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A strategic analysis of the group-buying as a promotion way

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Abstract

In recent years, many new and interesting business models for Internet-based selling have emerged with the advent of electronic commerce, one of which is the Web-based group-buying. As an online promotion form, group-buying can be quickly built and removed. Our purpose is to analyze whether a firm should offer a traditional price discount or open a group-buying when they promote their product. To achieve this purpose, we develop a two-period decision model for a manufacturer-retailer supply chain, calculate out their optimal decisions such as the manufacturer's wholesale price, the retailer's retail price, the group-buying price in the promotion and regular period, respectively. Main conclusions of this paper include: (i) a high promotion effect of group-buying is not always good for the manufacturer and the retailer; (ii) the retailer always prefers the manufacturer providing the group-buying, whereas the manufacturer would rather the retailer providing the group-buying when the promotion effect of group-buying is large.

Keywords: group-buying; dual channels; pricing; promotion

1. Introduction

In recent years, many new and interesting business models for Internet-based selling have emerged with the advent of electronic commerce, one of which is the Web-based group-buying. The Internet-based group buying was first introduced in the Internet in the late 90s (Kauffman and Wang, 2001), and is being widely used for both business-to-business (B2B) and business-to-consumer (B2C) transactions. In some industries such as food services and health care, group purchasing organizations have a dominant presence (Mitchell 2002). In group buying, a seller offers discounted group rates to encourage individual customers purchasing through buying groups. Thus, a lower price occurs in the group buying.

Generally, Group Buying can utilize either dynamic price or fixed price schedule. Under the dynamic price schedule, the group price is a function of the total demand of the group, and thus it changes from time to time when consumers enter into or quit from the group. Examples of group buying websites that utilize such dynamic price schedule include Mercata.com, Mobshop.com and Letsbuyit.com.

When a group-buying website apply a fixed price schedule, the group price is fixed, no matter how many demand may be gathered during the promotion period. While almost all the

group-buying websites from China utilize such a schedule, Groupon.com may be the most successful and famous one in USA. Without take any advertising fees from suppliers and consumers, Groupon.com charges suppliers a portion of their revenue for each deal.

Because the fixed price schedule is more popular in group-buying and Groupon.com has gained big success from it, we focus on the fixed price schedule in this paper. Our purpose is to build a group-buying model that helps marketers determine the correct optimal prices and the optimal channel structure.

Our model accommodates two significant and novel challenges. The first is the presence of multiple decision makers and multiple periods. In this paper, we consider a two-level distribution channel consisting of one leader manufacturer and one retailer. At same time, a multi-period marketing decision problem including the promotion period and the regular sales period is studied. In the promotion period, both the manufacturer and the retailer could choose a price discount or a group-buying to attract more consumers.

The second is a special promotion way. As an online promotion form, Group-buying can be quickly built and removed. Furthermore, since the online consumers are really a different group, firms can not only differentiate the customers into different groups, but also open a new market by offering an online group buying schedule.

We incorporate the above issues and study the manufacturer and retailer's optimal promotion strategies with existing various promotion ways. Our managerial objective is to address the following interrelated questions facing the manufacturer and the retailer:

(1) What are manufacturer and retailer's optimal marketing decisions in the promotion and regular sale period?

(2)What is the difference between the optimal retail price in the promotion period and that in the regular sales period? What is the difference between the optimal wholesale price in the promotion period and that in the regular sales period? How do the market factors (e.g., the potential consumers or migration rate) affect such differences?

(3) Which strategy is the best for the manufacturer? Which strategy is the best for the retailer?

The remainder of this paper is organized as follows: in section 2, we review the existing literature. Section 3 develops the model. Section 4 analyzes the optimal promotion strategies for the manufacturer and retailer. Conclusion and future research directions are in Section 5.

2. Literature Review

Two areas of prior research are closely related to our work. The first area is dual channel structures which have been extensively researched by the market researchers (Frazier, 1999; Geyskens et al., 2002; Tsay and Agrawal, 2004; Mukhopadhyay et al., 2008).

Some literatures consider the scenario in which the market exists the traditional retail channel and a direct channel. Balasubramanian (1998) models the competition in the multiple-channel

environment with direct marketers and obtains the price equilibrium. Chiang et al. (2003) develop a model which conceptualizes the impact of customer acceptance of a direct channel, the degree to which customers accept a direct channel as a substitute for shopping at a traditional store, on supply-chain design. Netessine and Rudi (2006) model the dual strategy as a noncooperative game among the retailers and the wholesaler, analyze it, and obtain insights into the structural properties of the equilibrium solution to facilitate development of recommendations for practicing managers. Dumrongsiri et al. (2008) study a dual channel supply chain in which a manufacturer sells to a retailer as well as to consumers who choose the purchase channel based on price and service qualities, directly. Yan（2008）uses a game theory approach to focus on the strategic role played by profit sharing in a manufacturer-retailer dual-channel supply chain.

