Cooperative Advertising in a Distribution Channel with Fairness Concerns

Jing Yang
Department of Mathematical Sciences
Tsinghua University, Beijing 100084, China
Email: jyang07@mails.tsinghua.edu.cn

Jinxing Xie*
Department of Mathematical Sciences
Tsinghua University, Beijing 100084, China
Tel: (+86-10) 6278-7812, Fax: (+86-10) 6277-3400
Email: jxie@math.tsinghua.edu.cn

Xiaoxue Deng
Science and Technology on Information System Engineering Laboratory
National University of Defense Technology, Changsha 410073, China
Email: littlesnow18@gmail.com

Huachun Xiong
Department of Mathematical Sciences
Tsinghua University, Beijing 100084, China

* Corresponding Author.

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Abstract: Cooperative (co-op) advertising has been widely used in practice and employed as a strategy to improve the performance of a distribution channel. It is known from the existing models that co-op advertising could not achieve the channel coordination (i.e., maximize the total channel profit). In this paper, we consider a distribution channel consisting of a single manufacturer and a single retailer, and investigate the effect of the retailer's fairness concerns. Applying the equilibrium analysis, we obtain the following results: (1) Channel coordination can be achieved if the retailer has fairness concerns and model parameters satisfy certain conditions. (2) Although both channel members become better off with co-op advertising if neither channel member has fairness concerns, we find situations where co-op advertising brings detrimental effects to the retailer if the retailer has fairness concerns. (3) The retailer’s fairness concerns may increase or decrease the equilibrium participation rate, the equilibrium advertising effort, and the equilibrium profit of the manufacturer and the whole channel. (4) We identify the conditions under which the effectiveness of co-op advertising can be improved or reduced by the retailer’s fairness concerns. As long as co-op advertising can bring extra profit to the manufacturer, the retailer's fairness concerns could improve the effectiveness of the co-op advertising. (5) There exists a Pareto improvement for the profits of both the manufacturer and the retailer when a retailer without fairness concerns becomes fair-minded.

Keywords: Marketing; Cooperative advertising; Fairness concerns; Channel coordination; Game theory
1. Introduction

In a typical distribution channel consisting of one manufacturer and one retailer, cooperative (co-op) advertising is often used to boost sales (Ahmadi-Javid and Hoseinpour 2012, Huang and Li 2001, Xie and Wei 2009). Co-op advertising, which the manufacturer pays a portion of the retailer’s advertising costs, is very popular in the current marketing practice. Many companies, such as IBM, Apple Computer, Intel, use this strategy (Brennan 1988, Clark 2000, Elkin 1999). Nagler (2006) conducts a large-scale empirical study for 2286 brands, and reveals that more than 60% of them (1142 brands) adopt co-op advertising.

Co-op advertising has also attracted much attention in the academic field (see, for example, Aust et al. 2012, Berger 1972, Bergen and John 1997, Dant and Berger 1996, Huang et al. 2002, He et al. 2011, Kim and Staelin 1999, SeyedEsfahani et al. 2011, Zhang et al. 2012). For more information regarding the game-theoretic models on cooperative advertising see a recent review by Xie and Zhang (2011).

Almost all of the existing studies on co-op advertising consider only rational channel members, who always try to maximize their own profit. However, many evidences show that decision makers care not only about their own profit, but also about whether their profit is higher or lower than the others’. These are often referred to as fairness concerns of the decision makers. The perception of fairness plays an important role in consumer decision making (Bolton et al. 2003, Feinberg et al. 2002, Kahneman et al. 1986, Xia et al. 2004). For example, Fehr and Schmidt (1999) present both theoretical and experimental findings that players dislike unequal outcomes compared to the payoffs of their opponents, and are willing to sacrifice a monetary amount to reach an outcome that they believe to be more fair. Moreover, fairness concerns also play an important role in developing and maintaining channel relationships (e.g., manufacturer-retailer relationships). Many empirical or experimental studies show that manufacturers and retailers would also sacrifice their own profits to improve the counterparts’ margin because of fairness concerns (see Kumar 1996, Loch and Wu 2008, Olmstead and Rhode 1985, Scheer et al. 2003).

Therefore, it is important to study co-op advertising when channel members have
fairness concerns. In this paper we propose a game-theoretic model in which one manufacturer sells a single product through one retailer. The retailer uses advertising to boost the sales, and the manufacturer shares a proportion of the advertising cost (i.e., adopts the co-op advertising). We characterize the equilibrium results in the following two cases: (1) neither channel member has fairness concerns; (2) only the retailer has fairness concerns. (We assume that the manufacturer is the leader of the channel, so it is reasonable to only consider the retailer’s fairness concerns.) By comparing the results in the above two cases, we obtain the following results.

(1) Although co-op advertising cannot coordinate the whole channel when neither channel member has fairness concerns, it can coordinate the whole channel in some cases where the retailer has fairness concerns. Similar findings are also established in other situations (see Cui et al. 2007, and Demirag et al. 2010).

(2) When neither channel member has fairness concerns, co-op advertising always brings benefit to the retailer, as well as the manufacturer and the whole channel. However, when the retailer has fairness concerns, we give situations in which co-op advertising brings detrimental effects to the retailer.

(3) The retailer’s fairness concerns may affect the equilibrium participation rate of the manufacturer, the equilibrium advertising effort of the retailer, and the equilibrium profits of the manufacturer and the whole channel. Whether the existence of fairness concerns has positive or negative effect depends on the value of the equitable ratio for the retailer, which is a ratio in the retailer’s belief that characterizes what is an equitable outcome (if the retailer’s profit over the manufacturer’s equals to this equitable ratio, the retailer regards it as an equitable outcome). If the equitable ratio is low, the retailer’s fairness concerns decrease the equilibrium participation rate, the equilibrium advertising effort, and the equilibrium total channel profit, and increase the manufacturer’s equilibrium profit. If the equitable ratio is high, the opposite results hold.

