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# A STUDY OF DIGITAL MUSIC PRICING MODELS

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## Abstract

*The development of Internet brought in revolutions in pricing models in the music industry. Currently, there are two common schemes to sell digital music. The first one is referred to as the ownership model, under which the consumers purchase and download the singles they prefer. The second one is referred to as the subscription model, under which consumers subscribe to the streaming services by paying a subscription fee. Our paper reveals that the advertisement revenue rate impacts music service providers' choice of pricing models. The music provider should choose the subscription model, when the advertisement revenue rate is low; the ownership model when the advertisement revenue rate is moderate; and offer the music for free and exploit profit from advertisements when the advertisement revenue rate is high.*

*Keywords: music pricing models, subscription, ad-sponsored*

# 1 INTRODUCTION

The traditional way of consuming music is to purchase an album as a bundle of several singles. The development of digital technologies enables consumers to purchase only the singles they prefer. iTunes Music Store firstly introduces the music pricing scheme based on singles. Since then, the market of digital music has been developing rapidly. For example, sales of digital music increased 6.9 percent in 2014<sup>1</sup>.

There are two common ways of consuming digital music: to purchase and download a single or to subscribe to a streaming service. We refer to purchasing and downloading singles as the ownership pricing model and subscribing to the streaming service as the subscription pricing model through this paper. Under the subscription model consumers have access to unlimited music by paying a subscription fee on a recurring basis. Subscription model is usually implemented as a premium business model. Examples include Pandora, Spotify, Tidal, Rdio and Deezr. In this pricing model, consumers can either to choose to subscribe to enjoy ad-free music or to enjoy music for free which comes with advertisements (usually also come with low quality).

Under the ownership model, the consumers purchase and download singles and consume the purchased singles without time limit. Examples include Bandcamp, Netease, Tencent and Xiami. Similar to the subscription model, the music service providers under the ownership model usually also provide ad-supported free service to consumers.

Currently, downloading remain the biggest source of digital revenues, accounting for 52 percent of the digital market in 2014. However, the revenue from downloading declined by 8.0 percent while the revenue from subscription increased by 39 percent in 2014<sup>2</sup>.

It seems both pricing models split the market share but the subscription model is cannibalizing the market share of ownership model. But is the subscription model is the dominating model in the future? And importantly, which pricing model should be adopted from the music service providers' perspectives?

This paper aims to provide insights to the above questions. Specifically, this paper addresses the following research questions: what is the optimal pricing strategies under different models? What is the optimal pricing strategy and under what conditions?

The analysis shows that the advertisement revenue rate, referring to the revenue generated by advertisements from one consumer, is a significant factor that impacts the music provider's choice of pricing models. When the advertisement revenue rate is low, the music provider should choose the subscription model; when the advertisement revenue rate is moderate, the music provider should choose the ownership model; when the advertisement revenue rate is high, either pricing models should be adopted and the music provider will instead offer the music for free and harvests profit from advertisements.

This paper relates most to the research on ad-sponsored business models. Riggins (2002) has discussed a separating equilibrium of how to balance the content quality and price based on the

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<sup>1</sup> See <http://ifpi.org/news/IFPI-publishes-Recording-Industry-in-Numbers-2015>

<sup>2</sup> See <http://ifpi.org/news/IFPI-publishes-Recording-Industry-in-Numbers-2015>.

free ad-sponsored model, two types consumers are involved. In our study, the content quality is an exogenous variable, and we use inconvenience sensitivity to differentiate consumers instead of only two types of consumers. Prasad et al. (2003) and Gabszewicz et al. (2006) have explored how to balance subscription price and the amount of advertising and they find that advertising lowers the prices. Different from these studies, we endogenize the amount of advertisements and the price level to get optimal profits. Besides subscription model, our research also include analysis on ownership model. There are also much research about the relationship between the content and advertising in the ad-sponsored business model (e.g., Steiner 1952; Beebe 1977; Spence and Owen 1977; Doyle 1998; Gal-Or and Dukes 2003; Bourreau 2003; Gabszewicz et al. 2006; Peitz and Valletti 2008). In our study, however, we focus on the relationship of the level of advertising and the price of the content under the ad-sponsored model.