Other researchers study the impact of the channel based on the Internet for the market participants. The fact that the dual channel (hybrid of physical and e-tail channels) holds most promise for the future is proclaimed by Levary and Mathieu (2000). Yao and Liu (2003) build a dynamic channel diffusion model and analyze how the sales will redistribute between the "pure-direct" channel and "adopted-direct" channel in a given time-variant marketplace and find that, under certain conditions, both channels enjoy stable demand. King, Sen and Xia (2004) use a game-theory approach to study the impact of web-based e-commerce on retailers' choices of distribution channel strategies. The problem studied by Chen et al. (2007) is a predigestion of the decision faced by online retailers who may sell its product not only through its online and bricks-and-mortar stores, but also through the websites of one or more third parties.

Our study has some differences with the above dual-channel researches. First, we study a new Internet-based business models which is called the Internet-based group-buying model. Second, we consider a multi-period marketing decision problem including the promotion period or spread period and the regular sales period and find the impact of the existing of the dual-channel to the future sales.

A second area of related research is group-buying. Many researches who study on buyer groups have focused enhanced buying power that justifies the formation of buyer co-operatives, buyer alliances, and horizontal mergers (e.g., Chipty 1995, Dana 2006, Horn and Wolinsky 1988, Inderst and Wey 2003, Marvel and Yang 2008). Che and Gale (1997) examine how an organized "buyer alliance" manage competition among insurance firms by focusing on their choices of the format of competition, the number of firms allowed to compete, and the quality of care offered by the firms. Inderst and Wey (2003) study the impact of size/power of buying groups on suppliers' technology adoption decisions. Chen and Roma(2011) consider a two-level distribution channel with a single manufacturer and two retailers who compete for end customers and show under linear demand curves, group buying is always preferable for symmetric (i.e., identical) retailers. Chen et al. (2008) explore buyers' bidding strategy under different GB mechanisms in B2B exchanges.

Few papers present the effect of the group-buying from the perspective of the seller. Anand

and Aron (2003) build on the monopolist's optimal group-buying model considering varying conditions of heterogeneity in the demand regimes, and compare its profits with those that obtain under the more conventional posted-price mechanism. Jing and Xie (2011) formally model such an information-sharing effect and examine if and when Group Buying is more profitable than (1) traditional individual-selling strategies, and (2) another popular social interaction scheme. Our paper regards the group-buying as a promotion way and consider the group-buying impact on the sellers.

3. Model Development

We focus on a supply chain consisting of a manufacturer and a retailer, and specifically study a two-period marketing decision problem, i.e., a promotion period and a regular sale period. Because customers of the first period are potential ones of the second period, market participants often provide a low price to attract consumers as much as possible in the promotion period.

A group-buying schedule can be an efficient promotion way due to the following reasons. First, as an online promotion form, it can be quickly built and removed. Second, compared to the traditional price discount, the group-buying schedule faces a different customer group who has a habit of online shopping, thus the marketers can not only differentiate the customers into different groups, but also open a new market by offering an online group buying schedule.

Considering that marketers can either offer an online group-buying schedule, or provide a traditional retail price discount, we investigate the following three scenarios in this paper, i.e., (i) the retailer provides a price discount in the promotion period; (ii) the manufacturer provides a group-buying schedule in the promotion period; (iii) the retailer provides a group-buying schedule in the promotion period.

The following notations are used through the paper. Any additional notations will be given where they are needed.

$i = 1, 2$	$i = 1$ refers the promotion period and 2 refers the regular sale period;
$j = 1, 2$	$j = 1$ stands for the traditional retail channel and 2 for the group-buying channel;
$k = I, II, III$	the k th scenario as mentioned above;
θ	the proportion that the consumers of first period which will also be the consumers of the second period;
p_{ij}^k	the price of channel j during the i th period in the Scenario k ;
q_{ij}^k	the demand of channel j during the i th period in Scenario k ;
w_i^k	the manufacturer's wholesale price during the i th period in Scenario k ;
$\pi_{M_i}^k$	the manufacturer's profit during the i th period in Scenario k ;
$\pi_{R_i}^k$	the retailer's profit during the i th period in Scenario k ;
π_M^k	the manufacturer's total profit in Scenario k
π_R^k	the retailer's total profit in Scenario k .

3.1 Scenario I: The retailer provides a price discount

In this scenario, the retailer provides a price discount in the promotion period. After the promotion, the retail price will be back to the regular price. The sequence of moves in the game-theoretic model is as follows:

(i)The manufacturer first determines the wholesale price w^I at the beginning of promotion period;

(ii)The retailer then decides its regular retail price p^I and the discount rate η $(0<\eta<1)$ for the promotion period.