(4) The effectiveness of co-op advertising for the manufacturer may be improved or reduced by the retailer’s fairness concerns: As long as co-op advertising can bring extra profit to the manufacturer, the retailer's fairness concerns could improve the
effectiveness of the co-op advertising.

(5) There exists a Pareto improvement of the profits of the manufacturer and the retailer when a retailer without fairness concerns becomes fair-minded, in other words, the manufacturer may not try to avoid dealing with a fair-minded retailer even if he can eliminate the retailer's fairness concerns at no cost.

The rest of the paper is organized as follows. Section 2 considers the basic case that neither channel member has fairness concerns. Section 3 discusses the case that the retailer has fairness concerns. In Section 4, we investigate the influence of the retailer’s fairness concerns on the equilibrium results and the effectiveness of co-op advertising. Finally, in Section 5 we conclude the paper and put forward some future research directions. All the proofs are collected in the Appendix.

2. Model without fairness concerns

Consider a distribution channel with one manufacturer and one retailer. The manufacturer produces an infinitely divisible product and sells it to consumers through the retailer. Let $\rho_M$ be the gross profit margin of the manufacturer and $\rho_R$ be the gross profit margin of the retailer, where $\rho_M, \rho_R > 0$ are constants. Furthermore, we assume $\rho_M > \rho_R / 2$ to avoid trivial cases. (If $\rho_M \leq \rho_R / 2$ it is not profitable for the manufacturer to adopt co-op advertising, which is not in this paper’s consideration.) Market demand of the product depends on the level of the advertising effort devoted by the retailer:

$$S(A) = T + kA,$$

where $T \geq 0$ is the sales saturate asymptote, $k > 0$ denotes the effectiveness of advertising, and $A$ is the level of advertising effort devoted by the retailer. $T$ stands for the quantity demanded in the market if there is no advertising, while $k$ is the retailer's ability to change the advertising into the demand of the product. We consider a single sales season when the retail price is a constant, and the market demand is independent of the retail price (Aust and Buscher 2012, Huang et al. 2001, 2002, Zhang et al. 2012). As our work is the first one that discusses the effect of the retailer's fairness
concerns in co-op advertising, we adopt the basic market demand function, a function of the advertising effort alone, to work out the theoretical solutions.

The cost corresponding to the advertising effort $A$ is $A^2/2$, which is an extensively-accepted assumption in co-op advertising literature (Chintagunta and Jain 1992, Chu and Desai 1995, Desai 1997, Nair and Narasimhan 2005, Sigue and Chintagunta 2008).

To set up a benchmark for our analyses later on, we first consider the centralized case, in which there is a central planner making decision for the whole channel. The centralized decision problem is to choose a level of advertising effort $A$ to maximize the total channel profit $\Pi_c(A)$:

$$\text{Max}_{A>0} \quad \Pi_c(A) = (\rho_M + \rho_R)S(A) - A^2/2 = (\rho_M + \rho_R)(T + kA) - A^2/2. \quad (2)$$

It can be easily verified that Problem (2) has a unique solution

$$A_c^* = k(\rho_M + \rho_R), \quad (3)$$

and the optimal profit for the whole channel is

$$\Pi_c^* = (\rho_M + \rho_R)T + (\rho_M + \rho_R)^2k^2/2. \quad (4)$$

Then we turn to the decentralized situation. First we summarize the notation of the paper for the ease of reference in Table 1.

<table>
<thead>
<tr>
<th>Manufacturer (M) uses co-op ad.</th>
<th>M does not use co-op ad.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retailer (R) has fairness concerns</td>
<td>$t^{CF};A^{CF};\Pi^{CF}_i, i = M, R, C;U^{CF}_R$</td>
</tr>
<tr>
<td>R doesn’t have fairness concerns</td>
<td>$t^{CN};A^{CN};\Pi^{CN}_i, i = M, R, C$</td>
</tr>
</tbody>
</table>

Table 1. Notation.

In Table 1, $t$, $A$, $\Pi$ and $U$ stand for the equilibrium participation rate, the equilibrium advertising effort, the equilibrium profit, and the equilibrium utility of the retailer respectively. The subscripts ‘$M$’, ‘$R$’, and ‘$C$’ respectively stand for the manufacturer, the retailer and the total channel. The first letter ‘C’ in superscript ‘$CF$’
and ‘CN’ denotes that the manufacturer adopts co-op advertising, while the first letter ‘N’ in superscript ‘NF’ and ‘NN’ denotes that the manufacturer does not adopt co-op advertising. The second letter ‘F’ in both ‘CF’ and ‘NF’ stands for the case that the retailer has fairness concerns, while the second letter ‘N’ in both ‘NN’ and ‘CN’ stands for the case in which the retailer does not have fairness concerns.

In the decentralized situation the manufacturer and the retailer play a Stackelberg game. The timing of events is as follows. First, the manufacturer decides the participation rate \( t \in [0,1) \). (Here we exclude the trivial case \( t=1 \), in which the retailer will devote infinite advertising effort but undertake no cost.) Then, observing \( t \), the retailer decides the level of advertising effort \( A \). All parameters are common knowledge to both members. In the decentralized situation, if the equilibrium total channel profit equals to \( \Pi^*_c \), we say the channel is coordinated, or co-op advertising coordinates the channel.

