Revenue-Sharing Contract with Promotion Cost for the Film Supply Chain

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Abstract. In the film supply chain, a multi-period revenue-sharing contract is usually adopted. Such contract specifies how to divide the box office revenue between the film distributors and exhibitors. We consider a film supply chain composed of one distributor and one exhibitor (theater) that sign a two-period revenue-sharing contract with periodically adjusted sharing ratio. The distributor provides a contract with specified revenue-sharing ratios in the two periods, and the exhibitor decides the number of movie screening for each period. In the first period, both parties are uncertain regarding the potential box office performance of the movie (high or low in our model). After the first period, the box office performance is realized. If the box office performance is low, then the theater may adopt promotional efforts to stimulate the revenue and decides the number of movie screening in the second period. In this case, the distributor determines the sharing ratio of the promotion cost with the theater. In this study, we develop a two-period revenue-sharing model considering promotion cost and cost-sharing ratio for the film supply chain and use this model to obtain analytical results. We then conduct a numerical analysis to observe the strategic move of the distributor and the response action of the theater under various conditions.

Keywords: supply chain, film industry, revenue-sharing contract, promotional efforts

1. INTRODUCTION

In recent years, the growth of film industry in the world has made movie watching one of the major public recreational activities. The movies in Taiwan box office range from Hollywood movies to domestic movies. The improvement in movie production technology enhances move image quality and special effects. Furthermore, the advancement in playback devices, such as 4DX, IMAX, and 3D, provides multiple viewing options for consumers. The diverse movie themes and the progress in social media also attract consumers to watch movies in theaters.

Although the film industry is growing, only 95% of the domestic movies in Taiwan can actually generate revenue in 2014 and most of them have low box office performance. Thus, many movie promotional strategies have been proposed. For example, cinemas provide ticket combos that usually include movie tickets, popcorns, drinks, and movie merchandises. They also make strategic alliance with different business sectors to offer free items to consumers when they buy movie tickets.

In the film supply chain, a multi-period revenue-sharing contract is usually adopted. Such contract specifies how to divide the box office revenue between the film distributors and exhibitors. The ratio of the box office revenue is constantly decided by the bargaining power of the distributor and the exhibitor in the supply chain. However, the sharing ratio of the box office revenue differs according to the types, origin countries, and cast of the movies. Given that only few movies can actually generate revenue, the distributor and the exhibitor generally invest on promotions to increase the box office performance.

In our study, we consider a supply chain composed of one distributor and one exhibitor (theater) that sign a two-period revenue-sharing contract. In this contract, the sharing ratio is adjusted periodically and promotion cost is considered. Although promotional efforts are expected to stimulate the box office revenue, the distributor and the exhibitor must afford the promotion cost. Accordingly, the distributor provides a cost-sharing ratio to share the promotion cost with the theater. Thus, we build a two-period revenue-sharing model considering promotion cost and cost-sharing ratio for the film supply chain and use this model to obtain analytical results. We then conduct a numerical analysis to observe the strategic move of the distributor and the response action of the theater under various conditions.

The rest of the paper is organized as follows. In Section 2, we provide a detailed literature review regarding the film industry, revenue-sharing contract, and promotional efforts. In Section 3, we present our model and analytical results. In Section 4, we show our numerical results under various conditions. Finally, we elaborate the conclusion and suggestion for further research in Section 5.

2. LITERATURE REVIEW

2.1 Film Supply Chain

The film supply chain, from marketing to operation, has been extensively studied. Swami et al. (1999) explored the scheduling problem of the movie exhibition. They considered movies as jobs and movie screenings as parallel machines, and constructed the integer programming model to solve the optimal movie scheduling problem and thus obtain the optimal profit. Considering that movies can deliver feelings and emotions, Wierenga (2006) argued that the marketing initiatives of the film industry must consider consumer behaviors, marketing channels, and emotional faculties, such as intuition. Sunada (2009) discussed that vertical integration is good for the film supply chain and showed that the revenue improved when such integration is considered than ignored. Orhun et al. (2015) studied the effect of the entry of a new theater, which can be co-owned or rivaled, using empirical analysis. The incumbent theater invests to broadcast the top movie and adopts a new release time of the movie under competitive pressure. Gil and Lafontaine (2012) gathered movie data in Spain, such as box office revenue, release time, and run length. Subsequently, they built different contract types, such as revenue-sharing contract, fixed weekly fee contract, and lump-sum fee contract, to show that the distributor can earn more if the theater sets flexible ticket prices.

2.2 Revenue-Sharing Contract

The revenue-sharing contract is widely applied in the supply chain management field to coordinate the supply chain and deal with the information asymmetry problem.