The demands of the two periods are assumed as follows:

$$q_{11}^I = a_1 - \eta p^I, \tag{1}$$

$$q_{21}^I = a_2 + \theta q_{11}^I - p^I, \tag{2}$$

where a_i is the potential demand during the i th period. η is the discount rate . θ is the proportion of customers of the first period who are potential ones of the second period. p^I is the retail price in the regular sale period.

To maintain analytical tractability, we don't consider the manufacturer's production cost. The manufacturer and retailer's profit functions are:

$$\pi_M^I = \pi_{M_1}^I + \pi_{M_2}^I = w^I(q_{11}^I + q_{21}^I), \tag{3}$$

$$\pi_R^I = \pi_{R_1}^I + \pi_{R_2}^I = (\eta p^I - w^I)q_{11}^I + (p^I - w^I)q_{21}^I, \tag{4}$$

3.2 Scenario II: The manufacturer provides a group-buying schedule

Different from Scenario I, in this scenario, the manufacturer provides a group-buying schedule during the promotion period (see Figure 1).

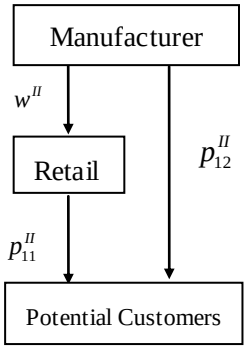


Figure 1 Conceptual model of the promotion period in the scenario II

The decision sequence is as follows. At the beginning of the promotion period, the manufacturer first decides his wholesale price w_1^{II} for the promotion period, then simultaneously, the manufacturer decides the group price p_{11}^{II} and the retailer

determines his retail price p_{12}^{II} for the promotion period. After the promotion period, the manufacturer re-decides his regular whole sale price w_2^{II} and then the retailer decides his regular retail price p_{21}^{II}. To avoid the retailer buy product from the group-buying channel, it is assumed that $p_{12}^{II} \geq w_1^{II}$.

For the promotion period, the demands of the two channels are assumed as follows:

$$q_{11}^{II} = a_{11} - p_{11}^{II} - \beta(p_{11}^{II} - p_{12}^{II}), \tag{5}$$

$$q_{12}^{II} = a_{12} - p_{12}^{II} + \beta(p_{11}^{II} - p_{12}^{II}), \tag{6}$$

where a_{11} is the number of the potential consumers in the traditional retail channel, a_{12} is the potential consumers in the group-buying market, and the item $\beta(p_{11}^{II} - p_{12}^{II})$ in equations (5) and (6) is to illustrate that customers may migrate between two channels if they find a difference between p_{11}^{II} and p_{12}^{II}. Since consumers in the two channels have different shopping habits, the migration rate β is relatively small.

When the manufacturer provides a group-buying schedule through an online group-buying website, the website will charge a portion of its revenue as broker fee. Assuming that the broker fee rate is $1-\delta$ ($0<\delta<1$), then the manufacturer's profit in the promotion period is

$$\pi_{M_1}^{II} = \delta p_{12}^{II} q_{12}^{II} + w_1^{II} q_{11}^{II}, \tag{7}$$

and that of the retailer is

$$\pi_{R_1}^{II} = (p_{11}^{II} - w_1^{II}) q_{11}^{II}, \tag{8}$$

In the regular sales period, only the retailer sells the product in the traditional retail channel. Consumers that have pleasant purchase experiences in the promotion period will become consumers in the second period. Assuming that the portion is θ, then the demand of the regular sales period is:

$$q_{21}^{II} = a_{21} + \theta(q_{11}^{II} + q_{12}^{II}) - p_{12}^{II}, \tag{9}$$

We assume the potential demands of the traditional retail channel in the promotion period are the same as that in the regular sales period, i.e., $a_{11} = a_{21}$.

The manufacturer and retailer's profit functions in the regular sales period are then given by:

$$\pi_{M_2}^{II} = w_2^{II} q_{21}^{II}, \tag{10}$$

$$\pi_{R_2}^{II} = (p_{21}^{II} - w_2^{II}) q_{21}^{II}, \tag{11}$$

and the total profits of the manufacturer and retailer are:

$$\pi_M^{II} = \pi_{M_1}^{II} + \pi_{M_2}^{II} = (\delta p_{12}^{II} q_{12}^{II} + w_1^{II} q_{11}^{II}) + w_2^{II} q_{21}^{II}, \tag{12}$$

$$\pi_R^{II} = \pi_{R_1}^{II} + \pi_{R_2}^{II} = (p_{11}^{II} - w_1^{II}) q_{11}^{II} + (p_{21}^{II} - w_2^{II}) q_{21}^{II}. \tag{13}$$

3.3 Scenario III: The retailer provides a group-buying schedule

Compared to Scenario II, the difference is that the retailer provides a group-buying schedule in the promotion period and decides the price in the group-buying. The conceptual model of the promotion period in Scenario III is shown in Figure 2.