This co-op advertising model has been widely discussed in other studies when the retailer does not have fairness concerns. For any given participation rate \( t \in [0,1) \) of the manufacturer, the retailer’s and the manufacturer’s profits with advertising effort \( A \) are

\[
\Pi_R(A \mid t) = \rho_R S(A) - (1-t)A^2 / 2 = \rho_R (T + kA) - (1-t)A^2 / 2, \tag{5}
\]

\[
\Pi_M(A \mid t) = \rho_M S(A) - tA^2 / 2 = \rho_M (T + kA) - tA^2 / 2. \tag{6}
\]

We employ the standard backward induction to solve this game. In Table 2, we list the equilibrium results including the participation rate, the advertising effort and profits of the manufacturer, the retailer and the whole channel.
Case | No co-op advertising | Co-op advertising
---|---|---
Participation rate | 0 | $t^{CN} = \frac{2\rho_M - \rho_R}{2\rho_M + \rho_R}$
Advertising effort | $A^{NN} = \rho_k k$ | $A^{CN} = \frac{k(2\rho_M + \rho_R)}{2}$
Manufacturer’s profit | $\Pi_M^{NN} = \rho_M T + \rho_M \rho_R k^2$ | $\Pi_M^{CN} = \rho_M T + \frac{(2\rho_M + \rho_R)^2}{8} k^2$
Retailer’s profit | $\Pi_R^{NN} = \rho_R T + \frac{\rho_R^2}{2} k^2$ | $\Pi_R^{CN} = \rho_R T + \frac{(2\rho_M + \rho_R)\rho_R}{4} k^2$
Total channel profit | $\Pi_c^{NN} = (\rho_M + \rho_R)T + \frac{(2\rho_M + \rho_R)\rho_R}{2} k^2$ | $\Pi_c^{CN} = (\rho_M + \rho_R)T + \frac{(2\rho_M + \rho_R)(2\rho_M + 3\rho_R)}{8} k^2$

Table 2. Equilibrium results when channel members do not have fairness concerns

**Proposition 1.** $A^C_c > A^{CN} > A^{NN}$, $\Pi^C_c > \Pi^{CN} > \Pi^{NN}$, $\Pi^{CN} > \Pi^{NN}$, $\Pi^{CN}_M > \Pi^{NN}_M$.

**Proof.** The proof of this proposition, as well as other propositions, is provided in the Appendix.

The results in Proposition 1 are similar to and consistent with existing studies (e.g., Berger 1972, 1996, Bergen and John 1997). From Proposition 1, we have the following two observations. First, co-op advertising encourages the retailer to make greater efforts on advertising, and furthermore, the manufacturer, the retailer and the whole channel will be better off with co-op advertising. Second, if neither channel member possesses fairness concerns, co-op advertising cannot lead to channel coordination.

### 3. Model with retailer possessing fairness concerns

We consider the case that the retailer has fairness concerns, but the manufacturer does not. The manufacturer maximizes his own profit whereas the retailer maximizes his utility depending on the profits of both members. For any given participation rate $t \in [0,1]$ dictated by the manufacturer, the retailer’s utility function is

$$U_R(A \mid t) = \Pi_R(A \mid t) - \alpha \max\left[[\gamma \Pi_M(A \mid t) - \Pi_R(A \mid t), 0]\right] - \beta \max\left[[\Pi_R(A \mid t) - \gamma \Pi_M(A \mid t), 0]\right].$$

(7)
where $\gamma > 0$ is the equitable ratio for the retailer (in other words, the retailer deems the outcome as equitable if $\Pi_R(A|t) = \gamma \Pi_M(A|t)$; see Cui et al. 2007). $\alpha > 0$ measures the retailer’s disutility of earning less than the manufacturer (disadvantageous inequality), and $\beta \in [0,1]$ measures the retailer’s disutility of earning more than the manufacturer (advantageous inequality). Many studies have shown that subjects suffer more from inequity that is to their monetary disadvantage than from inequity that is to their monetary advantage (Fehr and Schmidt 1999, p. 822), which means $\beta \leq \alpha$. Other assumptions are the same as in Section 2.

Using backward induction, we characterize the retailer’s best response for any given participation rate $t \in [0,1]$. The retailer chooses $A(t) \geq 0$ to maximize his utility defined in Eqn. (7). The decision problem can be divided into the following two subproblems:

$$\max_{A \geq 0} U_R(A|t) = \Pi_R(A|t) - \alpha(\gamma \Pi_M(A|t) - \Pi_R(A|t))$$

$$s.t. \gamma \Pi_M(A|t) \geq \Pi_R(A|t)$$

$$\max_{A \geq 0} U_R(A|t) = \Pi_R(A|t) - \beta(\Pi_R(A|t) - \gamma \Pi_M(A|t))$$

$$s.t. \gamma \Pi_M(A|t) \leq \Pi_R(A|t)$$

Subproblem (8)-(9) corresponds to the case that the retailer feels disadvantageous inequality and Subproblem (10)-(11) corresponds to the case that the retailer feels advantageous inequality. In both subproblems, the objective functions and constraints are quadratic. After solving these two subproblems, we derive the manufacturer’s decision respectively to find out the best choice of the manufacturer, in other words, the equilibrium results of the game.

**Proposition 2.** When the manufacturer adopts co-op advertising with the fair-minded retailer, (a) If $\gamma \in (\gamma_1, \gamma_4]$, then $t^{CF} = t^*_C$, $A^{CF} = A^*_C$, $\Pi^{CF} = \Pi^*_C$, $\Pi^{CF} = \Pi^*_M$, $\Pi^{CF} = \Pi^*_R$, and $U^{CF} = U^{CF}_R$. In this case, $\Pi^{CF}_R = \gamma \Pi^{CF}_M$.

(b) If $\gamma \in (0, \gamma_1]$, then $t^{CF} = t^*_\beta$, $A^{CF} = A^*_\beta$, $\Pi^{CF} = \Pi^*_C$, $\Pi^{CF} = \Pi^*_M$, $\Pi^{CF} = \Pi^*_R$, and $U^{CF} = U^{CF}_R$. In this case, $\Pi^{CF}_R = \gamma \Pi^{CF}_M$. 


and $U^*_{CF} = U^*_{R\beta}$. In this case, $\Pi^*_{CF} > \gamma \Pi^*_{CM}$.

