Pricing Strategies and Network Effect in the On-Line Music Industry

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ABSTRACT

This paper explains the impacts of a record company adopting different pricing strategies for virtual music goods on company profits, consumer surplus, and social welfare. We show that after a record company begins charging for virtual music goods, some virtual music goods users become unwilling to pay the goods; this influences the users who use physical music goods, and as a result, company profits, consumer surplus, and social welfare all increase. According to the principles of fair trade, companies that charge for virtual music goods are profitable. Hence, charging constitutes economic efficiency. We suggest that companies would attempt to raise user utility for virtual music goods. For instance, companies can provide multiple payment options or customization to raise the number of users to further enhance social welfare.

INTRODUCTION

The popularization of the internet has facilitated the digitization of the traditional communications industry, and the prosperous development of the digital content industry has rapidly promoted the digitization of business opportunities. Examples of related innovations include MP3s, high capacity multifunctional mobile media players, cell phone backgrounds and ringtones, and digital music websites. Among these innovations, digital music is the most popular, mainly because digital technologies such as MP3s and P2P software have solved the distortion problems in data replication and because the younger generation prefers music to be convenient rather than being overly concerned with quality.

Due to the gradual decline of the traditional music market and rise of the virtual music market, can legally authorized business models that offer instant popular music increase profits by providing diversified marketing channels and products? Do they benefit consumers and overall social welfare? These are all issues worthy of further investigation. As such, this study employed Hotelling's (1929) location model to investigate the competitive behavior of the digital goods industry, and used subgame perfect equilibrium and backward induction to find a solution in two steps. More precisely, first the equilibrium price of goods was found, and then it was used to obtain the locational equilibrium of companies. The two music goods that are provided by post-transition record companies, physical music goods and virtual music goods, were then analyzed along with how virtual music goods affect company profits, consumer surplus, and overall social welfare before and after payment. The methods record companies should employ to determine marketing strategies in order to enhance consumer benefits with regards to fair trade were also explored.
Gary and Shy (2003) has indicated that traditional record companies should seek horizontal resources and diversification and integrate limited resources through collaboration with P2P providers or vertical integration to achieve maximum benefits. In other words, the traditional music industry is already being affected by the impacts of transition. In addition, Bakker (2005) also suggested that the market that can be expanded by legal sharing services is more diverse and attractive compared to illegal sharing service markets. Therefore, a win-win situation can be achieved under the consensus of consumers, companies, and songwriters. Lastly, following the popularization of digital music, Fang et al. (2004) stated that the main reason for the music industry recession has been the constant rise in CD prices and the inconsistent quality of music. Gayer and Shy (2006) believe that in positive network externality, piracy issues only diminish the profits of record companies, while artists can hold concerts to compensate for losses or even increase profits. Therefore, piracy does not affect artists in any way and, thus, the decline in CD sales directly impacts record companies. In order to predict the life cycle of music, Bhattacherjee, Gopal, Lertwachara, and Marsden (2004, 2005) found that albums with more P2P downloads have higher piracy rates and album sales. Therefore, the P2P sharing download rate can serve as a leading indicator to predict future market sales and album rankings. Furthermore, Ozer (2001) found that the same group of potential users held different preferences, interests, and perspectives towards online music services. Molteni (2003) asserted that downloading music is no longer the only form of consumption in a digital environment. Different consumption habits should be differentiated using artist selection and pricing strategy while predicting each new consumption model and preparing various strategies to manage the market environment. Regarding legal issues, Fetscherin (2005) argued that the relevant authorities should set up a complete punishment system for illegal providers of P2P video downloads and that legal providers should focus on the quality of legally downloaded goods. The results showed that the risk of being caught, as well as the price, quality, and quantity of high quality goods influence consumers’ download behavior. Scott (2001) believed that record companies only gained a momentary victory as this incident inspired Napster and others to enter the online music market and establish a new business model where users pay for downloaded music.

There are few studies that have analyzed these subjects from the perspective of the industrial economy or cyber economy. Therefore, this study explored the business model that provides legally authorized online music for listening only and not for download and how this model affects record companies, consumers, and overall social welfare.