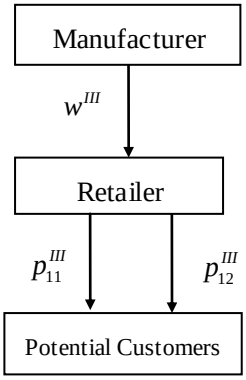


Figure 2. Conceptual model of the promotion period in the scenario III

Since the channel demand functions are the same as that in Scenario II, we ignore the demand functions and just present the profit functions of the manufacturer and retailer here.

The manufacturer and retailer's profit functions in the promotion period are

$$\pi_{M_1}^{III} = w_1^{III}(q_{12}^{III} + q_{11}^{III}), \tag{14}$$

$$\pi_{R_1}^{III} = (p_{11}^{III} - w_1^{III})q_{11}^{III} + \delta p_{12}^{III} q_{12}^{III} - w_1^{III} q_{12}^{III}, \tag{15}$$

and their profit functions in the regular sales period are

$$\pi_{M_2}^{III} = w_2^{III} q_{21}^{III}, \tag{16}$$

$$\pi_{R_2}^{III} = (p_{21}^{III} - w_2^{III})q_{21}^{III}, \tag{17}$$

Thus, the total profits of the retailer and manufacturer are:

$$\pi_M^{III} = \pi_{M_1}^{III} + \pi_{M_2}^{III} = w_1^{III}(q_{12}^{III} + q_{11}^{III}) + w_2^{III} q_{21}^{III}, \tag{18}$$

$$\begin{aligned} \pi_R^{III} &= \pi_{R_1}^{III} + \pi_{R_2}^{III} \\ &= ((p_{11}^{III} - w_1^{III})q_{11}^{III} + \delta p_{12}^{III} q_{12}^{III} - w_1^{III} q_{12}^{III}) + (p_{21}^{III} - w_2^{III})q_{21}^{III} \end{aligned}. \tag{19}$$

4. Model Analysis

In this section, we will get the optimal marketing decisions of the manufacturer and retailer under three scenarios, respectively. Through a numerical analysis of profits, we will give the optimal promotion strategies of the manufacturer and the retailer.

The two channel member's objectives are to maximize their profits. To obtain the

equilibrium solutions, we use the concept of sub-game-perfect Nash equilibrium that leads to a backward induction procedure. In this solution procedure, we initially solve for price equilibrium in the sub-game problems at the regular sales period, assuming that prices at the promotion period have been set. We then find a sub-game-perfect price equilibrium which is the price for the manufacturer and retailer such that neither the manufacturer nor the retailer would choose a different price unilaterally.

4.1 The retailer provides a price discount

In this scenario, the retailer provides a price discount in the promotion period, and the retail price will be back to be the regular price in the regular sales period.

The problem faced by the retailer is to find his optimal price and the discount rate, and the manufacturer is to choose a wholesale price maximizing his profit.

Proposition 1. *In Scenario I, the manufacturer's equilibrium wholesale price is*

$$w^{I^*} = \frac{a_1 + a_2}{4} \quad , \tag{20}$$

the retailer's equilibrium retail price is

$$p^{I^*} = \frac{2(a_1 + 5a_2) + \theta(3a_1 - a_2) - \theta^2(a_1 + a_2)}{4(4 - \theta^2)} \tag{21}$$

and his optimal discount rate is

$$\eta^* = \frac{2(a_1 + 5a_2) + \theta(a_1 - 3a_2) - 4\theta^2 a_1}{2(a_1 + 5a_2) + \theta(3a_1 - a_2) - \theta^2(a_1 + a_2)} \quad . \tag{22}$$

Thus, the retailer's discount retail price in the promotion period is

$$\eta^* p^{I^*} = \frac{2(a_1 + 5a_2) + \theta(a_1 - 3a_2) - 4\theta^2 a_1}{4(4 - \theta^2)} \tag{23}$$

Substituting the manufacturer and retailer's equilibrium decisions into their profit function, we get their equilibrium profits as follows.

Proposition 2. *In Scenario I, the manufacturer's equilibrium profit*

$$\pi_M^{I^*} = \frac{(a_1 + a_2)^2}{8(2 - \theta)} \tag{24}$$

and that of the retailer is

$$\pi_R^{I^*} = \frac{(10 - 3\theta)(a_1^2 + a_2^2) + 2a_1 a_2(5\theta - 6)}{16(4 - \theta^2)} \tag{25}$$

4.2 The manufacturer provides a group-buying schedule

In this scenario, the manufacturer provides a group-buying schedule in the promotion period. So for the manufacturer, we should get the optimal price in the group-buying channel in the

promotion period and the optimal wholesale prices of two periods. And for the retailer, the retail prices of two periods should be decided.