(c) If $\gamma \in (\gamma_4, +\infty)$, then $t^*_{CF} = t^*_{CM}$, $A^*_{CF} = A^*_{CM}$, $\Pi^*_{CF} = \Pi^*_{CM}$, $\Pi^*_{CF} = \Pi^*_{CM}$, $\Pi^*_{R} = \Pi^*_{R\alpha}$, and $U^*_{CF} = U^*_{R\alpha}$. In this case, $\Pi^*_{CF} < \gamma \Pi^*_{CM}$.

where

$$\gamma_1 = \frac{(\rho^2 - \rho^2_M)k^2 + 2\rho_T}{2\rho_M(\rho_M + \rho_R)k^2 + 2\rho_MT},$$

$$\gamma_4 = \arg(\Pi^*_{CM} = \Pi^*_{CM}).$$

and $t^*_{i}$, $A^*_{i}$, $\Pi^*_{j}$, $U^*_{Ri}$, $i = C, \alpha, \beta$, $j = M, R, C$ stand for the analytic forms of the equilibrium solutions, which are showed in Table 3.

Part (a) of Proposition 2 indicates that if the retailer has fairness concerns, the whole channel can be coordinated by co-op advertising under certain conditions (i.e., $\gamma_1 < \gamma \leq \gamma_4$). It is well known when profit maximization is used as the objective, channel coordination cannot be achieved. Once the fairness concerns are introduced into the model, the objective changes from profit maximization to utility maximization. Since the objective function changes, certain conditions with certain parameters actually determine the ratio of profits between the manufacturer and the retailer, which will force the manufacturer’s participation rate and the retailer’s advertising effort to move to the channel optimal levels, even in Stackelberg set up, therefore channel coordination is achieved. This is the main reason why two channel members can coordinate the channel with certain parameters under the retailer’s fairness concerns.

To demonstrate the results in Proposition 2 more clearly, we provide a numerical example in which $T = 0$, $k = 1$, $\rho_M = 1$, $\alpha = 0.7$, $\beta = 0.3$. The numerical results are showed in Fig. 1 (A), in which Region I corresponds to Part (a) of Proposition 2, Region II corresponds to Part (b) and Region III corresponds to Part (c).
For the purpose of comparison, we next provide equilibrium results of the situation that the manufacturer does not adopt co-op advertising (i.e., $t=0$) when the retailer has fairness concerns.

**Proposition 3.** When the manufacturer does not adopt co-op advertising with the fair-minded retailer, 

(a) If $\gamma \in (\gamma_2, \gamma_3]$ then $A^{NF} = A^*_e$, $\Pi^{NF}_C = \Pi^*_Ce$, $\Pi^{NF}_M = \Pi^*_Me$, $\Pi^{NF}_R = \Pi^*_Re$, and $U^{NF}_R = U^*_Re$. In this case, $\Pi^{NF}_R = \gamma \Pi^{NF}_M$.

(b) If $\gamma \in (0, \gamma_3]$ then $A^{NF} = \hat{A}^*_\beta$, $\Pi^{NF}_C = \hat{\Pi}^*_C\beta$, $\Pi^{NF}_M = \hat{\Pi}^*_M\beta$, $\Pi^{NF}_R = \hat{\Pi}^*_R\beta$, and $U^{NF}_R = \hat{U}^*_R\beta$. In this case, $\Pi^{NF}_R > \gamma \Pi^{NF}_M$.

(c) If $\gamma \in (\gamma_3, +\infty)$, then $A^{NF} = \hat{\hat{A}}^*_\alpha$, $\Pi^{NF}_C = \hat{\hat{\Pi}}^*_C\alpha$, $\Pi^{NF}_M = \hat{\hat{\Pi}}^*_M\alpha$, $\Pi^{NF}_R = \hat{\hat{\Pi}}^*_R\alpha$, and $U^{NF}_R = \hat{\hat{U}}^*_R\alpha$. In this case, $\Pi^{NF}_R < \gamma \Pi^{NF}_M$.

where

$$\gamma_2 = \frac{(1-\beta)(2T + \rho_R k^2)}{(\sqrt{T^2(1-\beta)^2 + 2T\rho_R k^2 + \rho_R^2 k^4} + (1-\beta)(T + \rho_R k^2))} \cdot \frac{\rho_R}{\rho_M},$$  \hspace{1cm}  (14)$$

$$\gamma_3 = \frac{(1+\alpha)(2T + \rho_R k^2)}{(\sqrt{T^2(1+\alpha)^2 + 2T\rho_R k^2 + \rho_R^2 k^4} + (1+\alpha)(T + \rho_R k^2))} \cdot \frac{\rho_R}{\rho_M},$$  \hspace{1cm}  (15)

satisfying $\gamma_1 < \gamma_2 < \gamma_3 < \gamma_4$. $\hat{A}^*_e, \hat{\Pi}^*_C, \hat{\Pi}^*_M, \hat{\Pi}^*_R, \hat{U}^*_R, \hat{\hat{A}}^*_\alpha, \hat{\hat{\Pi}}^*_C, \hat{\hat{\Pi}}^*_M, \hat{\hat{\Pi}}^*_R, \hat{\hat{U}}^*_R$ stand for the analytic forms of the equilibrium solutions, which are showed in Table 4.

Part (a) of Proposition 3 indicates that if the retailer has fairness concerns, he may feel equal to the manufacturer, but the whole channel cannot be coordinated without
co-op advertising. To better describe Proposition 3, we present a numerical example in which the parameters are the same as in the previous example. The numerical results are demonstrated in Fig.1 (B), in which Region I corresponds to Part (a) of Proposition 3, Region II corresponds to Part (b) and Region III corresponds to Part (c). Comparing (A) and (B) in Fig.1, we find that for the fair-minded retailer with the same parameters, the equitable region is larger when the manufacturer adopts co-op advertising.

