THE PRICING AND COPYRIGHT'S PAYMENT STRATEGY IN ONLINE MOVIE DISTRIBUTION

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Abstract

This paper discusses the online movie distribution model. Under this model, the movie would be released through both theatrical channels and online channels. The producer has to bargain with the online distributor in order to determine the pricing and the payment method of copyright. Varied cases are considered, including the formation of the market players and the substitution rate between theatrical version and online version. This paper further gives out the prevailing payment method under different scenarios and analyses how the price and the demand would change in different cases.

1 Introduction

The traditional movie distribution model contains two di.erent distribution channels, the exhibition channel through theatres and the distribution channel through DVD. With the development of the internet, the online distribution channel has gradually played an important role during the introduction of a digital product. This paper gives out the pricing strategy and the payment method of online movie distribution.

Previous studies and literatures that focus on the movie distribution model are as followed. Mussa and Rosen (1978) first considered the pricing problems invoking in quality-di.erentiated goods and showed that versioning is optimal. Stokey (1979) proved that versioning may not be the best strategy under specific contexts. Followed the unified model of Mussa and Rosen (1978), Belleflammme (2002) analysed the pricing behaviour of producers of information goods in the presence of copying. Bockstedt, Kau.man and Riggins (2005) studied online music distribution rather than movie distribution, and devised model for understanding the transformation of market structure in the music industry, considering the existence of intellectual property rights. Luan and Sudhir (2006) then generalised the model of versioning by allowing the products to be substitutes and even complements. Rao (2011) concentrated on the online content pricing by considering the best strategy of payment method applied by the consumers. Calzada and Valletti (2012) considered the inter temporal movie distribution model with a vertically-separated industry by taking not only the substitution rate, but also the delaying of releasing low quality product into account. Yuji (2013) analysed the impact of versioning on heterogeneous retailers on physical product market.

Our paper differs from previous studies in that it analysed the optimal payment method applied by the retailer in the online movie industry. Unlike Calzada and Valletti (2012), this paper focused on the online movie rather than the DVD distribution. In our model, the movie would be released through both theatrical channels and online channels, and the producer has to bargain with the online distributor in order to determine the pricing and the payment method of copyright. Varied cases are considered, including the formation of the market players and the substitution rate between theatrical version and online version.

2 Model

Consider that the movie distribution market is formed by three players: producer P, theatrical movie distributor E and online movie distributor D. The producer P first introduces the high quality product H (i.e., theatrical version) to E and then releases the low quality product L (i.e., online version) to D. Suppose the producer will always choose to release the online movie under the premise that the copyright or the revenue sharing rate is positive. This assumption is reasonable, since the overwhelming majority of movies are available online. The notations are summarised in the following table, in which the product quality ratio

Table 1: Definitions of variables

$P/E/D$	producer/exhibitor/online distributor
H/L	high quality/low quality product
B	both products
d/s	discount rate/substitution rate
q_H/q_L	quality of theatrical movie/online movie
p_H/p_L	price of theatrical movie/online movie
α	bargain power of P to D
β	bargain power of P to the E
C	copyright
b	revenue sharing between P and D
a	revenue sharing between P and E
θ	consumer's type
Q_H/Q_L	demand of product H/L
k	product quality ratio

$k = \frac{q_H}{q_L} > 1$ (i.e., $q_H > q_L$).

Here, all the costs of P, E and D are normalised to zero, which has been applied by John Calzada and Tommaso M. Valletti (2011). Suppose each consumer is represented by his/her type θ, which is uniformly distributed over the segment [0,1]. The period of time between release of theatrical movie and online movie causes the discount on the valuation on the online movie. Suppose the producer and the consumer have the same discount factor δ. Denote d as the compound discount factor for the delay of releasing online movie in t_1. The compound discount factor d is determined by δ^t, where $t = t_1 - t_0$. Suppose d is not decided by the negotiation between P and D, but rather follows the regulations of the Film Association, which implies that $d \in (0, 1)$, and the cases of $d = 0$ (simultaneously release) and $d = 1$ (infinite delay of L) will not exist. In China, the typical period of t is between three months to five months.