This paper is organized as follows. Section 2 presents the model description and model setup. Section 3 analyzes and compare the subscription model and ownership model. Section 4 concludes the paper.

## 2 MODEL

We will derive the music provider's profit functions under each pricing models in this section. The notation used in this paper is summarized in Table 1.

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$K$	Maximal utility consumer can get from music provider
$u$	Consumer's utility on music
$\beta$	the proportion of maximal utility in free version
$\gamma$	Advertisement revenue rate
$\theta$	Cost sensitivity
$c_f$	Usage cost of accessing music in the free version
$c_s$	Usage cost of accessing music in the subscription
$c_o$	Usage cost of accessing music in the ownership
$\lambda$	Extent of the influence on free music, if consumer chooses the ownership pricing
$q$	Songs one consumer purchases when $K$ equals infinity under ownership model
$\alpha$	Advertising level
$P$	Price for one song
$T$	Fixed subscription fee

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*Table 1. List of Notation*

Let  $K$  denote the maximal utility that consumers obtain from adopting the paid music services (including the subscription model and ownership model).  $K$  is used to capture the

fact that one person is only able to allocate limited amount of time to consume music each day and thus can only obtain limited utility at most. When the consumers adopt the free service model, however, the maximal utility consumers can obtain is given by  $\beta K$ , where  $0 < \beta < 1$ .  $\beta$  is used to capture features including the reduced music quality and limited access to new songs of the free service. For example, the free music service provided by Pandora and Spotify come with lower quality compared to the paid services. Netease's Cloud Music provides limited access to new singles under the free music service.

When choosing to enjoy the music for free, the consumers don't need to pay for the music but need to tolerate the advertisements. Let  $a$  denote the intensity of the advertisement. The higher  $a$  is, the lower consumers' utilities are.

Further, there are usage costs incurred to consumers when they choose the free service model. Consumers have to tolerate some inconveniences under the free service. For example, Google Play Music, Xbox Music, Spotify and Pandora provide free services with limited skips. That is, consumers can skip songs for limited times per hour. In addition, Spotify disables offline listening for the free music service. Thus, we let  $c_F$  denote the aggregate usage cost under the free service model.

Consumers are heterogeneous in the sensitivity to the usage cost. The cost sensitivity is designated by  $\theta$ , which is uniformly distributed in the interval  $[0, \text{inf}]$ .

Similar to the model set up in Fan (2007), the utility consumers derive from consuming music under the free service model is given by

$$u_F = \beta K - a - \theta c_F. \quad (1)$$

We then explore consumers' utility function under the subscription model.

Let  $T$  denote the subscription fee. Under the subscription, there also exists usage cost incurred to consumers that might come from two sources. The first is that under some music providers (e.g. Spotify) there exists search cost for singles the consumers prefer. The second is that some music providers (e.g. Pandora) offer streamed music like a radio station with pre-selected lists of songs (although consumers can skip songs they dislike). This may also lead to a usage cost incurred to consumers. Thus, we let  $c_S$  denote the aggregate usage cost under the subscription model.

Thus, the utility consumers obtain from consuming music under the subscription model is given by

$$u_S = K - T - \theta c_S, \quad (2)$$

Last, we derive the consumers' utility function when they choose the ownership model. Note that consumers are still able to consume music provided by the free service besides the purchased singles. Thus, consumers' utility function under the ownership model consists of two parts as follows.

$$u_o = \lambda(\beta K - a - \theta c_F) + u(q(1 - e^{-K})) - pq(1 - e^{-K}) - \theta c_o, \quad (3)$$

Under the ownership model, there are usage costs incurred to consumers as well. These costs may include the time and efforts spent on making online payments for singles and managing purchased singles locally. We use  $c_o$  to denote the aggregate usage cost under the ownership model.  $u(q(1 - e^{-K})) - pq(1 - e^{-K}) - \theta c_o$  is the consumers' utility obtained from the singles

they purchased. For simplicity and tractability, we let  $q(1 - e^{-K})$  denotes the number of singles each consumer will purchase, which is positively correlated with the maximal utility consumers obtain from music provider  $K$ . The number of singles consumers will purchase equals 0 when  $K=0$  and equals  $q$  when  $K=\infty$ . The number of singles consumers purchase cannot be infinity since consumers can only spend certain amount of time on consuming music. The utility consumers obtained by consuming music should be non-decreasing and concave in the number of singles they consumed. Thus,  $u(q(1 - e^{-K}))$  has the

following characteristics:  $u(0) = 0$  ;  $\frac{\partial u}{\partial(q(1 - e^{-K}))} \geq 0$  ;  $\frac{\partial^2 u}{\partial(q(1 - e^{-K}))^2} < 0$  for all  $q(1 - e^{-K})$ .