**BASIC MODEL**

Assume that a record company offers virtual and traditional physical channels. In other words, the company sells two types of goods: (1) physical digital products such as cassette tapes, CDs, and videos sold in stores (referred to as P goods) and (2) legal and authorized virtual digital products that can be used online but cannot be downloaded (referred to as V goods). Assume that the consumption pattern \( t \) is uniformly distributed and falls between \([a, b]\), where \( b>a>0\). Assume that the differentiation standardization of the consumption pattern is \( 1 \); that is, \( b-a=1 \). When people are not good at using computers or are particularly picky about audio quality, the consumption pattern approaches \( a \). Thus, if they are forced to use specific software to consume virtual goods, they will find it inconvenient. On the contrary, when people are good at using computers or are less concerned about quality, the
consumption pattern approaches $b$. As such, it would not be inconvenient for them to consume $V$ goods using a specific type of software. Therefore, consumers can choose from the following three consumption patterns: (1) consumers choose not to use the digital goods provided by companies; (2) consumers choose to use $P$ goods and gain the use value of $\alpha_E s - \tau(t-a)$; (3) consumers choose to use $V$ goods and gain the use value of $\beta_s v - \tau(b-t)$. In those equations, $\alpha>0$ and $\beta>0$ are used to measure the basic utility of $P$ goods and $V$ goods; that is, the price users are willing to pay. The $s$ parameter represents the type of good. The $\tau$ parameter indicates the cognitive difference between obtaining digital goods from actual stores and downloading them from the internet.

Thus, according to Shy (2001) and Gayer and Shy (2003), the consumer surplus function is:

$$U_j = \begin{cases} 
\alpha_E s - \tau(t-a) + \gamma_E n_{Ej} & \text{for } P \text{ goods} \\
\beta_s v - \tau(b-t) + \gamma_v n_{Vj} & \text{for } V \text{ goods} \\
0 & \text{if both don't use} 
\end{cases}$$

Where $n$ and $\gamma$ describe the network effect of the number of users on the use of digital goods. $n_{Ej}>0$ and $n_{Vj}>0$ represent the total number of users of $P$ goods and $V$ goods in market $j$. $\gamma$ represents the crowding cross effect; thus, $\gamma_E$ indicates the influence of the number of virtual goods users. In other words, virtual and physical goods users with the latest or newest information have common topics of discussion (for example, the melody of a song, the meaning behind the lyrics, the artist’s singing ability and skills, the background music in the video, filming methods, casting and acting skills, added software functionality and interface operability), thereby affecting the utility of physical goods users. $\gamma_v$ represents the influence of the number of physical goods users; that is, physical and virtual goods users with the latest or newest information have common topics of discussion, thereby affecting the utility of virtual goods users.

In addition, assume that two digital goods are produced and published by monopolies and that the manufacturing cost and development cost are fixed. Thus, as sales increase, average fixed costs decrease. However, the replication of albums for $P$ goods creates marginal costs ($C_{E}$, variable cost). This marginal cost is negligible. $V$ goods have no marginal cost for album replication ($C_{V}$). Thus, this study assumed that the marginal cost for goods was $C_{E}=C_{V}=0$, which was beneficial during follow-up analysis.

**MARKET MODEL**

**Market I**

Companies only provide $P$ goods within traditional physical channels, and without any virtual channels, the number of $V$ goods users is 0 (i.e., $n_{V1}=0$). The price for $P$ goods is $P_{E1}$. Therefore, to adjust for the market environment in Market I, is modified to Eq. (1) can be rewritten as

$$U_j = \begin{cases} 
\alpha_E s - \tau(t-a) - P_{E1} & \text{for } P \text{ goods} \\
0 & \text{Unused} 
\end{cases}$$