It is important to note that we use the equitable ratio $\gamma$ to describe the boundaries of all the propositions in the paper. Here the equitable ratio is a function of other parameters, such as the sales saturate asymptote $T$, the effectiveness of advertising $k$, the disadvantageous inequality $\alpha$ and the advantageous inequality $\beta$. We use $\gamma$ to describe all the boundaries because we can get the explicit (closed-form) solutions in this way, while it is difficult for us to do so for the other parameters in the model.

When neither channel member has fairness concerns, it is shown in Proposition 1 that co-op advertising makes both channel members, as well as the whole channel, (strictly) better off. An interesting question is: Does the same result remain true when the retailer has fairness concerns? Obviously, as the channel leader, the manufacturer certainly benefits from co-op advertising. Next proposition will tell us whether the retailer and the whole channel also benefit from co-op advertising.

**Proposition 4.** (a) The following statements are always true: $A^{\text{CF}} \geq A^{\text{NF}}$, $\Pi^{\text{CF}}_M \geq \Pi^{\text{NF}}_M$, $\Pi^{\text{CF}}_C \geq \Pi^{\text{NF}}_C$, where “=” hold if and only if $\gamma \in [\tilde{\gamma}_1, \gamma_1]$.

(b) $U^{\text{CF}}_R$ may be greater or smaller than $U^{\text{NF}}_R$. In particular, $U^{\text{CF}}_R > U^{\text{NF}}_R$ if $\gamma \in (0, \min\{\gamma_1, \tilde{\gamma}_1\}) \cup (\gamma_2, \tilde{\gamma}_2)$; $U^{\text{CF}}_R < U^{\text{NF}}_R$ if $\gamma \in (\gamma_1, \gamma_2] \cup (\tilde{\gamma}_2, +\infty)$; and $U^{\text{CF}}_R = U^{\text{NF}}_R$ if $\gamma \in [\tilde{\gamma}_1, \gamma_1]$.

where

\[ \tilde{\gamma}_1 = \frac{(2\rho_M - \rho_R)}{3\rho_M} \cdot \frac{1-\beta}{\beta}, \]  

\[ \tilde{\gamma}_2 = \frac{1+\alpha}{\alpha} \cdot \frac{\rho_R}{\rho_M}. \]
Part (a) of Proposition 4 indicates that when the retailer has fairness concerns, the manufacturer and the whole channel will not be worse off with co-op advertising than without it. In particular, when \( \gamma \) satisfies certain conditions, i.e., \( \gamma \in [\hat{\gamma}_1, \gamma_2] \), the manufacturer will set the participation rate to zero and thus doesn’t participate in co-op advertising. Part (b) of Proposition 4 reveals that co-op advertising can be either detrimental or beneficial to the retailer, depending on the values of model parameters. If the retailer doesn’t have fairness concerns, by co-op advertising the manufacturer can improve the total sales as well as both channel members’ profits. However, if the retailer has fairness concerns, he cares not only his own profit but also the manufacturer’s. Although the retailer’s profit may increase when \( \gamma \) is big enough if the manufacturer adopts co-op advertising, the profit that the retailer believes to deserve may increase faster, which in fact will reduce the retailer’s utility. In particular, when \( \gamma \in (\gamma_1, \gamma_2) \), although with a lower profit and a lower utility, the retailer feels more equal with the manufacturer when the manufacturer applies co-op advertising. On the other hand, even with a higher profit and a higher utility, the retailer feels more advantageous when the manufacturer doesn’t apply co-op advertising. This interesting phenomenon implies that the retailer’s fairness concerns provide the manufacturer one more choice to improve the profit, and the manufacturer prefers to let the retailer feel equal rather than advantageous.

From Proposition 4 we can draw a conclusion that co-op advertising may be beneficial to both the manufacturer and the whole channel, but, in the meantime, it may be unfavorable for the retailer. Moreover, the retailer’s fairness concerns should be paid more attention to by the manufacturer because they provide an extra choice for the manufacturer to increase his profit.

4. Influence of fairness concerns

In this section, we investigate the influence of fairness concerns over equilibrium results and the effectiveness of co-op advertising.

Proposition 5.
(a) (Participation rate) If $\gamma \in (0, \tilde{\gamma}_3]$, $t^{CF} \leq t^{CN}$; if $\gamma \in (\tilde{\gamma}_3, +\infty)$, $t^{CF} > t^{CN}$.

(b) (Advertising effort) If $\gamma \in (0, \min\{\gamma_1, \tilde{\gamma}_1\}]$, $A^{CF} \leq A^{CN}$; if $\gamma \in (\min\{\gamma_1, \tilde{\gamma}_1\}, +\infty)$,

$$A^{CF} > A^{CN}.$$ 

(a) (Total channel profit) If $\gamma \in (0, \min\{\gamma_1, \tilde{\gamma}_1\}]$, $\Pi^{CF}_C \leq \Pi^{CN}_C$; if $\gamma \in (\min\{\gamma_1, \tilde{\gamma}_1\}, +\infty)$, $\Pi^{CF}_C > \Pi^{CN}_C$.