In order to keep this model as simple as possible, in this paper it only considers the extreme cases when $s = 0$ (H and L are independent) and $s = 1$ (H and L are perfect substitute). When $s = 0$, the product line offered by the producer is L/B, which has already been proved by previous literature. When s=1, no consumer would choose to buy B, since it is a standard case of single-unit purchase. The product line offered by the producer is L/H.

Under the above assumptions, the consumer's utility function could then be generalised under different level of substation rate between H and L. Based on the consumer's utility function, the expression for the demand quantity of different products can be determined by

$$Q_H(s=0) = 1 - \theta_{LB}, \quad Q_L(s=0) = 1 - \theta_{L0}$$

$$Q_H(s=1) = 1 - \theta_{LH}, Q_L(s=1) = \theta_{LH} - \theta_{L0}$$

where $\theta_{LB} = \frac{p_H}{q_H}$, $\theta_{L0} = \frac{p_L}{q_L}$, $\theta_{L0} = \frac{p_L}{q_L}$, $\theta_{LH} = \frac{p_H - dp_L}{q_H - dq_L}$.

3 Main Results

Case 1: Online distributor v. Producer + Exhibitor (Copyright)

Case 1 is the situation when producer and exhibitor are integrated and the payment method of online distributor is one-time buyout copyright. Since there are two products in the market, the substitution rate and the discount factor should be considered under this case. The timing of the negotiation and debut of movie is as followed

$$t_{-1} \longrightarrow t_0 \longrightarrow t_1,$$

where t_{-1}: Producer and exhibitor bargain with the online distributor over the copyright C; t_0: Exhibitor sets p_H, online distributor sets p_L, and H is released; t_1: L is released.

1). $s = 0$

Under the case that $s = 0$, the producer offers the product line L/B, which has been proved by previous literature.

- t_0

Exhibitor and producer sets p_H in order to maximise $\pi_{LB}^{PE} = p_H(1 - \theta_{LB}) + C$. Online distributor sets p_L in order to maximise $\pi_L^D = dp_L(1 - \theta_{L0}) - C$. In that case, we could obtain the price of the theatrical movie, the price of the online movie, the profit of the distributor, and the profit of producer.

$$p_H = \frac{q_H}{2}, \quad p_L = \frac{q_L}{2}$$
$$\pi_{LB}^{PE^*} = \frac{q_H}{4} + C, \quad \pi_{LB}^{D^*} = \frac{dq_L}{4} - C$$

- t_{-1}

Producer would bargain with the online distributor to set the pricing of the copyright C, $C \in (0, dp_L(1 - \theta_{L0}))$ in a Nash bargain. α represents the relative bargain power of the producer, $\alpha \in (0, 1)$. Under the assumption that online versioning is a must option, the producer would still release the online movie regardless that the copyright approaches to zero, and the producer could still get the profit of releasing the theatrical version. From this perspective, the producer's base of the Nash bargain equals to the profit he obtains through releasing the theatrical version, which is $p_H(1 - \theta_{LB})$. The distributor's base of the Nash bargain still equals to 0.

$$\max_C {}_{LB}^{PE,D}(\pi_{LB}^{PE} - p_H(1 - \theta_{LB}))^{\alpha}(\pi_{LB}^{D} - 0)^{1-\alpha}$$
$$= \max_C {}_{LB}^{PE,D}(C)^{\alpha}(dp_L(1 - \theta_{L0}) - C)^{1-\alpha}$$

The equilibrium price of copyright which maximise the global profit can then be obtained.

$$C^* = \frac{\alpha d q_L}{4}$$

The profit of the online distributor, the profit of the producer, the demand of H and the demand of L are as followed under the equilibrium price of copyright.

Profits of the players:

$$\pi_{LB}^{D^*} = \frac{dq_L}{4} - C^* = \frac{(1-\alpha)dq_L}{4}$$
$$\pi_{LB}^{PE^*} = \frac{q_H}{4} + C^* = \frac{q_H}{4} + \frac{\alpha d q_L}{4}$$

Demand of the products:

$$1 - \theta_{LB} = \frac{1}{2}, \quad 1 - \theta_{L0} = \frac{1}{2}$$

Notice that the distributor's profit is always positive. The copyright is of positive correlation with the bargain power of the producer, and the profit of the online distributor is of negative correlation with the bargain power of the producer.

