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Impact of social relationship on firms' sharing reward program

Wei Wei Mei Shu'e Zhong Weijun

(School of Economics and Management, Southeast University, Nanjing 211189, China)

Abstract: In order to make strategic decision on firms' sharing reward program (SRP), a nested Stackelberg game is developed. The sharing behavior among users and the rewarding strategy of firms are modeled. The optimal sharing bonus is worked out and the impact of social relationships among customers is discussed. The results show that the higher the bonus, the more efforts the inductor is willing to make to persuade the inductee into buying. In addition, the firms should take the social relationship into consideration when setting the optimal sharing bonus. If the social relationship is weak, there is no need to adopt the SRP. Otherwise, there are two ways to reward the inductors. Also, the stronger the social relationship, the fewer the sharing bonuses that should be offered to the inductors, and the higher the expected profits. As a result, it is reasonable for the firms to implement SRPs on the social media where users are familiar with each other.

Key words: social relationship; sharing reward program; incentive strategy; social commerce

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With the proliferation of social media such as Facebook, WeChat and Weibo, it becomes much easier for users to communicate with each other[1]. Also, firms' social media initiatives have strengthened firm-customer interaction[2]. According to the report of iResearch, almost 79.3% of users followed business accounts on WeChat and over 88.9% of users were willing to share information with friends (http://www.iresearch.com.cn/report/2393.html). Consequently, more and more enterprises have launched sharing reward programs (SRPs) to boost sales. For instance, many vendors in Taobao.com have launched sharing reward programs to encourage customers (inductors) to share business information with friends (inductees) through social media, such as Wechat, Weibo, QQ, etc. If the inductees successfully buy the products which the inductors recommended, the inductors will receive bonuses paid by the vendors. In addition, firms like Didi, Mobike, ele.me in China also offer users Hongbao to encourage them to share business information in their friends' circles of WeChat. Although SRPs have been adopted as an effective tool to acquire potential customers in many industries, they can also cost the firms much money since the bonuses are highly dependent on the successful purchases of the inductors[3]. Thus, it is of great significance to make managerial decisions on the optimal design of SRPs.

Our study is related to two streams of research. In the first stream, many researchers have explored the factors which may influence the users' sharing willingness. Wirtz and Chew[4] showed that the price and the customers' satisfaction had great impact on their sharing willingness. However, Ahrens et al.[5] proposed that the bonus difference between inductors and inductees also influenced the inductors when sharing information. Wentzel et al.[6] noted if the information contained more social emotions instead of business advertisements, users were more willing to share. Some researchers also found that users' sharing behavior had an impact on firms' performance. On the one hand, Armelini et al.[7] proposed that referral behavior reduced the users' perceived risk, which improved firms' profits. On the other hand, Tuk et al.[8] considered that sharing business information showed a lack of sincerity, which reduced the customers' intensions.

The literature in the second stream focuses on the design of the referral reward program. Biyalogorsky et al.[9] proposed that the basis of offering a bonus was the successful purchase in referral reward programs, which might avoid inductors' free riding. Also, the referral reward program is more effective than the low price strategy. Kornish et al.[10] considered the inductors' satisfaction degree and provided a strategy to design reward programs. On the basis of Kornish's study, Xiao et al.[3] took price into consideration and discussed the optimal design of reward programs. Mirzaei et al.[11] showed that compared with offering bonuses, the users on social media were more inclined to share their favorite firms' information for free. Arbatskaya and Konishi[12] proposed that when adopting referral reward program, firms can decrease the advertisement cost.

Although there is much similarity with each other, the sharing reward program differs from the referral reward program in many aspects. For example, the SRPs are often implemented on an e-commerce platform and on social media, and are highly dependent on a successful pur-

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Biographies: Wei Wei (1988—), male, graduate; Mei Shu'e (corresponding author), female, doctor, professor, meishue@seu.edu.cn.