On the other hand, consumers can still access to the free music service under the ownership model. Usually, consumers will purchase limited amount of singles and thus will spend some time to enjoy unpurchased singles through the free service.  $\lambda(\beta K - a - \theta c_F)$  refers to consumers' utility obtained from using the free service under the ownership model. By Eq. (1),  $\beta K - a - \theta c_F$  is the consumers' utility obtained by only using the free service.  $\lambda(0 < \lambda < 1)$  is a discount factor here to capture the fact that consumers will only allocate one portion of time to consuming music through the free service under the ownership model.

We then derive the music provider's profit functions under the two pricing models.

We first explore the subscription model. Under this model, consumers can choose either to subscribe ads-clean service or enjoy the music for free which comes with advertisements.

The market segmentation is given by Fig. 1 as follows.



Figure 1. Market Segmentation in the Subscription Model

Let  $\theta_s$  denotes the marginal consumer type who is indifferent between the subscription model and the free model. Solving the equation  $u_F = u_s$ , we can obtain that

$$\theta_s = \theta(u_F = u_s) = \frac{T - a - (1 - \beta)K}{c_F - c_s}. \text{ The number of consumers choose to adopt the free service}$$

$$D_F^s = \frac{T - a - (1 - \beta)K}{c_F - c_s}.$$

Consumers with a  $\theta$  greater than  $\theta_s$  will choose to subscribe.  $\bar{\theta}_s$  is obtained by letting

$$u_s = 0. \text{ Thus, we obtain that } \bar{\theta}_s = \frac{K - T}{c_s}. \text{ The number of consumers will choose to subscribe}$$

$$\text{thus is } D_s = \bar{\theta}_s - D_F^s = \frac{K - T}{c_s} - \frac{T - a - (1 - \beta)K}{c_F - c_s}.$$

Thus, we can write down the music provider's profit function under the subscription model as follows.

$$\pi_s = D_F^s a\gamma + D_s T = \frac{T - a - (1 - \beta)K}{c_F - c_s} a\gamma + \left( \frac{K - T}{c_s} - \frac{T - a - (1 - \beta)K}{c_F - c_s} \right) T, \quad (4)$$

where  $\frac{T - a - (1 - \beta)K}{c_F - c_s} a\gamma$  is the profit from advertisement in the free version,  $\gamma$  is the

advertisement revenue rate, and  $\left( \frac{K - T}{c_s} - \frac{T - a - (1 - \beta)K}{c_F - c_s} \right) T$  is the profit from the

subscription fee.

To guarantee non-negative demand, the conditions  $D_F^s \geq 0$  and  $D_s \geq 0$  must be satisfied,

$$\text{which leads to } T \geq a + (1 - \beta)K \text{ and } T \leq K - \frac{(\beta K - a)c_s}{c_F}.$$

Similarly, consumers can choose to purchase favorite singles or only use the free service. Note that consumers can still use the free service after purchased singles. The market segmentation is given by Fig. 2 as shown below.

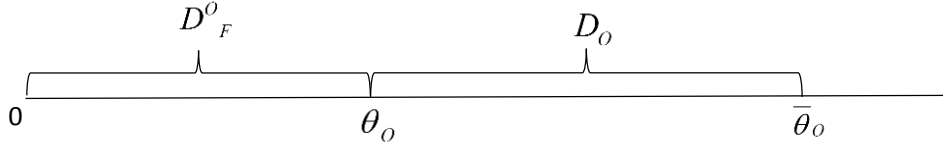


Figure 2. Market Segmentation in the Ownership Model

The marginal consumer type who is indifferent between to purchase singles and only use the free service is denote by  $\theta_o$ . Solving the equation  $u_F = u_o$ , we can obtain that

$$\theta_o = \frac{T - a - (1 - \beta)K}{c_F - c_S}.$$

Consumers with a  $\theta$  smaller than  $\theta_o$  will choose to only use the free service. Thus, the number of consumers who choose only to use the free service is given by

$$D_F^o = \theta_o = \frac{(1 - \lambda)\beta K - (1 - \lambda)a + pq(1 - e^{-K}) - u}{(1 - \lambda)c_F - c_o}.$$