In the film supply chain, Palsule-Desai (2013) compared adopting revenue-independent sharing contract with adopting revenue-dependent sharing contract. The result shows that adopting revenue-dependent sharing contract is better in coordinating the film supply chain. Yao et al. (2008) described a manufacturer facing two retailers, which compete against each other and sell seasonal products. Considering the demand variability and the price sensitivity of the retailer, the distributor can earn more by adopting revenue-sharing contract than adopting the price-only contract. Linh and Hong (2009) applied revenue-sharing contract in newsvendor problem to coordinate the supply chain. Cachon and Lariviere (2005) discussed the strength and constraints of using revenue-sharing contract to coordinate the supply chain. Hou et al. (2009) considered a supply chain composed of one manufacturer and one retailer. The lead time of the manufacturer can affect the inventory of the retailer. Thus, they adopted a two-period revenue-sharing contract considering the bargaining power to elevate the efficiency in the supply chain.

2.3 Efforts

Given that applying efforts can change the consumer's behavior and the interaction between the supplier and the retailer, efforts are widely applied in different industries. The approaches on efforts include promotions, discounts, and freebies. Promotions can be divided into monetary promotions and non-monetary promotions. Monetary promotions include discounts and refunds. Shugan and Xie (2000), and Tang et al (2004). showed the process of adopting discounts to offset the consumer's risk during advance selling. Xie and Gerstner (2007) demonstrated that vendors offer refunds to consumers to alleviate their concerns. Meanwhile, non-monetary promotions affect consumer's reference to product price (Camppbell and Diamond, 1990). The most common strategies in non-monetary promotions are freebies. Pillania and Banerjee (2009) discussed the effect of freebies and discounts on market demand. The result shows that freebies can attract different ethnic consumers and can bring new consumer's attention.

When the frequency of promotion is probabilistic, Kurata and Liu (2007) showed that dynamic programming for controlling inventory can be used to find the optimal promotional plan. Dongbo and Qingyi (2011) demonstrated the process of sharing the promotion cost by adopting a revenue-sharing contract between the supplier and the retailer to coordinate the supply chain.

Promotion can also change the consumer's behaviors, such as buying in advance, buying more, and altering the preference. Huang and Cheng (2013) revealed the effect of promotion and brand awareness on consumer's perception of product quality. Advertisement is one of the popular methods in promotion. Media advertising can affect consumer's brand choice, learning, and sensitivity (Terui et al., 2011). Lee and Tsia (2014) showed that the time length of promotion influence consumer's brand loyalty and satisfaction.

3. MODEL

3.1 Problem Description

We consider a film supply chain composed of one distributor and one exhibitor (theater) that sign a revenue-sharing contract for the screening of a movie. Movies can be divided into two types: hit movies or flop movies. Hit movies attract a large number of viewers and generate high revenue, such as Marvel movies. Conversely, flop movies generate low revenue, such as art films or independent movies. The box office performance of a movie is influenced by many factors, such as word of mouth, movie cast, and movie theme. Thus, before a movie is released in the cinema, the distributor and the exhibitor can foresee the probability of the movie being a hit or a flop one. The exhibitor decides the number of movie screening considering the perishable nature of the movie. The movie revenue differs from one period to another, and thus, the exhibitor can change the number of movie screening in each period. Considering the diverse characteristics of the movie, the theater can adopt various promotional efforts to stimulate the box office performance and thus increase its revenue. Therefore, the distributor and the exhibitor can benefit from the promotional efforts. In this section, we construct a model based on the revenue-sharing contract considering promotional efforts.

3.1.1 Distributor Setting

The distributor (principal/he) provides the movie and designs a contract to the theater (agent/she). We assume that a movie will play in two periods. Before the first period begins, the distributor will provide a revenue-sharing contract that includes the sharing ratio in the first period θ and the theater's adjusted sharing ratio in the second period α. Specifically, the theater will obtain θ portion of the box office revenue in the first period and $\alpha\theta$ portion in the second period. The distributor will also receive a wholesale price w from the theater, which represents a patent or VPN. During the designing of the contract, the distributor is unaware of the real movie demand. The distributor is only aware that the probability of the movie being a hit is ρ or the probability of the movie being a flop is $1-\rho$; if the movie is a hit or a flop, then the potential revenue per movie screening is R_h or R_l. Without losing the generality, we let R_h be equal to 1, and R_l is between 0 and 1. At the end of the first period, the demand of the movie is realized. The distributor will determine whether the movie is a hit or a flop. The box office revenue will differ in the first and second period. If the potential revenue per movie screening is R_h in the first period, then the potential revenue per movie screening will be kR_h in the second period. When the movie is a flop at the end of the first period, the theater will probably adopt promotional efforts to increase the revenue. The distributor will also be willing to share the promotion cost, thereby enabling the distributor to decide on a cost-sharing ratio γ. Without losing generality, we normalize the cost of the distributor to 0.