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chase. However, as far as we have seen, little research has focused on sharing reward programs and none of them has taken both the users' shopping behavior and social elements into consideration. By integrating the two streams' research, we develop a nested game model based on Ref. [3] and concentrate on the scenario where only the inductors are rewarded. Our main aim is to figure out the best rewarding bonus and provide some guidance for firms when implementing SRPs on social media. Different from the previous research, we consider social media users' social relationships when studying the SRP. Moreover, the impact of social relationships on reward strategy is discussed.

1 Sharing Reward Program Model

Consider that the market consists of two types of customers: loyal customers and potential customers. The aim of the SRP is to utilize the loyal customers to acquire potential customers. Throughout the paper, we shall use "the inductor" and "the inductee" to refer to the loyal customer and the potential customer, respectively. In addition, there is one firm in the market selling products with price p to customers. For each customer, the evaluation of the product is V, where $V \sim U[0, 1]$. Whether the potential customers will purchase the products is dependent on product price p and trust cost h. Trust cost h represents the time and energy customers spend in trusting the vendors because of unfamiliarity with the products[13]. When $V \geqslant p + h$, they will make the purchase. In our model, price p is set to be an exogenous variable for two reasons. On the one hand, firms such as Taobao will not use discriminatory pricing strategy when adopting SRPs. On the other hand, if the firms lower their regular price, the loyal customers will not have the motivation to share information for bonuses.

Meanwhile, the firm will offer the loyal customers sharing bonus to encourage them to share business information with their friends, which will enhance the purchasing possibility. In order to obtain sufficient income to support SRP, we have to assume $p \geqslant 1 - h$. The constraint guarantees the existence of the optimal solution of the reward strategy. It also means that the firm cannot recoup the bonus cost by selling products when setting a low price. Thus, the following analysis is based on the previous assumption.

In the SRP, the firm will offer bonuses to encourage inductors to share business information and to persuade their friends to buy products. When the products are successfully purchased, the inductors will obtain the sharing bonus. Consequently, the SRP can be modeled as a nested Stackelberg game, as shown in Fig. 1. The inner game is between the inductor and the inductee. For the given bonus r, the inductor who is the leader first decides whether to make an effort e to share information. Then, the inductee decides whether to purchase the products. The outer game is between the firm, the inductor and the inductee, where the firm acts as the game leader. Once the inner game reaches equilibrium, the firm can determine the optimal sharing bonus r^*.

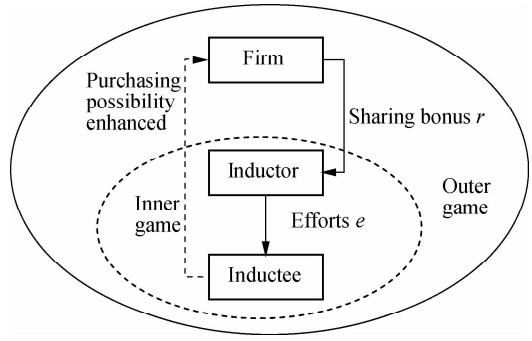

Fig. 1 The structure of sharing reward game

2 Equilibrium between the Inductor and Inductee

As illustrated before, each customer will purchase the products if $V \geqslant p + h$. In the SRP, consumers' trust cost h can be reduced by an inductor's efforts, such as explanation and persuasion. As a result, a consumer' trust cost h can be written as the linear function of the inductor's efforts, which is $h(e) = h_0 - \theta e$. Parameter h_0 shows a consumer's base trust cost and e is an inductor's effort. Parameter θ denotes the social relationship between inductors and inductees. It is clear that the closer the inductors and inductees are, the more likely the purchasing decision will be influenced[14]. Consequently, the inductees' purchasing possibility can be described as

$$P = \Pr\{V \geqslant p + (h_0 - \theta e)\} = (1 - p - h_0 + \theta e) \quad (1)$$