2). $s = 1$

Under the case that $s = 1$, the producer offers the product line L/H.

- t_0

$$p_H = \frac{(q_H - dq_L)(4q_H - dq_L)}{8q_H - 4dq_L}, \quad p_L = \frac{q_L(q_H - dq_L)}{4q_H - 2dq_L}$$

$$\pi_{LH}^{PE^*} = \frac{q_H}{4} - \frac{dq_L}{8} - \frac{3d^2q_L^2}{32(2q_H - dq_L)} - \frac{(dq_L)^3}{32(2q_H - dq_L)^2} + C,$$

$$\pi_{LH}^{D^*} = \frac{dq_L}{16} - \frac{(dq_L)^2}{16(2q_H - dq_L)} - C$$

- t_{-1}

$$\max_C {}_{LH}^{PE,D}(\pi_{LH}^{PE} - p_H(1-\theta_{LH}))^\alpha(\pi_{LH}^D - 0)^{1-\alpha} = \max_C {}_{LH}^{PE,D}(C)^\alpha(dp_L(\theta_{LH} - \theta_{L0}) - C)^{1-\alpha}$$

$$C^* = \frac{\alpha dq_L(q_H - dq_L)}{16q_H - 8dq_L}$$

from which, we could then obtain the equilibrium prices, demands and profits.

Case 2: Online distributor v. Producer + Exhibitor (Revenue Sharing)

Case 2 is the situation when producer and exhibitor are integrated and they bargain with online distributor over the revenue sharing rate rather than one-time buyout copyright. In every online movie sold, the producer gets b and the online distributor gets $p_L - b$. The process of bargaining is the same as case 1.

1). $s = 0$

- t_0

$$p_H = \frac{q_H}{2}, \quad p_L = \frac{q_L + b}{2}$$

$$\pi_{LB}^{PE} = \frac{q_H}{4} + db\frac{(q_L - b)}{2q_L}, \quad \pi_{LB}^{D^*} = \frac{d(q_L - b)^2}{4q_L}$$

- t_{-1}

$$\max_b {}_{LB}^{PE,D}(\pi_{LB}^{PE} - p_H(1-\theta_{LB}))^\alpha(\pi_{LB}^D - 0)^{1-\alpha} = \max_b {}_{LB}^{PE,D}(db\frac{(q_L - b)}{2q_L})^\alpha(\frac{d(q_L - b)^2}{4q_L})^{1-\alpha}$$

$$b^* = \frac{\alpha q_L}{2}$$

from which, we could then obtain the equilibrium prices, demands and profits.

2). $s = 1$

Under the case that $s = 1$, the producer offers the product line L/H.

- t_0

$$p_H = \frac{d^2q_L^2 + 6dbq_H + 4q_H^2 - 2d^2bq_L - 6dq_Hq_L}{8q_H - 4dq_L},$$

$$p_L = \frac{q_L}{2} + \frac{2bq_H - q_Hq_L}{4q_H - 2dq_L}$$

- t_{-1}

$$\max_b {}_{LH}^{PE,D}(\pi_{LH}^{PE} - p_H(1-\theta_{LH}))^\alpha(\pi_{LH}^D - 0)^{1-\alpha} = \max_b {}_{LB}^{PE,D}(db(\theta_{LH} - \theta_{L0}))^\alpha(d(p_L - b)(\theta_{LH} - \theta_{L0}))^{1-\alpha}$$

$$b^* = \frac{\alpha q_L}{4}$$

from which, we could then obtain the equilibrium prices, demands and profits.

Case 3: Online distributor v. Producer v. Exhibitor (Copyright)

Case 3 is the situation of one-time buyout copyright and two independent distribution channel: theatrical channel and online channel. Under Case 3. the producer has to bargain with the exhibitor and distributor separately. Suppose the payment method of theatrical version is settled as revenue sharing. The time line of the negotiation is as followed.

$$t_{-2} \longrightarrow t_{-1} \longrightarrow t_0 \longrightarrow t_1,$$

where t_{-2}: Producer bargains with the the exhibitor over the revenue sharing rate a; t_{-1}: Producer bargains with the online distributor over the pricing of copyright C; t_0: Exhibitor sets p_H, online distributor sets p_L, and H is released; t_1: L is released.