Consumers with a  $\theta$  greater than  $\theta_o$  will choose to purchase singles.  $\bar{\theta}_o$  is obtained by

letting  $u_o = 0$ . Therefore, we get that  $\bar{\theta}_o = \frac{\lambda(\beta K - a) + u - pq(1 - e^{-K})}{\lambda c_F + c_o}$ . The number of

consumers who choose to purchase singles is given by

$$D_o = \bar{\theta}_o - \theta_o = \frac{\lambda(\beta K - a) + u - pq(1 - e^{-K})}{\lambda c_F + c_o} - \frac{(1 - \lambda)\beta K - (1 - \lambda)a + pq(1 - e^{-K}) - u}{(1 - \lambda)c_F - c_o}.$$

Thus, the music provider's profit function is given by

$$\pi_o = (D_F + \lambda D_o)a\gamma + pq(1 - e^{-K})D_o, \quad (5)$$

where  $(D_F + \lambda D_o)a\gamma$  is the revenue from the advertisements,  $\gamma$  is the advertisement revenue rate and  $pqD_o$  is the revenue from the sales of singles.

To guarantee non-negative demand,  $D_F \geq 0$  and  $D_o \geq 0$  must be satisfied, which requires

$$p \geq \frac{u + (1 - \lambda)a - (1 - \lambda)\beta K}{q(1 - e^{-K})} \quad \text{and} \quad p \leq \frac{uc_F - (K\beta - a)c_o}{c_F q(1 - e^{-K})}.$$

### 3 THE COMPARISON BETWEEN THE SUBSCRIPTION MODEL AND OWNERSHIP MODEL

#### 3.1 The Optimal Design of the Subscription Model

In order to achieve the optimal profit under the subscription model, the music provider needs to solve the following decision problem.

$$\begin{aligned} \max_{a,T} & \frac{T-a-(1-\beta)K}{c_F-c_S} a\gamma + \left( \frac{K-T}{c_S} - \frac{T-a-(1-\beta)K}{c_F-c_S} \right) T \\ \text{s.t.} & \quad a+(1-\beta)K < T \leq K - \frac{(\beta K - a)c_S}{c_F}, 0 < a < \beta K \end{aligned} \quad (6)$$

**Proposition 1.** *When the music provider adopts the subscription model, there are three possible market outcomes:*

(i) When  $\gamma < \frac{1}{2\beta-1}$ , the optimal subscription fee is  $T^* = \frac{K}{2}$ , the optimal advertisement intensity is  $a^* = \frac{2K\beta-K}{2}$ , and the optimal profit the music provider will achieve is  $\pi_s^* = \frac{K^2}{4c_S}$ . Further, all consumers choose to subscribe to the music service rather than adopting the free service in this case.

(ii) When  $\frac{1}{2\beta-1} \leq \gamma < \frac{2c_F}{\beta c_S} - 1$ ,  $T^* = \frac{K\gamma(-2c_F + (1+\beta+\gamma-\beta\gamma)c_S)}{-4\gamma c_F + (1+\gamma)^2 c_S}$ ,

$a^* = \frac{K((-1+\gamma-2\beta\gamma)c_F + \beta(1+\gamma)c_S)}{-4\gamma c_F + (1+\gamma)^2 c_S}$ , and  $\pi_s^* = \frac{K^2\gamma(-c_F + \beta(1+\gamma-\beta\gamma)c_S)}{c_S(-4\gamma c_F + (1+\gamma)^2 c_S)}$ . In this case,

there exist both consumers who subscribe to the music service and consumers who adopt the free service.