3.1.2 Exhibitor Setting

After accepting the contract from the distributor, the theater will decide the number of movie screening according to the potential revenue per screening and the theater's sharing ratio of the movie upon the approval of the distributor. At the beginning of the first period, she will decide the number of movie screening in the first period q_1. Similar to the distributor, the theater fails to realize whether this movie is a hit or a flop in the first period. She only knows the probability of the movie being a hit, the potential revenue per movie screening in each period, and the changing rate in the potential revenue per screening. At the end of the first period, when the movie is a hit, she will decide the number of movie screening in the second period q_{2h}. However, when the movie is a flop, she will first decide whether to adopt promotional efforts or not, and then decide the number of

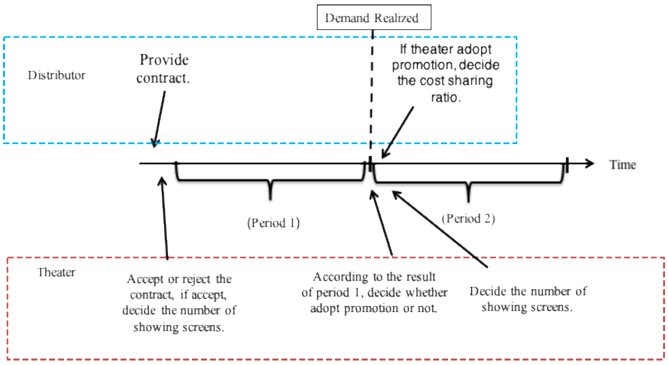

Figure 1: Time sequence of the two-period supply chain

movie screening in the second period q_{2l}. We assume that, if the theater adopts promotional efforts, then the potential revenue per screening will increase from kR_l to k. However, a cost $t(k-kR_l)$ will be produced per screening. Without losing generality, we normalize the cost of the theater to 0. Figure 1 shows the time sequence of the supply chain.

Table 1: Parameter and decision variable

Parameter	Description
ρ	The probability of being a hit movie
R_l	The potential revenue per screening of a flop movie
k	The adjusted rate of the potential revenue per screening in Period 2
w	The wholesale price per screening
t	The cost of promotion per screening
Decision variable	**Description**
θ	The theater's sharing ratio in Period 1
α	The theater's adjusted sharing ratio in Period 2
γ	The distributor's cost-sharing ratio
q_1	The number of movie screening in Period 1
q_{2s}	The number of movie screening in Period 2 under the condition $s = h, l$

3.2 Model Construction

We consider a two-period revenue-sharing model. We adopt the Stackelberg game in game theory as a basic model and use the backward induction to solve the problem. Following Palsule-Desai (2013), we consider promotional efforts to our model setting. Table 1 lists all the parameters and decision variables in the model.

First, the distributor considers the expected revenue for the following two periods. The distributor's revenue function in the first period is

$$\begin{aligned}\pi_M &= \rho\{[(1-\theta)(1-bq_1)+w]q_1+\pi_{2M}^h\}\\ &+(1-\rho)\{[(1-\theta)(R_l-bq_1)+w]q_1+\pi_{2M}^l\}.\end{aligned} \tag{1}$$

However, the theater also considers the expected revenue for the following two periods. The theater's revenue function in the first period is

$$\begin{aligned}\pi_R &= \rho\{[\theta(1-bq_1)-w]q_1+\pi_{2R}^h\}\\ &+(1-\rho)\{[\theta(R_l-bq_1)-w]q_1+\pi_{2R}^l\}.\end{aligned} \tag{2}$$

At the end of the first period, the demand will be realized and thus creating the following two cases at this moment:

Case 1: The movie is a hit.

Case 2: The movie is a flop.

If the movie is a hit in the first period, then it will also be a hit in the second period; similarly, if the movie is a flop, then it will also be a flop in the second period.

In Case 1, if the movie is a hit in the first period, then the distributor's revenue function in Period 2 is

$$\pi_{2M}^h = [(1-\alpha\theta)(k-bq_{2h})+w]q_{2h.} \tag{3}$$

Under this case, the theater's revenue function is

$$\pi_{2R}^h = [\alpha\theta(k-bq_{2h})-w]q_{2h.} \tag{4}$$

In Case 2, if the movie is a flop in the first period, two subcases are expected under this situation because the theater will probably adopt promotional efforts.