At the regular sales period (i.e. only the retailer sells the product in the traditional retail channel), the problem faced by the retailer is to find his optimal wholesale price, which can be stated as follows:

$$\max_{p_{21}^{II}} \pi_{R_2}^{II} = \max_{p_{21}^{II}} \left\{ (p_{21}^{II} - w_2^{II}) q_{21}^{II} \right\} \tag{26}$$

And the manufacturer is to

$$\max_{w_2^{II}} \pi_{M_2}^{II} = \max_{w_2^{II}} \left\{ w_2^{II} q_{21}^{II} \right\} \tag{27}$$

where q_{21}^{II} is given by Equation (9).

Solving the problem given by equations (26) and (27), we get the following proposition.

Proposition 3. *During the regular sales period of Scenario II, the optimal wholesale price is*

$$w_2^{II^*} = \frac{1}{2}(a_{21} + \theta(q_{11}^{II} + q_{12}^{II})) \tag{28}$$

and the retailer's optimal retail price

$$p_{21}^{II^*} = \frac{3}{4}(a_{21} + \theta(q_{11}^{II} + q_{12}^{II})). \tag{29}$$

Once we get the manufacturer and retailer's best response function for the decisions of the first period, the manufacturer's objective is then to

$$\max_{p_{11}^{II}} \pi_R^{II} = \max_{p_{11}^{II}} \left\{ (p_{11}^{II} - w_1^{II}) q_{11}^{II} + (p_{21}^{II} - w_2^{II}) q_{21}^{II} \right\} \tag{30}$$

and that of the retailer is to

$$\max_{w_1^{II}} \pi_M^{II} = \max_{w_1^2} \left\{ (\delta p_{12}^{II} q_{12}^{II} + w_1^{II} q_{11}^{II}) + w_2^{II} q_{21}^{II} \right\} \tag{31}$$

where q_{11}^{II} and q_{12}^{II} are given by equations (5) and (6).

Solving the problem given by equations (30) and (31), we get the following proposition.

Proposition 4. *In Scenario II, for the promotion period, the manufacturer's equilibrium wholesale price and group price are*

$$\begin{aligned} w_1^{II^*} &= \frac{1}{A}((1+\beta)((\theta^2(\delta\theta + 2\delta(\delta\beta + 8(2+5\beta))) + 8 - 4\delta(\theta(1-\beta) - 4\delta\beta))a_{12} \\ &+16(\theta + \delta(\beta + \theta(2+3\beta)))a_{11}) + (\delta\beta\theta^2(\theta + 2\delta\beta(\theta^2 + \theta - 16)) \\ &+4(1+2\beta) + \delta(\beta(97+80\beta) + 32))a_{11}) \end{aligned} \tag{32}$$

$$p_{12}^{II^*} = \frac{4\delta\theta(\theta a_{12}(1+\beta) + \beta a_{11}(1+\theta))}{B}, \tag{33}$$

respectively, and the retailer's equilibrium retail price is

$$\begin{aligned} p_{11}^{II^*} &= \frac{1}{B}((\theta(1+\theta) + 2\delta\beta(1+2\theta) + 8\delta\theta(1+\beta))a_{11}; \\ &+(\theta^2(1+4\delta(1+3\beta)) + 2\delta\theta(\beta - 1) - 4\delta^2\beta)a_{12}) \end{aligned} \tag{34}$$

for the regular sales period, the manufacturer's equilibrium wholesale price is

$$w_2^{II^*} = \frac{\delta(2\delta\beta+\theta)(\theta a_{12}(1+\beta)+\beta a_{11}(1+\theta))}{B}, \tag{35}$$

and the retailer's equilibrium retail price is

$$p_{21}^{II^*} = \frac{4\delta\theta(\theta a_{12}(1+\beta)+\beta a_{11}(1+\theta))}{B}, \tag{36}$$

where $A=(1+\beta)(8\delta(1+2\beta)\theta^2+(\theta+2\delta\beta)^2)$; $B=4\delta\beta(\delta\beta+\theta)+\theta^2(8\delta(1+2\beta)+1)$.

Also, we obtained the equilibrium profit of the two channel members.

Proposition 5. *In Scenario II, the manufacturer's equilibrium profit*

$$\pi_M^{II^*} = \frac{2\delta^2(\beta(1+\theta)a_{11}+\theta(1+\beta)a_{12})^2}{B}, \tag{37}$$

and that of the retailer is

$$\pi_R^{II^*} = (p_{11}^{II^*}-w_1^{II^*})q_{11}^{II^*}+(p_{21}^{II^*}-w_2^{II^*})q_{21}^{II^*} \tag{38}$$

where

$$\begin{aligned} q_{11}^{II^*} = \frac{1}{B}((1+\beta)a_{12}(\theta C-2\delta\theta-4\delta^2\beta)+a_{11}((1+\beta)(\theta+2\delta\beta) \\ +\beta\theta(C-2\delta\beta)+2\delta\theta(4+9\beta)+2\delta\beta^2(5\theta-2\delta))) \end{aligned}, \tag{39}$$

$$q_{12}^{II^*} = \frac{((1+\theta)(\beta\theta+2\delta\beta^2(1+4\theta))+4\delta\beta\theta(1+\delta))a_{11}+\theta(1+\beta)Ca_{12}}{B}, \tag{40}$$

$$q_{21}^{II^*} = \frac{2\delta(2\delta\beta-\theta)(\theta a_{12}(1+\beta)+\beta a_{11}(1+\theta))}{B}, \tag{41}$$

and $C=2\delta\beta+\theta+8\delta\beta\theta+4\delta\theta$.