(b) (Manufacturer’s profit) If $\gamma \in (0, \tilde{\gamma}_4]$, $\Pi^{CF}_M \geq \Pi^{CN}_M$; if $\gamma \in (\tilde{\gamma}_4, +\infty)$, $\Pi^{CF}_M < \Pi^{CN}_M$,

where

$$\tilde{\gamma}_3 = \frac{2\rho_R(2\rho_M + \rho_R)T + 2\rho_M \rho_R (\rho_M + \rho_R)k^2}{2\rho_M (2\rho_M + \rho_R)T + (2\rho_M^2 + \rho_M \rho_R + \rho_R^2)(\rho_M + \rho_R)k^2},$$

$$\tilde{\gamma}_4 = \frac{4\rho_M + 3\rho_R)\rho_R k^2 + 8\rho_R T}{(2\rho_M + \rho_R)^2 k^2 + 8\rho_M T}.$$ 

Proposition 5 characterizes the influence of fairness concerns over equilibrium results when the manufacturer adopts co-op advertising, including the participation rate, the advertising effort, the manufacturer’s profit and total channel profit. Since the retailer’s objective functions are different in the cases of “CF” and “CN” (utility v.s. profit), we will not compare results regarding the retailer. Proposition 5 indicates that the existence of the retailer’s fairness concerns may lead to mixed effects on the equilibrium results. The existence of the retailer’s fairness concerns diminishes the participation rate, the advertising effort, and the total channel profit if $\gamma$ is low, while it enhances them if $\gamma$ is high. The opposite is true for the manufacturer’s profit. We only provide the intuition behind the results when $\gamma$ is low, and it’s similar with high $\gamma$. When $\gamma$ is low, the fair-minded retailer tends to believe he deserves a lower profit comparing to the manufacturer’s. If he earns a profit considerably higher than what he believes to deserve, he will feel advantageous inequality (or, regret), which leads him to lower the level of advertising effort, with the result of lowering the manufacturer’s profit. Anticipating this, the manufacturer tends to set a lower participation rate to mitigate this negative effect. Thus the
equilibrium participation rate is lowered by the retailer’s fairness concerns if $\gamma$ is low. A lower participation rate of the manufacturer makes the retailer less active in local advertising, which lowers the advertising effort and total channel profit which only depends on the advertising effort. Thus, the equilibrium advertising effort and the profit of the whole channel is also lowered by the retailer’s fairness concerns if $\gamma$ is low. As explained above, when $\gamma$ is low, the retailer tends to feel advantageous inequality. To decrease this advantageous inequality and to increase his own profit, the retailer tends to make a decision favored by the manufacturer. Thus, the manufacturer’s equilibrium profit is increased by the retailer’s fairness concerns if $\gamma$ is low. Further research shows that similar results are also true for cases “NF” v.s. “NN” (but the conditions are slightly different). We omit them here to save space.

Next we investigate the influence of fairness concerns over the effectiveness of co-op advertising.

**Proposition 6.** (a) If $\gamma \in [\tilde{\gamma}_1, \gamma_1]$, then $0 = \Pi_M^{CF} - \Pi_M^{NF} < \Pi_M^{CN} - \Pi_M^{NN}$.

(b) If $\gamma \in (0, \tilde{\gamma}_1) \cup (\gamma_1, +\infty)$, then $\Pi_M^{CF} - \Pi_M^{NF} > \Pi_M^{CN} - \Pi_M^{NN}$.

Proposition 6 implies that the retailer’s fairness concerns may bring beneficial or detrimental influence over the effectiveness of co-op advertising. From Proposition 4 we get that if $\gamma \in [\tilde{\gamma}_1, \gamma_1]$, then $\Pi_M^{CF} = \Pi_M^{NF}$, so the effectiveness of co-op advertising is reduced by the retailer’s fairness concerns. Otherwise, as long as the manufacturer can achieve extra profit using co-op advertising with the fair-minded retailer, the effectiveness of co-op advertising is improved by the retailer’s fairness concerns. It is intuitive to understand Proposition 6 by considering the fact that the situation in which the retailer does not have fairness concerns is the special case of the situation with the fair-minded retailer. So, when the case changes from 'NF' to 'CF', the manufacturer has more choices than from 'NN' to 'CN', and he will achieve a higher profit as long as he can.

Next we consider whether there exists a Pareto improvement of the profits of both
channel members. Without qualitatively affecting the results presented below, we assume that the manufacturer can change a fair-minded retailer into a retailer without fairness concerns at no cost if the manufacturer chooses to do so.

**Proposition 7.** (a) If \( \gamma \in (\bar{\gamma}_5, \rho_r / \rho_M) \), then \( \Pi^C_{r} > \Pi^C_{\bar{r}} \).

(b) If \( \gamma \in [\bar{\gamma}_5, \bar{\gamma}_4] \cap [\gamma_1, \gamma_4] \), then there exists a Pareto improvement for the profits of the manufacturer and the retailer when a retailer without fairness concerns becomes fair-minded,

\[
\bar{\gamma}_5 = \frac{(2\rho_M + \rho_r)\rho_r k^2 + 4\rho_M T}{(\rho_M + \rho_r)^2 k^2 + \rho_M^2 k^2 + 4\rho_MT}.
\]

It is important to note that in Case 'CN', the retailer does not have fairness concerns, and he maximizes his profit. On the other hand, in Case 'CF', the retailer maximizes his utility. In Case 'CF' the retailer feels equal under the condition of \( \gamma \in [\gamma_1, \gamma_4] \), and maximizing his utility equals to maximizing his profit; therefore we can compare the retailer's profits in Case 'CN' and 'CF' with this condition.