(iii) When  $\gamma \geq \frac{2c_F}{\beta c_S} - 1$ ,  $T^* = \frac{2Kc_F - K\beta c_S}{2c_F}$ ,  $a^* = \frac{K\beta}{2}$ , and  $\pi_s^* = \frac{K^2\beta^2\gamma}{4c_F}$ . In this case, all

consumers adopt the free service and no consumer choose to subscribe.

The intuition behind Proposition 1 is illustrated as follows. When the advertisement revenue rate  $\gamma$  is low, the music provider won't receive much profit from the free music service (which makes profit by sending out advertisements). Thus, when  $\gamma$  is lower than a threshold value (corresponding to case 1 in Prop. 1), the best strategy for the music provider is to set  $T^*$  and

$a^*$  such than all consumers will choose to subscribe. When the advertisement revenue rate  $\gamma$  is moderate (corresponding to case 2 in Prop. 1), the music provider set  $T^*$  and  $a^*$  to harvest profit both from the free version and the subscription version. When the advertisement revenue rate  $\gamma$  is high enough (corresponding to case 3 in Prop. 1), the free music model is more efficient than the subscription model in terms of generating profit. Thus, the best strategy for the music provider is to set  $T^*$  and  $a^*$  such than all consumers will choose to adopt the free service.

### 3.2 The Optimal Design of the Ownership Model

Under the ownership model, the music provider needs to solve the following decision problem to achieve the optimal profit.

$$\begin{aligned} \max_{a,p} & \left( \frac{(1-\lambda)\beta K - (1-\lambda)a + pq(1-e^{-K}) - u}{(1-\lambda)c_F - c_O} + \lambda \left( \frac{\lambda(\beta K - a) + u - pq(1-e^{-K})}{\lambda c_F + c_O} - \frac{(1-\lambda)\beta K - (1-\lambda)a + pq(1-e^{-K}) - u}{(1-\lambda)c_F - c_O} \right) \right) a \gamma \quad (7) \\ & + pq \left( \frac{\lambda(\beta K - a) + u - pq(1-e^{-K})}{\lambda c_F + c_O} - \frac{(1-\lambda)\beta K - (1-\lambda)a + pq(1-e^{-K}) - u}{(1-\lambda)c_F - c_O} \right) \\ \text{s.t.} & \frac{u + (1-\lambda)a - (1-\lambda)\beta K}{q(1-e^{-K})} \leq p < \frac{uc_F - (K\beta - a)c_O}{c_F q(1-e^{-K})}, 0 < a < \beta K \end{aligned}$$

**Proposition 2.** Under the ownership model, the music provider sets the single price and advertising level as follows.

(i) If  $0 < \gamma < \frac{2u\lambda c_F - 2K\beta\lambda c_F + 2K\beta\lambda^2 c_F + uc_O - 2K\beta c_O + 3K\beta\lambda c_O + \sqrt{w}}{2K\beta\lambda c_O}$ , where

$$w = 4Ku\beta\lambda c_O^2 + (2u\lambda c_F - 2K\beta\lambda c_F + 2K\beta\lambda^2 c_F + uc_O - 2K\beta c_O + 3K\beta\lambda c_O)^2, \text{ then the optimal}$$

advertisement intensity is  $a^* = \frac{-u + K\beta(2 + (-2 + \gamma)\lambda)}{2 + 2(-1 + \gamma)\lambda}$ , the price for one song is

$$p^* = \frac{K\beta\gamma(-1 + \lambda)\lambda + u(1 + (-1 + 2\gamma)\lambda)}{2q(1-e^{-K})(1 + (-1 + \gamma)\lambda)}, \text{ and the optimal profit the music provider will achieve}$$

is  $\pi_o^* = \frac{(u + K\beta\gamma\lambda)^2}{4(1 + (-1 + \gamma)\lambda)(\lambda c_F + c_O)}$ . In this case, all consumers choose to pay for the music.