4.3 The retailer provides a group-buying schedule

Different from Scenario II, the retailer offers a group-buying schedule during the promotion period in Scenario III. Under such scenario, the retailer should not only decide the group prince for the promotion period, but also should decide his retailer price for both promotion and regular sale period. For the manufacturer, his decisions include the wholesale price of the two periods.

Using the same approaches as that in Section 4.2, we obtain Proposition 6.

Proposition 6. *In Scenario III, the manufacturer and retailer's equilibrium decisions are as follows: (i) for the promotion period, the retailer's retail price is*

$$\begin{aligned} p_{11}^{III^*} = \frac{1}{8H}(4\theta^2(D+(1+\delta)I)+3\theta D+\delta(1+2\beta)+4E^2\beta(1+3\delta) \\ -16\delta(\delta(3+10\beta)-2(1+3\beta)))a_{11} \\ +4(\theta^2 D+\beta((1+3\delta)(E^2-\delta\beta(11+\delta)-2\delta(\delta^2+12\delta+3))-4\delta^2)a_{12}) \end{aligned}, \tag{42}$$

Its group price is

$$p_{12}^{III^*} = \frac{1}{8H}((4\theta^2(1+\delta)(F+3\theta(F+1+2\beta))-8(\beta(3\delta(\delta+4)+1)+2\delta))a_{11} \\ +4(\theta^2(1+\delta)(F+I)+E^2\beta(3+\delta)+\beta^2(2+\delta)(\delta^2+8\delta+1) \\ -4\delta\beta(10+6\delta)-4\delta(3+2\delta))a_{12}) \quad , \qquad (43)$$

And the manufacturer's wholesale price is

$$w_1^{III^*} = \frac{1}{8G}(8(4\delta-E^2)p_{11}^{III^*}+((G+1)\theta^2+\theta G-16\delta(1+\beta))a_{11}; \qquad (44)$$
$$+((G-\delta)\theta^2-8\delta\beta(1+\delta))a_{12})$$

(ii) for the regular period, the manufacturer's wholesale price is

$$w_2^{III^*} = \frac{1}{8H}((\theta^2 I+4\theta(E^2-(\delta(2+5\beta)-\beta))+8E^2-32\delta(1+2\beta))a_{11}, \qquad (45)$$
$$+(4\theta(E^2+\delta(\delta\beta-2-5\beta)))a_{12})$$

the retailer's retail price is

$$p_{21}^{III^*} = \frac{3}{2}w_2^{III^*}, \qquad (46)$$

where $D=(1+\delta)(2\beta^2(1+3\delta)+\beta(1+5\delta)+\delta)$; $E=\beta(1-\delta)$; $F=1+\beta(5+\delta)+2\beta^2(3+\delta)$;

$G=3\delta\beta+2\delta+\beta$; $I=(1+\delta)(1+2\beta)$; $H=(1+\delta)(\theta^2(1+\delta)(4\beta(1+\beta)+1)-2\delta(17\beta^2+16\beta+4)$

$+4\beta^3(1-\delta)^2+2\beta^2(1-\delta+\delta^2))$.

Proposition 7. *In Scenario III, the manufacturer's equilibrium profit*

$$\pi_M^{III^*} = w_1^{III^*}(q_{11}^{III^*}+q_{12}^{III^*})+w_2^{III^*}q_{21}^{III^*}, \qquad (47)$$

and that of the retailer is

$$\pi_R^{III^*} = ((p_{11}^{III^*}-w_1^{III^*})q_{11}^{III^*}+\delta p_{12}^{III^*}q_{12}^{III^*}-w_1^{III^*}q_{12}^{III^*})+(p_{21}^{III^*}-w_2^{III^*})q_{21}^{III^*}, \qquad (48)$$

where

$$q_{11}^{III^*} = \frac{1}{8J}(4\theta E(-\theta E^2+\beta(2\delta^2+11\delta-1))+16\delta(\beta(5+\delta)+1+2\delta))a_{11} \\ +4(\theta^2(1+\delta)(\delta+\beta(3\delta-1-2E))-E^3 \quad , \qquad (49) \\ +\delta(\beta(E(11+\delta)+2(3-6\delta-\delta^2))-4\delta))a_{12}$$

$$q_{12}^{III^*} = \frac{1}{8J}(4\theta^2 I(1+E)+3\theta I(2+E)-24\delta\beta(2-\delta)-16\delta-8\beta)a_{11} \\ +(4\theta^2 I(-\delta+E)+4E^3+4\beta E(\delta^2-11\delta-2) \quad , \qquad (50) \\ +16\delta(1+2\delta+\beta(1+5\delta)))a_{12}$$

