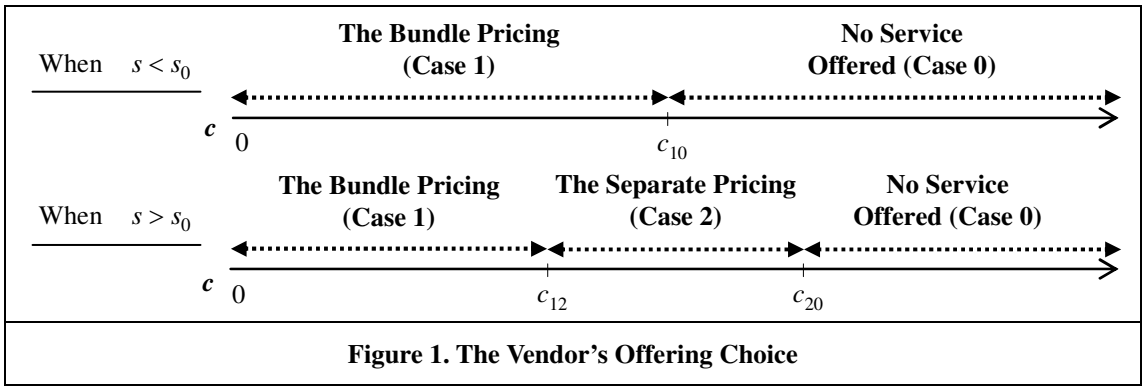

Figure 1. The Vendor's Offering Choice

Figure 1 describes the vendor's strategy choice according to Lemma 1. If $s \le s_0$ then the monopoly never finds it optimal to sell the service separately. In addition he offers the bundle only when the cost, *c*, is low enough (lower than a threshold value given by c_{10}).

If $s > s_0$ then when the marginal cost of offering the service is lower than a threshold value given by c_{12}, it is optimal for the vendor to charge customers a single-price for the product and its complementary service. On the other hand, when the marginal cost is between c_{12} and c_{20}, the monopolist chooses the separate pricing. When the marginal cost is higher than c_{20}, the service is not offered at all by the monopolist.

The above finding that the separate pricing is more likely to prevail when the marginal cost of the service is higher is consistent with a real-life example. According to recent surveys, users of *Starcraft*, *Warcraft III*, and *Diablo II*, online real-time strategy games produced by Blizzard Entertainment, spend 10.5 minutes a day on average in *Battle.net*, Blizzard's online gaming system; all three games are sold with the bundle pricing (Case 1). On the other hand, the average playing-time per day of a user of *World of Warcraft*, which is also developed by Blizzard, is 1.46 hours. This shows that Blizzard has to incur a higher cost in online systems to serve a *World of Warcraft* player than to serve a player of *Starcraft, Warcraft III*, or *Diablio II*. Indeed, *World of Warcraft* is sold by using the separate pricing strategy (Case 2).

How does the monopolist's pricing decision affect social welfare? Before presenting a detailed analysis, we provide a numerical example in Figure 2, which reveals that the service may be supplied less than social optimum.