1). $s = 0$

- t_0

Exhibitor sets p_H in order to maximise $\pi_{LB}^E = (p_H - a)(1 - \theta_{LB})$. Online Distributor sets p_L in order to maximise $\pi_{LB}^D = dp_L(1 - \theta_{L0}) - C$. The producer's profit is determined through bargaining, which is $\pi_{LB}^{P^*} = a(1 - \theta_{LB}) + C$.The price of both versions and the profit of all the players are as followed

$$p_H = \frac{q_H + a}{2}, \quad p_L = \frac{q_L}{2}$$

$$\pi_{LB}^{E^*} = \frac{(q_H - a)^2}{4q_H}, \quad \pi_{LB}^{D^*} = \frac{dq_L}{4} - C,$$

$$\pi_{LB}^{P^*} = \frac{a}{2} - \frac{a^2}{2q_H} + C$$

- t_{-1}

Producer would bargain with the online distributor to set the pricing of the copyright C, $C \in (0, dp_L(1 - \theta_{L0}))$ in a Nash bargain. α represents the relative bargain power of the producer, $\alpha \in (0, 1)$. Under the assumption that online versioning is a must option, the producer would still release the online movie regardless that the copyright approaches to zero, and the producer could still get the profit of releasing the theatrical version through the negotiation in t_{-2}. From this perspective, the producer's base of the Nash bargain equals to the profit he obtains through the bargaining of t_{-2}, which is $a(1 - \theta_{LB})$. The distributor's base of the Nash bargain still equals to 0.

$$\max_C {}^{P,D}_{LB} (\pi^P_{LB} - a(1-\theta_{LB}))^\alpha (\pi^D_{LB} - 0)^{1-\alpha}$$
$$= \max_C {}^{P,D}_{LB} (C)^\alpha (dp_L(1-\theta_{L0}) - C)^{1-\alpha}$$

The equilibrium price of copyright which maximise the global profit can then be obtained.

$$C^* = \frac{\alpha d q_L}{4}$$

Notice that the copyright is of positive correlation with the bargain power of the producer, and is always positive, which implies that the bargain would sustained.

- $\boldsymbol{t_{-2}}$

Producer bargains with the exhibitor in order to set the revenue sharing rate a. β represents the relative bargain power of the producer to the exhibitor, $\beta \in (0,1)$ in a Nash bargain. Under the assumption that releasing online version is a must option, the producer would always bargain with the online distributor and gain the copyright. Hence, the base of the producer equals to the profit he could gain during the bargain with the online distributor in t_{-1}, which equals to $C^* = \frac{\alpha d q_L}{4}$. The exhibitor's base during this Nash bargain equals to zero.

$$\max_a {}^{P,E}_{LB} (\pi^P_{LB} - C^*)^\alpha (\pi^E_{LB} - 0)^{1-\alpha} =$$
$$\max_a {}^{P,D}_{LB} (a(1-\theta_{LB}))^\alpha (\frac{(q_H - a)^2}{4q_H})^{1-\alpha}$$

The equilibrium revenue sharing rate a which maximise the global profit can then be obtained.

$$a^* = \frac{\beta q_H}{2}$$

The prices of both versions, the profit of the online distributor, the profit of the producer, the demand of H and the demand of L are as followed under the equilibrium price of copyright.

Prices of the products:

$$p_H = \frac{q_H(2+\beta)}{4}, \quad p_L = \frac{q_L}{2}$$

Profits of the players:

$$\pi^{D^*}_{LB} = \frac{dq_L}{4} - C^* = \frac{(1-\alpha)dq_L}{4}$$
$$\pi^{E^*}_{LB} = (p_H - a^*)(1-\theta_{LB}) = \frac{q_H(2-\beta)^2}{16}$$
$$\pi^{P^*}_{LB} = a^*(1-\theta_{LB}) + C^* = \frac{q_H\beta(2-\beta)}{8} + \frac{\alpha d q_L}{4}$$

Demand of the products:

$$1 - \theta_{LB} = \frac{1}{2} - \frac{\beta}{4}$$
$$1 - \theta_{L0} = \frac{1}{2}$$

Notice that the revenue sharing rate between producer and exhibitor is of positive correlation with the bargain power of producer. The profit of distributor is of negative correlation with the bargain power of the producer. And the classification of consumer is as expected.