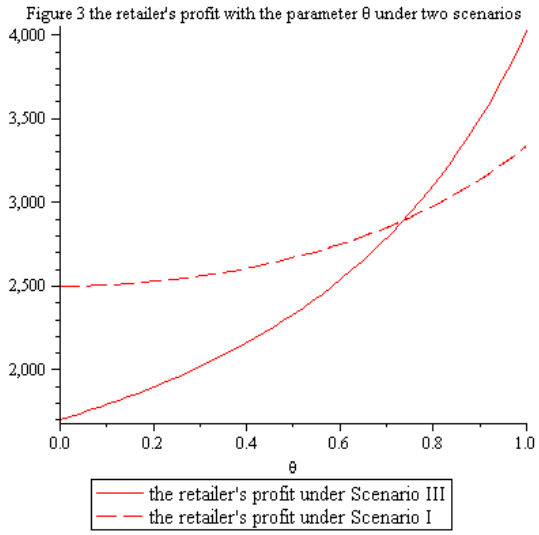
$$q_{21}^{III^*} = \frac{1}{16J}((\theta^2 I + 4\theta(E^3 - 2\delta - 5\delta\beta + \beta) + 8(E^2 - 4\delta(1+2\beta)))a_{11} + 4\theta(E^2 + \delta\beta(\delta - 5) - 2\delta)a_{12}) \quad , \quad (51)$$

And $J = (1+\delta)(1+2\beta)$.

4.4 The profits' comparison under three scenarios

In this section, we will present that how the parameters affect the optimal promotion strategy by a numerical example.

We first demonstrate the impact of the parameter θ (the proportion of the consumers existing the tendency of second purchase) on the optimal manufacturer's and retailer's promotion strategy.



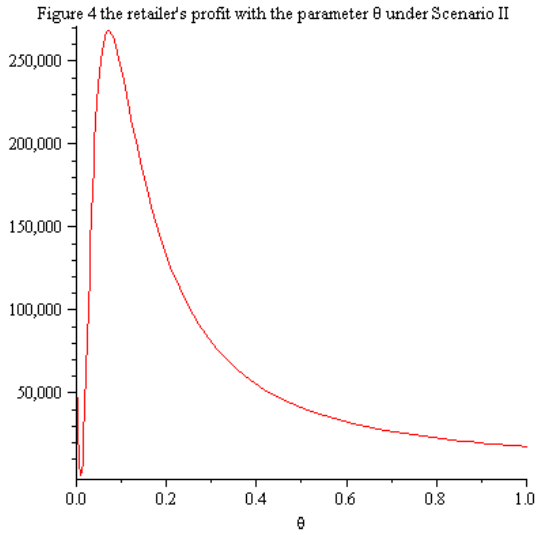


Fig. 3 and Fig. 4 present that the impact of the parameter θ on the optimal retailer's promotion strategy. The optimal promotion strategy for the retailer is that the manufacturer opens a group-buying in the promotion period. When the value of the parameter θ is small, it is better for the retailer to make a price discount than provide a group-buying; otherwise, compared with the price discount, providing a group-buying is better.

As can be seen from the Fig. 5, the preference for the manufacturer is given by $ScenarioIII \succ ScenarioI \succ ScenarioII$ when the value of the parameter θ is larger, and $ScenarioII \succ ScenarioIII \succ ScenarioI$ when the value of the parameter θ is small.