When $i_{E1}$ represents consumption where there is no difference between not using $P$ goods and using paid $P$ goods, for consumers at $i_{E1}$, $\alpha_E s - \tau(i_{E1} - a) - P_{E1} = 0$. Thus,

$$i_{E1} = \frac{\alpha_E s - P_{E1}}{\tau} + a .$$

Let $n_i$ represent the total number of digital goods users in Market I; therefore, $n_i = n_{E1} = (i_{E1} - a)$ can be used to calculate company profits

$$\pi_i = \pi_{E1} = P_{E1} n_{E1} = P_{E1} (i_{E1} - a) .$$
Substituting Eq. (3) into Eq. (4). Assuming profit maximization, differentiating $\pi_1$ in $P_{E1}$ and setting it as 0 results in the most suitable price

$$P_{E1} = \frac{\alpha s_E}{2}. \quad (5)$$

Then substitute Eq. (5) into Eqs. (3) and (4) to obtain

$$i_{E1} = \frac{\alpha s_E}{2\tau} + a \quad \text{and} \quad \pi_1 = \frac{(\alpha s_E)^2}{4\tau}. \quad (6)$$

Because companies only provide $P$ goods, consumption and profits were not influenced by $\gamma_E$ or $\gamma_v$. Consumer surplus ($CS_i = CS_{E1}$) and social welfare ($W_i = \pi_1 + CS_i$) were also solved for:

$$CS_i = \frac{(\alpha s_E)^2}{8\tau} \quad \text{and} \quad W_i = \frac{3(\alpha s_E)^2}{8\tau}. \quad (7)$$

Proposition 1 can be obtained using Eqs. (6) and (7).

Proposition 1: $\frac{\partial \pi_1}{\partial \alpha} > 0, \frac{\partial \pi_1}{\partial s_E} > 0, \frac{\partial \pi_1}{\partial \tau} < 0, \frac{\partial CS_i}{\partial \alpha} > 0, \frac{\partial CS_i}{\partial s_E} > 0, \frac{\partial CS_i}{\partial \tau} < 0, \frac{\partial W_i}{\partial \alpha} > 0, \frac{\partial W_i}{\partial s_E} > 0, \frac{\partial W_i}{\partial \tau} < 0$.

Proposition 1 shows that in traditional physical channels, higher consumer reservation prices (i.e., basic utility, $\alpha$) and more types of $P$ goods ($s_E$), collectively referred to as total basic utility ($\alpha s_E$), increase company profits, consumer surpluses, and social welfare. For instance, in Taiwan’s entertainment market, the most popular artists both act and sing, with some even also performing hosting duties. Artists use embedded marketing to promote their albums, television scores, or soundtracks when acting or hosting. This allows consumers to immerse themselves in the music and, as records contain many styles of music, increases consumers’ total utility. As consumers’ total utility increases, the number of digital goods purchased increases, thereby increasing company profits, consumer surplus, and social welfare. In addition, the disadvantages of $P$ goods include inconvenience and poorer quality or effects than expected. These problems can be solved with $V$ goods. However, the disadvantages of $V$ goods include being required to install specific software, time-consuming selection, and poor quality due to file format issues. Thus, if consumers believe that the difference between goods is due to the disadvantages of $V$ goods, consumers will choose to purchase $P$ goods to save time and companies can earn higher profits. On the contrary, if consumers believe that the difference between goods is due to the disadvantages of $P$ goods, then consumers would rather spend more time selecting $V$ goods, and companies would face yearly declines in profits due to consumer attrition. The current Taiwanese market conforms to the former market environment and facilitates the rise of $V$ goods. Thus, profits for companies selling $P$ goods decrease and consumer surplus reduces due to the disadvantages of $P$ goods. Social welfare is also negatively affected.

**Market II**

The recent popularization of broadband internet has attracted companies to sell virtual digital goods in addition to physical digital goods, thus increasing profits by providing a variety of goods. However, when crossing into the virtual digital goods market, the efficacy of the infrastructure provided and consumer reactions remain unknown. Therefore, companies provide free memberships and trials to test the feasibility of online markets.