2). $s = 1$

Under the case that $s = 1$, the producer offers the product line L/H. The process is the same as case 3a.

- $\boldsymbol{t_0}$

$$p_H = \frac{q_H}{2} + \frac{2aq_H - 6q_H^2}{4q_H - dq_L}, \quad p_L = \frac{q_L(a + q_H - dq_L)}{4q_H - dq_L}$$
$$\pi^{E^*}_{LH} = (1 + \frac{dq_L(a + q_H - dq_L) - (2aq_H - 6q_H^2)}{(4q_H - dq_L)(q_H - dq_L)} - \frac{2q_H}{q_H - dq_L})(2q_H - a + \frac{2aq_H - 6q_H^2}{4q_H - dq_L})$$
$$\pi^{D^*}_{LB} = \frac{dq_L}{16} + \frac{a^2}{9(q_H - dq_H)} - \frac{dq_L(4a - 3dq_L)^2}{48(4q_H - dq_L)^2} - \frac{1}{4q_H - dq_L}(\frac{4a^2}{9} + \frac{d^2q_L^2}{8} - \frac{adq_L}{2}) - C$$
$$\pi^{P^*}_{LB} = \frac{q_L(a^2 d - 2adq_H) + 2aq_H^2 - 2a^2 q_H}{(q_H - dq_L)(4q_H - dq_L)} + C$$

- $\boldsymbol{t_{-1}}$

$$\max_C {}^{P,D}_{LH} (\pi^P_{LH} - a(1-\theta_{LH}))^\alpha (\pi^D_{LH} - 0)^{1-\alpha}$$
$$= \max_C {}^{P,D}_{LH} (C)^\alpha (dp_L(\theta_{LH} - \theta_{L0}) - C)^{1-\alpha}$$

$$C^* = \frac{\alpha d q_H q_L (a + q_H - dq_L)^2}{(q_H - dq_L)(4q_H - dq_L)^2}$$

- $\boldsymbol{t_{-2}}$

$$\max_a {}^{P,E}_{LH} (\pi^P_{LH} - C^*)^\alpha (\pi^E_{LH} - 0)^{1-\alpha}$$
$$= \max_a {}^{P,D}_{LH} (a(1-\theta_{LH}))^\alpha ((p_H - a)(1-\theta_{LH}))^{1-\alpha}$$

$$a^* = \frac{\beta q_H(q_H - dq_L)}{2q_H - dq_L}$$

$$C^* = \frac{\alpha d q_H q_L (q_H - dq_L)(2q_H + \beta q_H - dq_L)^2}{(d^2 q_L^2 - 6dq_H q_L + 8q_H^2)^2}$$

from which, we could then obtain the equilibrium prices, demands and profits.

Case 4: Online distributor v. Producer v. Exhibitor (Revenue Sharing)

Case 4 is the situation of the revenue sharing and two independent distribution channel: theatrical channel and online channel. Under Case 4. the producer has to bargain with the exhibitor and distributor separately. The payment method applied by the producer and the online distributor is revenue sharing. Suppose the payment method of theatrical version is settled as revenue sharing. The time line of the negotiation is as followed. The bargaining process is the same as case 3.

1). $s = 0$

- $\boldsymbol{t_0}$

$$p_H = \frac{q_H + a}{2}, \quad p_L = \frac{q_L + b}{2}$$
$$\pi_{LB}^{E^*} = \frac{(q_H - a)^2}{4q_H}, \quad \pi_{LB}^{D^*} = \frac{d(q_L - b)^2}{4q_L},$$
$$\pi_{LB}^{P^*} = a(1 - \frac{q_H + a}{2q_H}) + db(1 - \frac{q_L + b}{2q_L})$$

- t_{-1}

$$\max_b {}_{LB}^{P,D}(\pi_{LB}^P - a(1-\theta_{LB}))^\alpha(\pi_{LB}^D - 0)^{1-\alpha}$$
$$= \max_b {}_{LB}^{P,D}(db(1-\theta_{L0}))^\alpha(d(p_L - b)(1-\theta_{L0}))^{1-\alpha}$$
$$b^* = \frac{\alpha q_L}{2}$$