Part (b) of Proposition 7 indicates that if a retailer without fairness concerns becomes fair-minded, the profits of both the manufacturer and the retailer may not decrease. Specially, if \( \gamma \in [\bar{\gamma}_5, \bar{\gamma}_4] \cap [\gamma_1, \gamma_4] \), both channel member's profits can increase. That is to say, the manufacturer may not have any incentive to unilaterally eliminate the retailer's fairness concerns even if it is possible and incurs no cost. These findings not only suggest that the effect of the retailer's fairness concerns on co-op advertising is sustainable but also indicate that both channel members may benefit from the retailer’s fairness concerns and the manufacturer may even try to facilitate such concerns for strategic reasons. We give a numerical example with the same parameters as the example in Figure 1 before. The shaded region in Figure 2 is the Pareto improvement region.
5. Conclusion

In this paper, we take an initial step to incorporate fairness concerns of channel members into the study of co-op advertising in a distribution channel consisting of a single manufacturer and a single retailer. It is well known that if neither channel member has fairness concerns, the channel cannot be coordinated by co-op advertising. However, when the retailer has fairness concerns, the channel can be coordinated by co-op advertising under certain conditions. The essential reason is that, with fairness concerns, the retailer's utility is related to the manufacturer's profit. By co-op advertising, the manufacturer can improve his own profit as well as the retailer's utility based on the retailer's fairness concerns. When the profits of the manufacturer and the retailer are positively correlated, maximizing the manufacturer's profit is equivalent to maximizing the channel's profit, which then leads to the channel coordination.

Our analysis also shows that co-op advertising may be detrimental to the retailer with fairness concerns. The retailer's fairness concerns may improve or reduce the effectiveness of co-op advertising to the manufacturer, the equilibrium participation rate, the equilibrium advertising effort, as well as the equilibrium profits of the manufacturer and the whole channel. Interestingly, there exists a Pareto improvement
of both the profits of the manufacturer and the retailer when a retailer without fairness concerns becomes fair-minded. In other words, the manufacturer may not try to avoid dealing with a fair-minded retailer even if he can eliminate the retailer's fairness concerns at no cost. These results suggest the sustainability and persistency of the effect on the retailer's fairness concerns on co-op advertising. From our study, we know that both the manufacturer and the retailer should attach importance to fairness concerns, which may bring benefits to both channel members.

There are several directions deserving future research. First, we assume the manufacturer to be the Stackelberg leader in this paper, but there are practical examples of large retailers (e.g., Walmart) as channel leaders. Thus it is an interesting direction that the retailer acts as the Stackelberg leader of the channel. Second, as Pavlov and Katok (2009) mentioned, if some information of the retailer is private, the manufacturer may have different strategies. Third, Ho and Su (2009) show that fairness concerns are more significant among peers. So it is more interesting to study a channel with a single manufacturer and multiple retailers who possess peer-induced fairness.

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Appendix A. Supplementary material
Supplementary material associated with this article can be found in the online version.

References


<table>
<thead>
<tr>
<th>Case</th>
<th>Case (a) (disadvantageous inequality)</th>
<th>Case (b) (advantageous inequality)</th>
<th>Cases (c) and (d) (coordination)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation rate</td>
<td>[ t^*_a = \frac{(1+\alpha)(2\rho_M + \rho_R)(1+\alpha) + 3\alpha \eta \rho_M}{(1+\alpha + \alpha \gamma)(2\rho_M + \rho_R)(1+\alpha) + \alpha \gamma \rho_M} ]</td>
<td>[ t^*_a = \frac{(1-\beta)(2\rho_M + \rho_R)(1-\beta) - 3\beta \eta \rho_M}{(1-\beta - \beta \gamma)(2\rho_M + \rho_R)(1-\beta) - \beta \gamma \rho_M} ]</td>
<td>[ t^*_c = \frac{(2\gamma + 1)(\rho_M + 2\rho_R - \rho_R)k^2 + 2(\eta \rho_M - \rho_R)T}{(1+\gamma)(\rho_M + \rho_R)^2 k^2} ]</td>
</tr>
<tr>
<td>Advertising effort</td>
<td>[ A^*_a = \frac{(2\rho_M + \rho_R)(1+\alpha) + \alpha \gamma \rho_M}{2(1+\alpha)} k ]</td>
<td>[ A^*_a = \frac{(2\rho_M + \rho_R)(1-\beta) - \beta \gamma \rho_M}{2(1-\beta)} k ]</td>
<td>[ A^*_c = (\rho_M + \rho_R)k ]</td>
</tr>
<tr>
<td>Manufacturer’s profit</td>
<td>[ \Pi^*_m = \rho_M T + \frac{[(2\rho_M + \rho_R)(1+\alpha) + \alpha \gamma \rho_M]^2 k^2}{8(1+\alpha)(1+\alpha + \alpha \gamma)} ]</td>
<td>[ \Pi^*_m = \rho_M T + \frac{[(2\rho_M + \rho_R)(1-\beta) - \beta \gamma \rho_M]^2 k^2}{8(1-\beta)(1-\beta - \beta \gamma)} ]</td>
<td>[ \Pi^*_m = (\rho_M + \rho_R)[k^2(\rho_M + \rho_R) + 2T] ]</td>
</tr>
<tr>
<td>Retailer’s profit</td>
<td>[ \Pi^*_r = \rho_R T + \frac{[(2\rho_M + \rho_R)(1+\alpha) + \alpha \gamma \rho_M]^2 k^2}{8(1+\alpha)^2(1+\alpha + \alpha \gamma)} \times [3\alpha \gamma (1+\alpha) \rho_R + 2(1+\alpha)^2 \rho_R - \alpha^2 \gamma^2 \rho_M] k^2 ]</td>
<td>[ \Pi^*_r = \rho_R T + \frac{[(2\rho_M + \rho_R)(1-\beta) - \beta \gamma \rho_M]^2 k^2}{8(1-\beta)^2(1-\beta - \beta \gamma)} \times [-3\alpha \gamma (1-\beta) \rho_R + 2(1-\beta)^2 \rho_R - \beta^2 \gamma^2 \rho_M] ]</td>
<td>[ \Pi^*_r = (\rho_M + \rho_R)[k^2(\rho_M + \rho_R) + 2T] ]</td>
</tr>
<tr>
<td>Retailer’s utility</td>
<td>[ U^*_r = (1+\alpha)\rho_R - \alpha \gamma \rho_M)T + \frac{[(1+\alpha)+\alpha \gamma \rho_M]}{4(1+\alpha)} \times [(1+\alpha)(2\rho_M + \rho_R) + \alpha \gamma \rho_M] k^2 ]</td>
<td>[ U^*_r = (1-\beta)\rho_R - \beta \gamma \rho_M)T + \frac{[(1-\beta)\rho_M + \beta \gamma \rho_M]}{4(1-\beta)} \times [(1-\beta)(2\rho_M + \rho_R) - \beta \gamma \rho_M] k^2 ]</td>
<td>[ U^*_r = (\rho_M + \rho_R)[k^2(\rho_M + \rho_R) + 2T] ]</td>
</tr>
<tr>
<td>Total channel profit</td>
<td>[ \Pi^*_c = (\rho_M + \rho_R)T + \frac{[(2\rho_M + \rho_R)(1+\alpha) + \alpha \gamma \rho_M]^2 k^2}{8(1+\alpha)^2} \times [(2\rho_M + 3\rho_R)(1+\alpha) - \alpha \gamma \rho_M] k^2 ]</td>
<td>[ \Pi^*_c = (\rho_M + \rho_R)T + \frac{[(2\rho_M + \rho_R)(1-\beta) - \beta \gamma \rho_M]^2 k^2}{8(1-\beta)^2} \times [(2\rho_M + 3\rho_R)(1-\beta) + \beta \gamma \rho_M] k^2 ]</td>
<td>[ \Pi^*_c = (\rho_M + \rho_R)[k^2(\rho_M + \rho_R) + 2T] ]</td>
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</table>