As companies provide free virtual digital goods and charge physical goods users a price of $P_{E2}$, then Eq. (1) is rewritten as
When $\hat{i}_{\text{E}}$ represents consumption for a marginal consumer where there is no difference between not using P goods or V goods and using paid P goods, then for $\hat{i}_{\text{E}}$ consumers, $\alpha_{E} - \tau(\hat{i}_{\text{E}} - a) + \gamma_{E}n_{\text{E}} - P_{\text{E}} = 0$. Similarly, when $\hat{i}_{\text{V}}$ represents consumption for another marginal consumer where there is no difference between not using P goods or V goods and using free V goods, then for $\hat{i}_{\text{V}}$ consumers, $\beta_{V} - \tau(b - \hat{i}_{\text{V}}) + \gamma_{V}n_{\text{V}} = 0$. Let $n_{\text{n}}$ represent the total number of digital goods users in Market II; as such, $\gamma_{E}n_{\text{E}} - \gamma_{V}n_{\text{V}} = n_{\text{n}}$. Substitution then reveals

$$
\hat{i}_{\text{E}} = \frac{\beta_{V} - \tau(b - \hat{i}_{\text{V}}) + \gamma_{V}n_{\text{V}}}{\gamma_{E}n_{\text{E}} - \gamma_{V}n_{\text{V}}} + a \quad \text{and} \quad \hat{i}_{\text{V}} = \frac{\tau(P_{\text{E}} - \alpha_{E}) - \beta_{V} + \gamma_{V}n_{\text{V}} - \tau\beta_{V}}{\gamma_{E}n_{\text{E}} - \gamma_{V}n_{\text{V}}^2}.
$$

Thus company profits are

$$
\pi_{\text{II}} = \pi_{\text{E}} = P_{\text{E}}n_{\text{E}} = P_{\text{E}}(\hat{i}_{\text{E}} - a).
$$

Substitute Eq. (9) into Eq. (10), and assuming profit maximization, differentiating the $\pi_{\text{n}}$ of $P_{\text{E}}$ and setting it as 0 leads to the optimal price

$$
P_{\text{E}} = \frac{\alpha_{E}s_{E} + \beta_{V} + \gamma_{E}n_{\text{E}}}{2\tau}.
$$

Substituting Eq. (11) into Eq. (9) through Eq. (10) results in

$$
\hat{i}_{\text{E}} - \frac{2\beta_{V}s_{E} + \alpha_{E}s_{E}}{2(\tau^2 - \gamma_{E}n_{\text{E}})} + a, \quad \hat{i}_{\text{V}} - \frac{2\beta_{V}s_{E} + \alpha_{E}s_{E}}{2(\tau^2 - \gamma_{E}n_{\text{E}})} + a, \quad \pi_{\text{II}} = \frac{(\beta_{E}s_{E} + \tau\alpha_{E}s_{E})^2}{4\tau(\tau^2 - \gamma_{E}n_{\text{E}}^2)}.
$$

Consumer surplus ($CS_{\text{II}} = CS_{\text{II}} + CS_{\text{I}}$) and social welfare ($W_{\text{II}} = \pi_{\text{II}} + CS_{\text{II}}$) were obtained using

$$
CS_{\text{II}} = \frac{\beta_{E}s_{E} + \alpha_{E}s_{E}}{8\tau^2(\tau^2 - \gamma_{E}n_{\text{E}}^2)^2} \left[ \beta_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \alpha_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \beta_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \alpha_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) \right]
$$

$$
= \frac{\beta_{E}s_{E} + \alpha_{E}s_{E}}{8\tau^2(\tau^2 - \gamma_{E}n_{\text{E}}^2)^2} \left[ \beta_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \alpha_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \beta_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \alpha_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) \right]
$$

$$
+ \frac{\beta_{E}s_{E} + \alpha_{E}s_{E}}{8\tau^2(\tau^2 - \gamma_{E}n_{\text{E}}^2)^2} \left[ \beta_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \alpha_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \beta_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \alpha_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) \right]
$$

$$
\text{and} \quad W_{\text{II}} = \frac{\beta_{E}s_{E} + \alpha_{E}s_{E}}{8\tau^2(\tau^2 - \gamma_{E}n_{\text{E}}^2)^2} \left[ \beta_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \alpha_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \beta_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) + \alpha_{E}s_{E} \left(2\tau^2 - \gamma_{E}n_{\text{E}}\right) \right].
$$

Eqs. (13) and (14) show that exogenous parameters have a complicated effect on consumer surplus and social welfare, making comparative static analysis difficult. Thus, the numerical analysis in the next section was conducted to investigate this influence. However, company profit in Eq. (12) leads to Proposition 2.