- t_{-2}

$$\max_a {}_{LB}^{P,E}(\pi_{LB}^P - db(1-\theta_{L0}))^\alpha(\pi_{LB}^E - 0)^{1-\alpha}$$
$$= \max_a {}_{LB}^{P,D}(a(1-\theta_{LB}))^\alpha(\frac{(q_H - a)^2}{4q_H})^{1-\alpha}$$
$$a^* = \frac{\beta q_H}{2}$$

from which, we could then obtain the equilibrium prices, demands and profits.

2). $s = 1$

Under the case that $s = 1$, the producer offers the product line L/H. The process is the same.

- t_0

$$p_H = \frac{q_H(2a + 2q_H + bd - 2dq_L)}{4q_H - dq_L}$$
$$p_L = q_L - \frac{3q_H q_L - aq_L - 2bq_H}{4q_H - dq_L}$$
$$\pi_{LH}^{E^*} = \frac{(2q_H - 2aq_H + adq_L + bdq_H - 2dq_H q_L)^2}{(q_H - dq_L)(4q_H - dq_L)^2}$$
$$\pi_{LH}^{D^*} = \frac{d^2 q_H^2(aq_L - 2bq_H + q_H q_L - dq_L^2 + bdq_L)^2}{q_L(q_H - dq_L)(4q_H - dq_L)^2}$$

- t_{-1}

$$\max_b {}_{LH}^{P,D}(\pi_{LH}^P - a(1-\theta_{LH}))^\alpha(\pi_{LH}^D - 0)^{1-\alpha}$$
$$= \max_b {}_{LH}^{P,D}(db(\theta_{LH} - \theta_{L0}))^\alpha(d(p_L - b)(\theta_{LH} - \theta_{L0}))^{1-\alpha}$$
$$b^* = \frac{\alpha q_L(a + q_H - dq_L)}{4q_H - 2dq_L}$$

- t_{-2}

$$\max_a {}_{LH}^{P,E}(\pi_{LH}^P - db(\theta_{LH} - \theta_{L0}))^\alpha(\pi_{LH}^E - 0)^{1-\alpha}$$
$$= \max_a {}_{LH}^{P,D}(a(1-\theta_{LH}))^\alpha(\pi_{LH}^E)^{1-\alpha}$$
$$a^* = \frac{\beta k q_L(k-d)(8k - 4d + \alpha d)}{2(8k^2 + 2d^2 - 8dk - \alpha dk)}$$
$$b^* = \frac{\alpha q_L}{2} - \frac{\alpha k q_L(2-\beta)}{8k - 4d} - \frac{\alpha\beta dk q_L(2-\alpha)}{8d^2 - 4d(8k + \alpha k) + 32k^2}$$

from which, we could then obtain the equilibrium prices, demands and profits.

4 Conclusions

This paper finds out that when $s = 1$, and the producer and the exhibitor act as an integrated player, a Pareto optimal strategy could be achieved under the payment method of revenue sharing rather than one-time buyout of copyright. However, when $s = 0$, there is a conflict between the payment method applied by the distributor and producer. Distributor prefers revenue sharing, while producers prefers one-time buyout. The global profit is increased under the one-time buyout method when $s = 0$. This is because when applying one-time buyout method as payment method, the distributor would set lower price. The copyright is considered as sunk cost, and it would not influence the pricing strategy of the distributor. In contrast, when applying revenue sharing as payment method, the distributor would set higher price in order to compensate the cost of copyright. When $s = 0$, the increase of the demand makes up for the decrease of the price, and the global profit of online movie distribution is increased under the payment method of copyright. The most complicated case is that when $s = 1$ in a vertically-separated industry. The exhibitor's profit is decreased when applying the payment method of copyright. The profits of distributor and producer are determined by the input parameters. Through numerical examples, it could be demonstrated that at most time, the distributor's profit is decreased when applying the payment method of one-time buyout copyright.

Possible extensions could be achieved by considering the situation when $s \in (0, 1)$, taking the possible gaining through advertising online into consideration, considering the determination of the product quality, as well as by considering the existence of the DVD distributor.

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