(ii) If  $\frac{2u\lambda c_F - 2K\beta\lambda c_F + 2K\beta\lambda^2 c_F + uc_O - 2K\beta c_O + 3K\beta\lambda c_O + \sqrt{w}}{2K\beta\lambda c_O} < \gamma < \frac{2uc_F}{K\beta c_O} - 1$ , where

$$w = 4Ku\beta\lambda c_O^2 + (2u\lambda c_F - 2K\beta\lambda c_F + 2K\beta\lambda^2 c_F + uc_O - 2K\beta c_O + 3K\beta\lambda c_O)^2, \text{ then the optimal}$$

advertising level is given by

$$a^* = \frac{2K\beta\gamma(-1 + \lambda)\lambda c_F^2 + (u(-1 + \gamma) + 2K\beta\gamma(-1 + 2\lambda)c_F c_O + K\beta(1 + \gamma)c_O^2)}{4\gamma(-1 + \lambda)\lambda c_F^2 + 4\gamma(-1 + 2\lambda)c_F c_O + (1 + \gamma)^2 c_O^2}, \text{ the optimal single price is}$$

given by

$$p^* = \frac{\gamma(2u(-1+\lambda)\lambda c_F^2 + (K\beta(-1+\gamma)(-1+\lambda)\lambda + u(-2+4\lambda))c_F c_O + (u(1+\gamma) + K\beta(-1+\gamma)(-1+2\lambda))c_O^2)}{q(1-e^{-K})(4\gamma(-1+\lambda)\lambda c_F^2 + 4\gamma(-1+2\lambda)c_F c_O + (1+\gamma)^2 c_O^2)}, \quad \text{the}$$

$$\text{optimal profit equals } \pi^* = \frac{\gamma(-(u^2 - K^2\beta^2\gamma(-1+\lambda)\lambda)c_F + K\beta(u(1+\gamma) + K\beta\gamma(-1+2\lambda))c_O)}{4\gamma(-1+\lambda)\lambda c_F^2 + 4\gamma(-1+2\lambda)c_F c_O + (1+\gamma)^2 c_O^2}. \quad \text{In}$$

this case, some consumers choose to pay for the music, some choose the free service.

(iii) If  $\gamma > \frac{2uc_F}{K\beta c_O} - 1$ , then the optimal level  $(p^*, a^*, \pi_O^*)$  are given by  $a^* = \frac{K\beta}{2}$ ,

$$p^* = \frac{2uc_F - K\beta c_O}{2q(1-e^{-K})c_F}, \quad \pi_O^* = \frac{K^2\beta^2\gamma}{4c_F}. \quad \text{In this case, all consumers choose the free service.}$$

Similar to the situation of the subscription model, when the advertisement revenue rate  $\gamma$  is low, the music provider won't receive much profit from the free music service (which makes profit by sending out advertisements). Thus, when  $\gamma$  is lower than a threshold value (corresponding to case 1 in Prop. 1), the best strategy for the music provider is to set  $p^*$  and  $a^*$  such that all consumers will choose to pay for the songs. When the advertisement revenue rate  $\gamma$  is moderate (corresponding to case 2 in Prop. 1), the music provider sets  $p^*$  and  $a^*$  to harvest profit both from the free version and the paid music. When the advertisement revenue rate  $\gamma$  is high enough (corresponding to case 3 in Prop. 1), the free music model is more efficient than the ownership model in terms of generating profit. Thus, the best strategy for the music provider is to set  $p^*$  and  $a^*$  such that all consumers will choose to adopt the free service.

### 3.3 Comparison between the Subscription and Ownership Models

In this section, we compare the optimal profits achieved under each model and explore the conditions under which each model performs better. We resort to computational analysis since the comparison of the formula is difficult.

Setting  $K=2$ ,  $\beta=0.8$  (the maximal utility obtained by using the free service is 80% of the paid service),  $u=1.5$ ,  $c_F=0.4$ ,  $c_S=0.2$ ,  $c_O=0.12$ , we obtain Fig. 3 as follows.