Proposition 2(1) $\frac{\partial \pi_{\text{n}}}{\partial \alpha} > 0$, $\frac{\partial \pi_{\text{n}}}{\partial \beta} > 0$, $\frac{\partial \pi_{\text{n}}}{\partial s_{E}} > 0$; (2) $\frac{\partial \pi_{\text{n}}}{\partial \gamma_{E}} > 0$, $\frac{\partial \pi_{\text{n}}}{\partial \gamma_{V}} > 0$, $\frac{\partial \pi_{\text{n}}}{\partial \beta} > 0$.

Proposition 2(1) shows that higher reservation prices ($\alpha$) and greater external influences ($\gamma_{E}$) for physical goods and more types of P goods ($s_{E}$) correspond with higher company profits. This is because when companies provide high quality P goods, consumers will believe that the product is worth a higher price. Furthermore, more people downloading a V good implies that that particular product is well-received, which indirectly attracts more potential users of physical goods, thereby increasing company profits. On the contrary, when companies provide low quality P goods, consumers will believe...
that the product is not worth purchasing. Furthermore, less people downloading a V good implies that that particular product is unpopular, which indirectly reduces the number of buyers, thereby decreasing company profits.

Proposition 2-(2) shows that higher reservation prices \((\alpha)\) and greater external influences \((\gamma_\iota)\) for virtual goods and more types of V goods \((s_\iota)\) correspond with higher company profits. This shows that the free V goods provided by companies have a positive effect on the sales of P goods because when the number of users of certain V goods increases, the relevant digital good will be well-received by the market, thus increasing P goods sales as well as total company profits.

Market III

Companies provide free goods to attract online consumers to become members while testing interface stability. After the interface has been tested, companies change their marketing strategies and charge virtual goods consumers a fixed fee. This fixed charge is presented as \(V_P\), and to maintain the same fixed charge for physical goods in Market I, it is presented as \(E_P\). Therefore, Eq. (1) is rewritten as

\[
U_i = \begin{cases} 
\alpha \pi_i - \tau(t-a) + \gamma_\iota n_3 - P_3 \text{ Paid P goods} \\
\beta s_\iota - \tau(b-t) + \gamma_\iota n_3 - P_3 \text{ Paid V goods} \\
0 & \text{Unused}
\end{cases}
\]  

When \(t_{e_3}\) represents consumption for a marginal consumer where there is no difference between not using P goods or V goods and using paid P goods, then for \(t_{e_3}\) consumers, \(\alpha \pi_i - \tau(t_{e_3} - a) + \gamma_\iota n_3 - P_3 = 0\).

Similarly, when \(t_{v_3}\) represents consumption for another marginal consumer where there is no difference between not using P goods or V goods and using paid V goods, then for \(t_{v_3}\) consumers, \(\beta s_\iota - \tau(b - t_{v_3}) + \gamma_\iota n_3 - P_3 = 0\). Let \(n_w\) represent the total number of digital goods users in Market III; as such, \(n_w = n_3 + n_3 = (t_{e_3} - a) + (b - t_{v_3})\). Substitution then reveals

\[
\dot{t}_{e_3} = \frac{\tau(\alpha \pi_i - P_3) - \gamma_\iota (P_3 - \beta s_\iota)}{\tau^2 - \gamma_\iota \gamma_\iota} + a\ , \quad \dot{t}_{v_3} = b - \frac{\gamma_\iota (\alpha \pi_i - P_3) - \tau(P_3 - \beta s_\iota)}{\tau^2 - \gamma_\iota \gamma_\iota},
\]  

and company profit is \(\pi_{III} = \pi_{e_3} + \pi_{v_3} = P_{e_3}n_{e_3} + P_{v_3}n_{v_3} = P_{e_3}(\dot{t}_{e_3} - a) + P_{v_3}(b - \dot{t}_{v_3})\)  