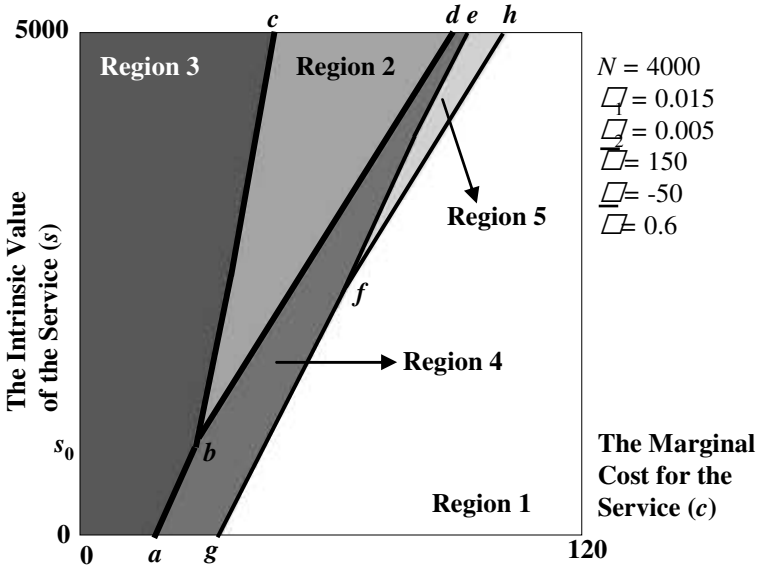

Figure 2. The Vendor's Choice and Social Optimum

Region	Monopoly's Choice	Social Optimum	
1	No Service	No Service	
2	The Separate Pricing	The Bundle Pricing	Under-provision
3	The Bundle Pricing	The Bundle Pricing	
4	No Service	The Bundle Pricing	Under-provision
5	No Service	The Separate Pricing	Under-provision

Figure 2 shows the profit maximizing choice and the one that maximizes social welfare over the range of the marginal cost (c) and the intrinsic value of the service (s). Notice that s_0 from Lemma 1 corresponds to the value of s at point b in Figure 1. In addition, the lines a-b, b-c, and b-d in Figure 1 correspond to the thresholds c_{10}, c_{12}, and c_{20} in Lemma 1, respectively. Figure 2 demonstrates three cases in which the service is under-supplied compared to what is socially optimum: in Region 2, bundling maximizes social welfare but the monopoly chooses separate pricing, and in Regions 4 and 5 them monopoly does not offer the service although this is not socially optimal.

Most of the bundling literature shows that bundling enables the monopoly seller to extract greater surplus from the consumers (Bakos and Brynjolfsson 1999). In contrast to previous models, Dewan and Freimer (2003) show that a software vendor might choose to sell add-in software separately from the base software, even though consumers prefer a bundle of the two (this paper does not examine the total surplus). Our findings of Region 2 in Figure 1, in which a bundle is socially optimal but the monopolist sells the service separately (which implies that consumers surplus is maximized with a bundle), is similar to the main finding from Dewan and Freimer (2003).

In Proposition 1, we compare the optimal seller's strategy with the strategy that is socially optimal for the case in which consumers are homogenous with respect to their service valuation (i.e. the case in which $\alpha_1 = \alpha_2$, or alternatively $\beta = 1$). Notice that when $\beta = 1$, the seller has no incentive to adopt the separate pricing strategy; he either sells a bundle, or does not offer the service at all.

Proposition 1. *(The Vendor's Pricing Strategy and Social Welfare) When $\beta = 1$, the vendor provides the service less*

than social optimum when $c_{10} < c < c_{S0}$, *where* $c_{S0} = \bar{\theta}\left(1 - \frac{(\Delta - \alpha_1 N)\sqrt{\Delta + 2}}{\sqrt{\Delta}\sqrt{\Delta(\Delta+2) - \alpha_1 N}}\right) + \alpha_1 s$.

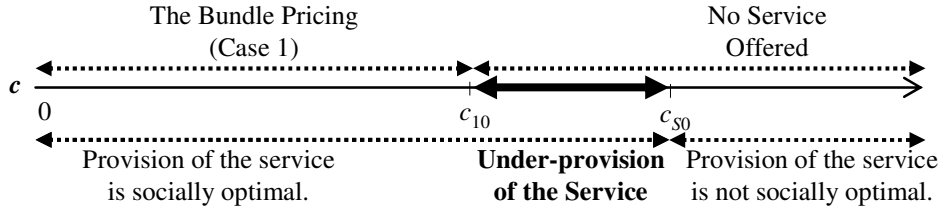

Figure 3. The Under-Provision of the Service when the Service Exhibits Network Externalities

Figure 3 demonstrated the results of Proposition 1; when consumers have homogenous valuation for the service, there exists a range of c values (between c_{10}, and c_{S0}) for which the monopoly chooses not to offer the service, although offering the service would maximize social welfare.