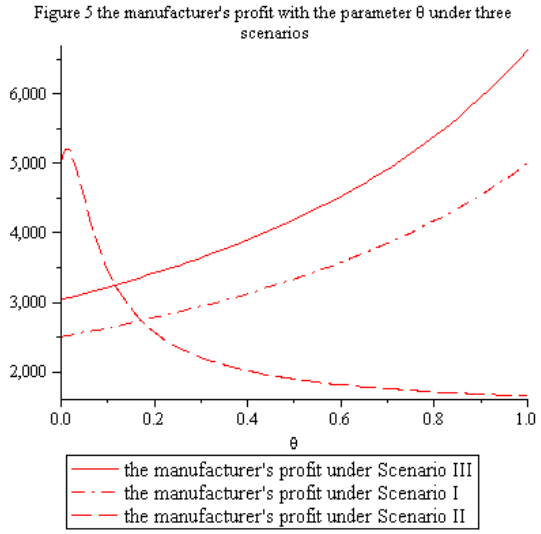
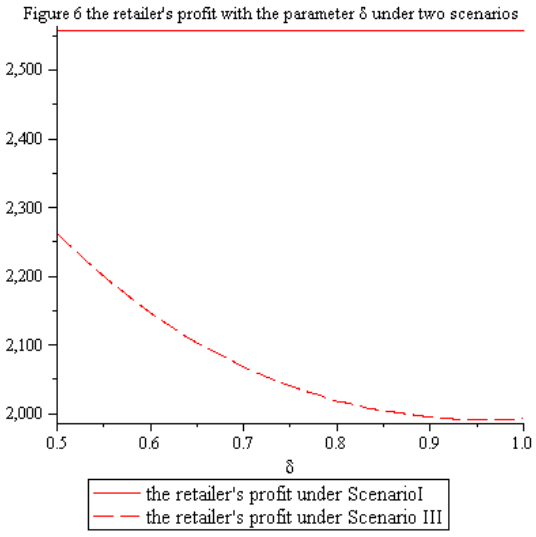
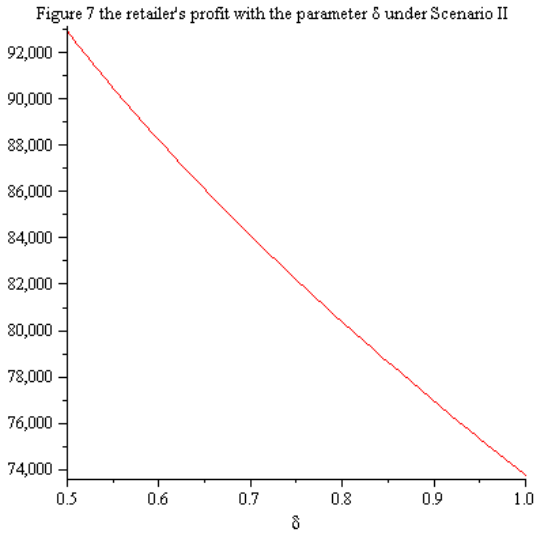
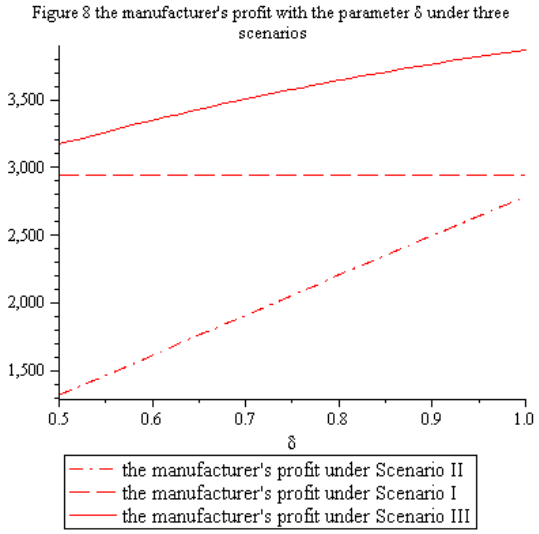


Fig. 6 and Fig. 7 present that the impact of the parameter δ on the optimal promotion strategy for the retailer. We find an interesting result in that the retailer prefers the scenario II to the scenario I, and the scenario III is the worst for the retailer, in contrast, the manufacturer's preference for the promotion strategy is $ScenarioIII \succ ScenarioI \succ ScenarioII$ (Fig. 8).







We finally compare all scenarios about the promotion strategy. We know no matter how the parameters change the optimal promotion strategy for the retailer is Scenario II in which the manufacturer provides a group-buying in the promotion period. That is to say, building a channel by the manufacturer is beneficial for the retailer, and the same result is got by Chiang (2003). When the value of the parameter θ is larger, the manufacturer prefer the scenario III which the retailer opens a group-buying in the promotion period; when the value of the parameter θ is small, it is best for the manufacturer to provide a group-buying by himself in the promotion period.

5 Conclusions

In the Internet era, more and more firms are introducing a Internet-based group-buying channel in addition to the traditional retail channel. In our paper, the group-buying is regarded as a promotion.

We consider a two-level distribution channel consisted of one manufacturer and one retailer. At the same time, a multi-period marketing decision problem including the promotion period or spread period and the regular sales period is studied. We have presented a game-theoretic formulation when in the market there is various promotion ways which could be chosen.

We get the optimal market strategies under three scenarios. This paper also find the manufacturer's and the retailer's optimal profits and which strategy is the best for the manufacturer or the retailer. We find an interesting result that under Scenario II, it is harm for the manufacturer and the retailer to have a large value of the parameter θ, but in other scenarios, the market participants expect a large value of the parameter θ. For the optimal promotion strategy, we find no matter how the parameters change, the optimal promotion strategy for the retailer is Scenario II, and when the value of the parameter θ is large, the manufacturer prefer Scenario III; and when the value of the parameter θ is small, it is the best for the manufacturer to provide a group-buying by himself in the promotion period.

Our model can be extended in many different directions. We could study a more complex

demand function rather than the linear type used in our model. We could consider a group-buying model which adopts a dynamic pricing. We could also introduce the competition, for example, there are two manufacturers to provide the product.

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