Substituting Eq. (16) into Eq. (17) and assuming profit maximization, differentiation of \(\pi_{III}\) and \(P_{e_3}\) of \(P_{v_3}\) and setting it as 0 arrives at the optimal prices

\[
P_{e_3} = \frac{(\alpha \pi_i + \gamma_\iota)((\alpha \pi_i + \gamma_\iota) + 2\tau(\alpha \pi_i + \beta s_\iota))}{(\gamma_\iota + \gamma_\iota)^2 - 4\tau^2}\]  

and

\[
P_{v_3} = \frac{(\alpha \pi_i + \gamma_\iota)((\alpha \pi_i + \beta s_\iota) + 2\tau(\alpha \pi_i + \gamma_\iota))}{(\gamma_\iota + \gamma_\iota)^2 - 4\tau^2}.
\]  

Substitution of Eqs. (18) and (19) into Eq. (16) through Eq. (17) yields

\[
\dot{t}_{e_3} = \frac{\beta s_\iota (\alpha \pi_i + \gamma_\iota) + 2\tau \alpha s_\iota}{4\tau^2 - (\gamma_\iota + \gamma_\iota)^2} + a\ , \quad \dot{t}_{v_3} = b - \frac{\alpha s_\iota (\gamma_\iota + \gamma_\iota) + 2\tau \beta s_\iota}{4\tau^2 - (\gamma_\iota + \gamma_\iota)^2} + \frac{[2\tau(\alpha s_\iota + \beta s_\iota \gamma_\iota)]\beta s_\iota (\gamma_\iota + \gamma_\iota) + 2\alpha s_\iota}{[\gamma_\iota + \gamma_\iota]^2 - 4\tau^2]^2}
\]  

and

\[
\pi_{III} = \frac{\gamma_\iota + \gamma_\iota + \gamma_\iota + \gamma_\iota + 2\alpha s_\iota}{\gamma_\iota + \gamma_\iota + \gamma_\iota + \gamma_\iota + 2\beta s_\iota}
\]  

Consumer surplus \((CS_{III} = CS_{e_3} + CS_{v_3})\) and social welfare \((W_{III} = \pi_{III} + CS_{III})\) were obtained using
Eqs. (21) and (23) show that exogenous parameters have a complicated effect on consumer profit, consumer surplus, and social welfare, making comparative static analysis difficult. Thus, the numerical analysis in the next section was conducted to investigate these influences.

NUMERICAL ANALYSIS

Prior to numerical simulation, this study assumed the exogenous parameters \( \alpha = 1, \beta = 0.5, s_E = 3, s_V = 2, \gamma_E = 1, \gamma_V = 0.6, \) and \( \tau = 4. \) The changes in the pricing standards, market size, profit levels, consumer surplus, and social welfare within the three markets were analyzed using these parameters.

Pricing standard differentiation

In Market I, companies only provide P goods and focus on improving the total utility of P goods \( (\alpha s_E) \); this benefits the pricing standards for P goods. In Market II, although companies provide two types of goods, they only charge consumers for physical goods. However, because physical goods are influenced by virtual goods, higher total utilities for physical or virtual goods, higher levels of influence, and lower differences all benefit the pricing standards for P goods. In Market III, companies not only provide two types of goods, but also charge for both. The total utility for physical goods \( (\alpha s_E) \) negatively affects the pricing of virtual goods, but the total utility of virtual goods positively affects the pricing of physical goods \( (\beta s_V) \), indicating that the prices of P goods crowd out V goods, while V goods help the pricing of P goods. In addition, a low differentiation between goods obtained from different channels positively affects P goods sales because V goods must be obtained through the internet and the music for download must be chosen, which is more inconvenient compared to buying through physical channels. However, when differentiation is high, it positively affects the pricing standards of V goods (Table 1).

<table>
<thead>
<tr>
<th>Table 1: Numerical analysis of pricing standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
</tr>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td>Pricing standard</td>
</tr>
</tbody>
</table>

Proposition 3 can be inferred from the numerical simulation in Table 2.

Proposition 3: \( P_{E2} > P_{E3} > P_{E1} \).