Table 3. Equilibrium results when the manufacturer adopts co-op advertising and retailer has fairness concerns.
<table>
<thead>
<tr>
<th>Case</th>
<th>$\Pi^N_R &lt; \gamma \Pi^N_M$ (disadvantageous inequality)</th>
<th>$\Pi^N_R &gt; \gamma \Pi^N_M$ (advantageous inequality)</th>
<th>$\Pi^N_R = \gamma \Pi^N_M$ (equality)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertising</td>
<td>$\hat{A}_e = \frac{(\rho_R (1+\alpha) - \alpha \gamma \rho_M) k}{(1+\alpha)}$</td>
<td>$\hat{A}_e = \frac{(\rho_R (1-\beta) + \beta \gamma \rho_M) k}{(1-\beta)}$</td>
<td>$\hat{A}_e = (\rho_R - \gamma \rho_M) k + \sqrt{(\rho_R - \gamma \rho_M)^2 k^2 + 2(\rho_R - \gamma \rho_M)T}$</td>
</tr>
<tr>
<td>Manufacturer’s</td>
<td>$\hat{\Gamma}_{\text{M},a}^* = \rho_M T + \rho_R (\rho_R (1+\alpha) - \alpha \gamma \rho_M) k^2$</td>
<td>$\hat{\Gamma}_{\text{M},b}^* = \rho_M T + \rho_R (\rho_R (1-\beta) + \beta \gamma \rho_M) k^2$</td>
<td>$\hat{\Gamma}_{\text{M},e}^* = \rho_M T + \rho_R k \hat{A}_e^*$</td>
</tr>
<tr>
<td>profit</td>
<td>$\hat{\Gamma}_{\text{R},a}^* = \rho_R T + \frac{(\rho_R (1+\alpha) + \alpha \gamma \rho_M) (\rho_R (1+\alpha) - \alpha \gamma \rho_M) k^2}{2(1+\alpha)^2}$</td>
<td>$\hat{\Gamma}_{\text{R},b}^* = \rho_R T + \frac{(\rho_R (1-\beta) - \beta \gamma \rho_M) (\rho_R (1-\beta) + \beta \gamma \rho_M) k^2}{2(1-\beta)^2}$</td>
<td>$\hat{\Gamma}_{\text{R},e}^* = \rho_R T + \rho_R k \hat{A}_e^* - \frac{\hat{A}_e^{*2}}{2}$</td>
</tr>
<tr>
<td>Retailer’s profit</td>
<td>$\hat{U}_{\text{R},a}^* = ((1+\alpha) \rho_R - \alpha \gamma \rho_M) T + \frac{[\rho_R (1+\alpha) - \alpha \gamma \rho_M]^2 k^2}{2(1+\alpha)}$</td>
<td>$\hat{U}_{\text{R},b}^* = ((1-\beta) \rho_R + \beta \gamma \rho_M) T + \frac{[\rho_R (1-\beta) + \beta \gamma \rho_M]^2 k^2}{2(1-\beta)}$</td>
<td>$\hat{U}<em>{\text{R},e}^* = \hat{\Gamma}</em>{\text{R},e}^*$</td>
</tr>
<tr>
<td>Retailer’s utility</td>
<td>$\hat{\Gamma}_{\text{C},u}^* = (\rho_R + \rho_M) T + \frac{(\rho_R (1+\alpha) - \alpha \gamma \rho_M) (2 \rho_R + \rho_M) (1+\alpha) + \alpha \gamma \rho_M) k^2}{2(1+\alpha)^2}$</td>
<td>$\hat{\Gamma}_{\text{C},p}^* = (\rho_R + \rho_M) T + \frac{(\rho_R (1-\beta) - \beta \gamma \rho_M) (2 \rho_R + \rho_M) (1-\beta) + \beta \gamma \rho_M) k^2}{2(1-\beta)^2}$</td>
<td>$\hat{\Gamma}_{\text{C},s}^* = (\rho_R + \rho_M) (T + k \hat{A}_e^*) - \frac{\hat{A}_e^{*2}}{2}$</td>
</tr>
</tbody>
</table>

Table 4. Equilibrium results when the manufacturer doesn’t adopt co-op advertising and retailer has fairness concerns.