Subcase 1: Do not adopt promotional efforts.

Subcase 2: Adopt promotional efforts.

In Subcase 1, the distributor's revenue function in Period 2 is

$$\pi_{2M}^l = [(1-\alpha\theta)(kR_l-bq_{2l})+w]q_{2l}. \tag{5}$$

Similarly, the theater's revenue function in this subcase is

$$\pi_{2R}^l = [\alpha\theta(kR_l-bq_{2l})-w]q_{2l}. \tag{6}$$

However, in Subcase 2, a cost will be incurred to the distributor because of the promotion cost shared with the theater. Therefore, the distributor's revenue function in this subcase is as follows:

$$\begin{aligned}\pi_{2M}^{l} &= [(1-\alpha\theta)(kR_l - bq_{2l}) + w]q_{2l}. \\ &-\gamma t(k - kR_l)q_{2l}\end{aligned} \tag{7}$$

Similar to the distributor, the theater will also obtain a cost caused by the promotional efforts. The theater's revenue function in this subcase is

$$\begin{aligned}\pi_{2R}^{l} &= [\alpha\theta(kR_l - bq_{2l}) - w]q_{2l} \\ &-(1-\gamma)t(k - kR_l)q_{2l} \ .\end{aligned} \tag{8}$$

In the following section, we analyze the model to obtain the optimal decisions.

3.3 Model Analysis

We adopt a backward induction to solve the problem from the second period to the first period. According to the revenue functions of the distributor and the theater, we analyze how the distributor sets the contract to maximize his revenue and how the theater decides the number of movie screening to maximize her revenue. There are two types of contracts for distributor. One is no-promotion contract and the other is promotion contract.

In brief, if the distributor's revenue in providing no-promotion contract is higher than that in providing a promotion contract, then he will offer a no-promotion contract to the theater and the theater consequently will also not adopt promotional efforts, and vice versa.

4. NUMERICAL ANALYSIS

In the previous section, the distributor designs two types of contracts: the no-promotion contract and the promotion contract. In this section, we conduct a numerical analysis to observe the contract strategy under different situations. The type of contract the distributor will provide must be identified by changing a single parameter. Each movie in the film industry has its own characteristics, such as the probability of being a hit movie ρ, the potential revenue per screening of being a flop movie R_l, and the adjusted rate of the potential revenue per screening in Period 2 k. We observe the change in contract strategy using these parameters.

4.1 Probability of Being a Hit Movie ρ

The probability of a movie being a hit is ρ and being a flop is $1-\rho$, where $\rho \in [0,1]$. With the probability shifting from 0 to 1, the change in contract strategy is observed. If the distributor provides a no-promotion contract, then the cost-sharing ratio γ is equal to zero. If the distributor provides a promotion contract, then the cost-sharing ratio γ is larger than zero. In Figure 2, when ρ is low, the optimal strategy for the distributor is the no-promotion contract. When ρ is increasing, the distributor will provide a promotion contract and will be willing to share the entire promotion cost. When ρ keeps increasing, he will also provide a promotion contract, but he will only share part of the promotion cost because his sharing ratio is decreasing. When ρ is equal to 1, the distributor no longer needs to consider the promotion contract. Thus, he will provide a no-promotion contract to the theater.

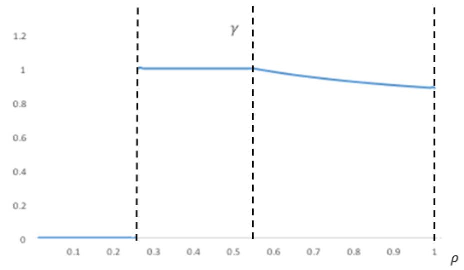

Figure 2: Contract strategy vs. ρ, $R_l = 0.8, k = 0.8, w = 0.25, t = 1.2, b = 0.01$

4.2 Potential Revenue per Screening of a Flop Movie R_l

In our study, we normalize the potential revenue per screening of a hit movie R_h to 1; thus, the potential revenue per screening of a flop movie R_l is between 0 and 1. $\gamma = 0$ means that the distributor provides a no-promotion contract, and $\gamma \neq 0$ means that the distributor offers a promotion contract. In Figure 3, three districts exist from left to right. In District 1, the distributor will provide a promotion contract with partial cost-sharing ratio because the entire promotion cost is significantly large and cannot be afforded by the distributor. In District 2, the distributor will also provide a promotion contract, but he will share the entire promotion cost because the cost is small. The distributor's sharing ratio $1-\alpha\theta$ is large in this district. In District 3, given that R_l is close to the potential revenue per screening of a hit movie, which is 1, the distributor will consequently provide a no-promotion contract to the theater.