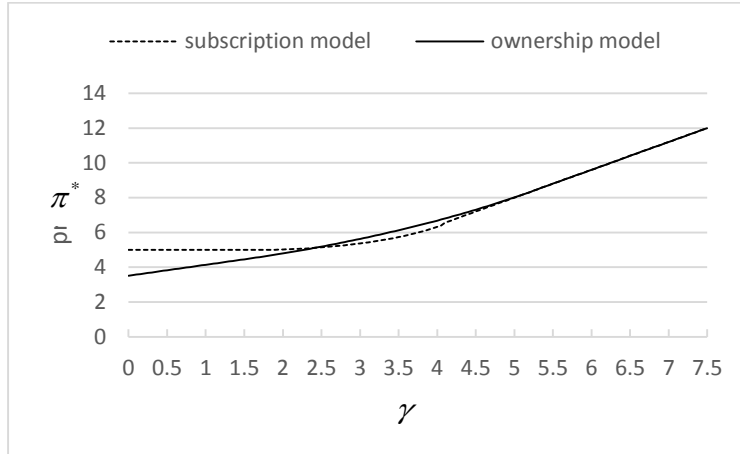


Figure 3. Comparison of Subscription model and Ownership model

When  $\gamma$  is relatively low in the first period, the music provider's profit primarily comes from charging consumers, which is similar to the pure pricing without advertising. According to the prior literature, the bundling strategy is dominant to pure unbundling. So the music provider should choose the subscription strategy---one kind of bundling strategies (Varian 1995).

When  $\gamma$  is moderate in the second period, the profits come from both advertising and payments. The ownership model is more flexible, people who choose ownership can also use the free version. But in the subscription model, if consumer choose subscription, there is no advertising. So, in the second period, the music provider should choose ownership model.

When  $\gamma$  is high in the last period, the music provider's profit depends on advertising revenue. So the music provider will push consumers be on the free version by increasing the subscription free or other methods. Then the profit functions of subscription and ownership are coincident.

## 4 CONCLUSION

Music industry is undergoing dramatic changes. The rapid development of the Internet first brought in the way of purchasing singles by downloading, namely the ownership model and then streaming service based on subscription. Thus, it is a crucial question facing the music service providers that whether to adopt the subscription model or the ownership model.

This paper provides guidelines on which pricing models to choose. We find that the advertisement revenue rate is an important factor which impacts music service providers' choice of pricing models. When the advertisement revenue rate is low, the music provider should choose the subscription model. When the advertisement revenue rate is moderate, the music provider should choose the ownership model. And lastly when the advertisement revenue rate is relatively high, both pricing strategies should not be adopted and the music provider will instead offer the music for free and harvests profit from advertisements.

In the future, we will conduct more analysis on the effects of other parameters. For example, the maximal utility consumers can get from music provider  $K$  and the proportion of maximal utility in free version  $\beta$ , might also affect music providers' choice of pricing strategies.

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## References

- Beebe, J. H. (1977). Institutional structure and program choices in television markets. *The Quarterly Journal of Economics*, 15-37.
- Bourreau, M. (2003). Mimicking vs. counter-programming strategies for television programs. *Information Economics and Policy*, 15(1), 35-54.
- Doyle, C. (1998). Programming in a competitive broadcasting market: entry, welfare and regulation. *Information Economics and Policy*, 10(1), 23-39.
- Fan, M., Kumar, S. and Whinston, A.B. (2007). Selling or advertising: strategies for providing digital media online. *Journal of Management Information Systems*, 24(3), 143-166.
- Gabszewicz, J. J., Laussel, D. and Sonnac, N. (2006). Competition in the media and advertising markets. *The Manchester School*, 74(1), 1-22.
- Gal-Or, E. and Dukes, A. (2003). Minimum differentiation in commercial media markets. *Journal of Economics & Management Strategy*, 12(3), 291-325.
- Peitz, M. and Valletti, T. M. (2008). Content and advertising in the media: Pay-tv versus free-to-air. *International Journal of Industrial Organization*, 26(4), 949-965.
- Prasad, A., Mahajan, V. and Bronnenberg, B. (2003). Advertising versus pay-per-view in electronic media. *International Journal of Research in Marketing*, 20(1), 13-30.
- Riggins, F. J. (2002). Market segmentation and information development costs in a two-tiered fee-based and sponsorship-based web site. *Journal of Management Information Systems*, 19(3), 69-86.
- Spence, M. and Owen, B. (1977). Television programming, monopolistic competition, and welfare. *The Quarterly Journal of Economics*, 103-126.
- Steiner, P. O. (1952). Program patterns and preferences, and the workability of competition in radio broadcasting. *The Quarterly Journal of Economics*, 194-223.
- Varian, H. R. (1995). Pricing information goods.

**Due to page limit, proofs of propositions are available upon request.**