Proposition 3 shows that the pricing standards in Market III are higher than those in Market I and lower than those in Market II. The reason for this could be that the V goods in Market II are free of charge, so companies transfer the costs of virtual goods to physical goods. However, in Market III, charging for V goods slightly lowers the price of P goods, yet this lower price is still higher than unsold V
goods. This situation can be presented by Proposition 3.

**Market size differentiation**

Table 2 shows that no matter the channel (physical or virtual) or type of good (physical or virtual), it is necessary for companies to strive to increase the total utility of goods ($\alpha_sE$ or $\alpha_sV$) in order to increase market size and sales. When consumer awareness of options for obtaining goods through different channels differs greatly ($\tau$), the market size decreases. In addition, the numerical simulation shows that the market sizes for those in Market II are the largest, followed by Market III and lastly Market I. The main reason for this is that more consumers are attracted to the free virtual goods in Market II. Once the goods are no longer free of charge, consumers who are not willing to pay are lost. However, after companies develop virtual channels, the market size for physical goods increases. This phenomenon led to Proposition 4.

**Table 2: Numerical analysis of market size**

<table>
<thead>
<tr>
<th>Market</th>
<th>Market I</th>
<th>Market II</th>
<th>Market III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>$n_{E1}$</td>
<td>$n_{E2}$</td>
<td>$n_{E3}$</td>
</tr>
<tr>
<td>Market size</td>
<td>0.375</td>
<td>0.422</td>
<td>0.313</td>
</tr>
<tr>
<td>Total market size</td>
<td>0.375</td>
<td>0.735</td>
<td>0.625</td>
</tr>
</tbody>
</table>

**Proposition 4:** $n_{E2} > n_{E3} > n_{E1}$; $n_{II} > n_{III} > n_{I}$.

Proposition 4 shows that network externality exists for the number of people purchasing P goods regardless of whether or not V goods are free. However, the network externality is greater when virtual goods are free. Therefore, the market size for Market II was the largest, followed by Market III, and lastly, Market I.

**Social welfare differentiation**

A comparison of the profit levels shown in Table 3 with those shown in Tables 2 and 3 shows that while Market III increases the total utility of P goods, reducing the price of V goods, it attracts more V goods users, ultimately increasing the total profit for V goods. This indicates that V goods are suitable for a marketing strategy stressing small profits and quick returns. Furthermore, although the number of users in Market III is lower than that in Market II, more profits are created, indicating that regardless of whether users think about payment, companies will charge for V goods in order to maximize profits, even if developing new channels has already earned increased profit (i.e., the profits in Market II are higher than in Market I). Findings also showed that developing virtual channels diminishes the existing market size for P goods, but benefits company profits. Hence, Proposition 5 was obtained.

**Table 3: Numerical analysis of company profit, consumer surplus, and social welfare**

<table>
<thead>
<tr>
<th>Market</th>
<th>Market I</th>
<th>Market II</th>
<th>Market III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>$\pi_{E1}$</td>
<td>$\pi_{V1}$</td>
<td>$\pi_{E2}$</td>
</tr>
<tr>
<td>Profit levels</td>
<td>0.563</td>
<td>0.686</td>
<td>0.729</td>
</tr>
<tr>
<td>Parameter</td>
<td>$CS_{E1}$</td>
<td>$CS_{V1}$</td>
<td>$CS_{E2}$</td>
</tr>
<tr>
<td>Consumer surplus</td>
<td>0.281</td>
<td>0.277</td>
<td>0.319</td>
</tr>
<tr>
<td>Parameter</td>
<td>$W_I$</td>
<td>$W_{II}$</td>
<td>$W_{III}$</td>
</tr>
<tr>
<td>Social welfare</td>
<td>0.844</td>
<td>0.963</td>
<td>1.048</td>
</tr>
</tbody>
</table>

**Proposition 5:** $\pi_{E2} > \pi_{E3} > \pi_{E1}$; $\pi_{III} > \pi_{II} > \pi_{I}$. 
Proposition 5 indicates that although the profits from P goods in Market II are higher than those in Market III, total profits in Market III are higher than in Market II. Moreover, companies consider overall profits, so they will tend to adopt Market III to maximize profits.