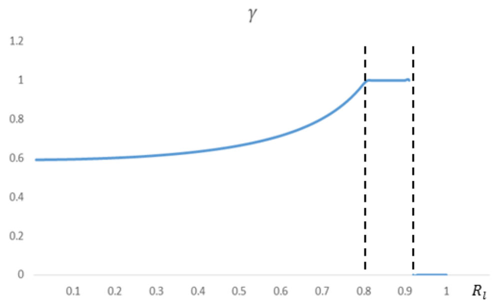

Figure 3: Contract strategy vs. R_l, $\rho = 0.8, k = 0.8, w = 0.25, t = 1.25, b = 0.01$

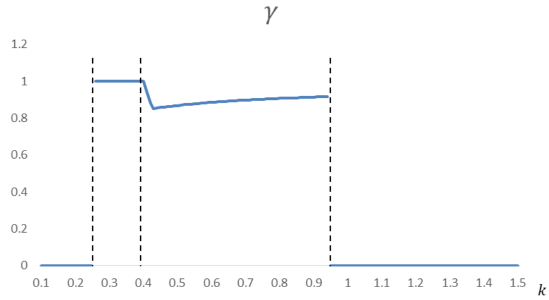

Figure 4: Contract strategy vs. k, $\rho = 0.8, R_l = 0.8, w = 0.25, t = 1.25, b = 0.01$

4.3 Adjusted Rate of the Potential Revenue per Screening in Period 2 k

The revenue will differ in Period 1 and Period 2; thus, we denote this parameter as k. k can be smaller than 1 or larger than 1. Accordingly, we set the range of k from 0 to 1.5. The contract strategy is shown in Figure 4. In this figure, four districts exist from left to right. In District 1, given that k is less than the fixed cost for theater w, k will not improve after adopting promotion. Accordingly, the distributor will provide a no-promotion contract. In District 2, when $k \geq w$, the distributor will provide a promotion contract and share the entire promotion cost. Given that the potential revenue will become extremely low in this district, increasing revenue is relatively easy with low promotion cost. Considering that the cost is low, the distributor will share the entire promotion cost. In District 2, the promotion cost increases and thus the cost-sharing ratio is not 1. In District 3, the cost-sharing ratio decreases as k increases on the left part, whereas the cost-sharing ratio increases as k increases on the right part. Given that the theater's sharing ratio in Period 2 $\alpha\theta$ is 1 on the left part, the distributor only earns the fixed payment w. However, the promotion cost is increasing because of k; thus, the cost-sharing ratio will decrease on this part. On the right part, the theater's sharing ratio $\alpha\theta$ is no longer 1 but between 0 and 1. The theater's sharing ratio $\alpha\theta$ decreases as k increases. This result suggests that the distributor's sharing ratio also increases as k increases. However, given that the cost is large, the distributor will not share the entire promotion cost. In this case, the cost-sharing ratio increases as k increases. In District 4, k is large; thus, the promotion cost is also large. If the distributor provides a promotion contract, then the optimal cost-sharing ratio must be close to 1 or equal to 1. After weighing the cost and revenue in the promotion contract and the revenue in the no-promotion contract, providing no promotion contract is good for the distributor. Thus, the distributor will provide a no-promotion contract when k is large.

5. CONCLUSION

Various promotional strategies are used in the film industry, and they directly affect the box office revenue. A contract strategy that considers promotion cost is worth discussing. In this study, we consider a film supply chain composed of one distributor and one exhibitor (theater) that sign a multi-period revenue-sharing contract. At the beginning of the first period, the distributor provides a contract that includes the theater's sharing ratio in each period. The theater can either accept or reject this contract. After accepting the contract, the theater then decides the number of movie screening in Period 1. At the end of the first period, the distributor and the theater can realize the movie demand. If the movie is a flop, then the theater will probably adopt promotional strategies to increase the box office revenue and the distributor will share with the promotion cost. Then, the theater must decide the number of movie screening in Period 2. If the distributor's revenue when providing a no-promotion contract is better, then he will provide a no-promotion contract to the theater. Accordingly, the theater will not adopt promotional efforts when the movie is a flop at the end of Period 1. If the distributor's revenue when providing a promotion contract is better, then he will provide a promotion contract to the theater. Consequently, the theater will adopt promotional efforts when the movie is a flop at the end of Period 1. After obtaining the analytical results, we determine the effect of changing a single parameter on the strategic move of the distributor and the response action of the theater through numerical analysis.

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