In what follows we give additional insight as to why the service may be supplied less than is socially optimum at the presence of network externalities. Our main argument is that the monopoly can not capture all of the benefits generated for consumers by the network effects, and thus the vendor may choose not to operate the service even though this is not socially optimal.

We first analyze an alternative model in which the complementary service does not involve network externalities. Suppose the utility from the service is denoted by $\alpha_1 s$ and does not depend upon the number of service subscribers[4]. Then it can be shown that the vendor offers the service with a price of $(\alpha_1 s + c)/2$ only when $c < \alpha_1 s$, a decision which maximizes social welfare. Thus, when the service does not create network effects, there is no under-provision of service. However, when the service does have network externalities, the service may be under-provided in the market.

The next proposition gives additional insight as to why the service may be supplied less than is socially optimum at the presence of network externalities.

Proposition 2. *Consumer surplus increases in the degree of network externalities to a greater extent than the monopolist's profit does. More specifically, When* $\beta = 1$, $c < \bar{\theta}$, *and* $\bar{\theta} - \underline{\theta} > 2$, $\frac{\partial}{\partial \alpha_1} CS_1 > \frac{\partial}{\partial \alpha_1} \pi_1$. *As a result, Social welfare increases to a greater extent than the profit, as well.*

Suppose that a progress in information technologies increases the degree of network externalities (α_1) by offering a greater level of interactivity between game players. Proposition 2 states that an increase in the degree of network externalities affects consumer surplus to a greater extent than it affects the vendor's profit. An increase in α_1 makes it possible for the vendor to charge a higher price for the bundle. By raising the price of the bundle, however, the vendor may lose marginal customers who have low valuation for the base product. Thus, the vendor cannot raise its price to an extent that will let him capture a significant portion of consumer welfare generated by the greater degree of network externalities.

Another reason for the under-provision of the service is the fact that the service does not have standalone value; it can be sold only to customers who also buy the product. For a comparison, suppose that the service can be sold independently even to those who do not buy the base product. In such a case, the monopolists charges $\alpha_1(s + N)$ for the service as long as this is equal to or greater than c, and customers expect that all the customers subscribe to the service. In this case, the monopolist can capture the entire consumer surplus generated from the service, while it cannot when the service has no value without the base product as in our setting.

[4] The utility from the base product and the service becomes $u = \theta + \alpha_1 s - p_1$.

Conclusion

We model a monopolist which sells a product and its complementary service, where the latter exhibits network externalities. Our motivation is based on our observation that, for some products, network externalities arise from a complementary service and not from the product itself. One industry to which our model applies is the computer games industry – where online services are available to those who buy packaged games. In our model, the vendor can either operate the service or not, and if it chooses to offer the service, it can either bundle it with the product, offering the bundle for a single price, or offer the service with a separate service subscription fee.

We derive the conditions under which each pricing strategy becomes the vendor's optimal choice. We find that the pricing choice depends upon the marginal cost of the service as well as the intrinsic value of the service. Under the presence of network externalities, we find that the vendor may provide the bundle less than social optimum. This finding is in contrast to general contentions in the bundling literature that the bundling is a tool to capture a greater amount of consumer surplus. But it is consistent with several recent papers such as Dewan and Freimer (2003), which show that a bundle is provided less than social optimum.

There are numerous ways to extend our study. First, it would be interesting to consider a duopoly where each firm might either bundle the service with the product or sell it separately, and examine whether under provision of service still prevails. Second, the case in which customers use the service for multiple periods by paying periodic service fees can be considered. Lastly, it would be interesting to examine how price discrimination (by identifying customers associations to the two groups) can effect the under provision of service than social welfare. In case of *World of Warcraft*, for example, subscribers in the U.S. pay a monthly fee of $19.99, while those in Europe pay 12.99 euro. Interestingly, Chinese subscribers have to pay about $3.72 per 60 hours.

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