Also, consumers can only purchase P goods in Market I, so the total consumer surplus equals the consumer surplus for P goods. However, Markets II and III both offer two goods for consumers to choose from, so the total consumer surplus equals that for both P goods and V goods. As such, the total consumer surplus in Table 4 leads to Proposition 6.

Proposition 6: \( CS_{III} > CS_{I} > CS_{II} \).

Proposition 6 shows that Market III has the highest consumer surplus, followed by Market I and, lastly, Market II. This result is very different from what could be expected in terms of general concepts. The reasons include the following: 1) Companies perceive markets that provide free virtual goods as a waste of money. If V goods do not increase the purchase rate for P goods, over time, companies expend less effort on maintaining the quality of V goods, resulting in poorer quality, slower download speeds, and less variety. However, because the products are free, users provide less negative feedback, and consumers who seek cheaper goods will continue to consume. Yet this does not increase the usage rate, so consumer surplus reduces. Therefore, the growth of \( V \) goods consumer surplus is less than the decline of P goods consumer surplus, resulting in a lower consumer surplus in Market II compared to Market I. 2) The number of users in Market II is the highest, but the prices for P goods are the highest, which does benefit consumer surplus. 3) Compared to Market I, the free V goods in Market II could increase the overall consumer surplus, but that is not the case. If consumers worry about illegality, they will choose to purchase official P goods. However, because there are similar products available free of charge, some consumers who are unwilling to or cannot access the internet begin to have a change of heart, while willing and able consumers will switch to V goods. Thus, when a difference in the consumption cognition arises between payment for P goods and V goods, some users choose to not use both, thus reducing consumer surplus. 4) Additionally, because Market III charges for virtual goods, some virtual goods users choose to only use when goods are cheap. Also, physical goods users decrease due to network externality, but because virtual goods are being charged, the prices for physical goods are reduced; thus, the difference between the consumer surplus for physical goods in Market III and Market I is small, but larger than Market II. Although V goods are being charged, there are still some users willing to pay and continue to use, so even though the consumer surplus of V goods is lower than in Market II, it is higher than in Market I. Thus, the consumer surplus in Market III is the highest.

These results indicate that company profits and total consumer surplus are the highest in Market III, and because the sum of company profits and consumer surplus is social welfare, the social welfare in Market III is also the highest. As the amount by which Market I consumer surplus is greater than Market II consumer surplus is less than the amount by which Market I profit levels are less than Market II profit levels, the social welfare of Market I is the lowest. This result can be explained using Proposition 7.

Proposition 7: \( W_{III} > W_{II} > W_{I} \). 

**CONCLUSION**

When record companies manage both the physical and virtual markets, charging for virtual digital goods, increasing the types of goods, and increasing consumers' differentiation towards purchasing from different channels can all increase company profits. Although neither good is free, virtual channels diminish the market size for physical channels (Market II), but increase overall profits for record
companies. Overall, charging for virtual music goods benefits record companies. Findings also showed that when record companies provide paid physical goods and free virtual goods, virtual goods have a positive effect on the profits from physical goods. In other words, the more people use virtual goods, the more people will purchase physical goods. However, after record companies begin charging for both goods, the number of users decreases. This decrease in the number of consumers reduces profits from physical goods but increases the profits from virtual goods. When this increase is higher than the decrease, the company’s profit levels are raised. Moreover, when both goods are charged for, consumer surplus and social welfare both experience a positive effect.

Furthermore, from the perspective of fair trade, it is right that record companies charge for virtual music goods because it increases overall social welfare. In addition, after virtual goods are charged for (Market III), the variations in company profit and consumer surplus compared to those of Market II are extremely small. Thus, after record companies begin to charge for virtual digital goods that were once free of charge, they should consider marketing approaches that increase consumers' willingness to pay. In addition to increasing the types of digital goods and consumers' opinion of the goods, companies can also customize goods so that consumers feel that the products were exclusively designed for them. Customization is a paid value-added service that consumers may select according to their own needs. Therefore, this study recommends that record companies diversify payment systems and customize music goods in order to increase the number of users, thus also increasing consumer surplus and overall social welfare.

REFERENCES