The inductor's income derives from the sharing bonus and relies on the inductee's successful purchase. Meanwhile, the inductors have to make some efforts to persuade the inductees, which will cost them some time and energy. So, the inductors' cost function is $C(e) = \frac{1}{2}ke^2$. Without loss of generality, we use the quadratic form to reflect the diminishing returns on effort investment, which has been widely used in previous literature[15]. The parameter k represents the sensitivity of cost to efforts. Assuming that the purchasing possibility and sharing bonus are given, the inductor's expected income is

$$E(S) = rP - \frac{1}{2}ke^2 = r(1 - p - h_0 + \theta e) - \frac{1}{2}ke^2 \quad (2)$$

Assuming the second-order partial derivatives of $E(S)$ with respect to e, we can find $\frac{\partial^2 E(S)}{\partial e^2} = -k < 0$, which means that $E(S)$ is strictly concave in e. Then, we can obtain the following proposition.

Lemma 1 Assuming that the sharing bonus is given,

the inductor's optimal efforts are $e^* = r\theta/k$, and the inductor's optimal expected income is $E(S^*) = r(r\theta^2 - 2h_0k - 2kp + 2k)/2k$.

Proof Take the first-order derivatives of $E(S)$ with respect to e and we obtain $\partial E(S)/\partial e = r\theta - ke$. Let it be zero and solve the equation, then we can calculate the optimal bonus $e^* = r\theta/k$. Substituting e^* into Eq. (2), the optimal expected income can be obtained.

From Lemma 1, we can see $\frac{\partial e^*}{\partial \theta} = \frac{r}{k} \geqslant 0$, $\frac{\partial e^*}{\partial r} = \frac{\theta}{k} \geqslant 0$, $\frac{\partial E(S^*)}{\partial \theta} = \frac{r^2\theta}{k} \geqslant 0$, $\frac{\partial E(S^*)}{\partial r} = \frac{2r\theta}{k} \geqslant 0$, which means that efforts and the inductor's expected income will increase if the social relationship or the bonus increases. It is reasonable to expect that the inductor will make more effort to persuade his friends to buy the products if the firm is willing to offer a greater bonus. When the social relationship between inductors and inductees is closer, the chance that the inductee will buy the products is greater, which means that the inductor will have more income.

3 Equilibrium between the Firm and Inductor

When the inner game reaches equilibrium, we can obtain the response of the inductor and inductee to bonus r. In the outer game, the firm, who is the leader, will set the optimal bonus r based on the inductee's purchase possibility and the inductor's optimal efforts. Assume that the firm makes the bonus decision at one stage, and the inductor only shares the information with one inductee. The revenue comes from the inductees' successful purchase and the cost is the reward offered to the inductors. Then, we can obtain the expected profit function of the firm as

$$E[\pi(r)] = LPp - LPr = \left[L\left(\frac{r^2\theta + k - pk - kh_0}{k} \right)(p - r) \right] \tag{3}$$

Meanwhile, the inductor will have the motivation to share the business information only because of his/her expected income $E(S^*) \geqslant 0$. So, finding optimal r to maximize the expected profits $E[\pi(r)]$ is equivalent to solving

$$\begin{aligned} &\max_{r>0} E[\pi(r)] = \left[L\left(\frac{r^2\theta + k - pk - kh_0}{k} \right)(p - r) \right] \\ &\text{s. t.} \quad \frac{r(r\theta^2 - 2h_0k - 2kp + 2k)}{2k} \geqslant 0 \end{aligned} \tag{4}$$

As it turns out, the optimal sharing bonus is dependent on the strength of the social relationship between the inductor and the inductee, which is shown in Proposition 1 and Proposition 2.

Proposition 1 If $\theta^2 < (2h_0k + 2kp - 2k)/p$, there is no need for the firm to adopt the SRP. If $(2h_0k + 2kp - 2k)/p \leqslant \theta^2 < (3h_0k + 3kp - 3k)/p$, the optimal bonus is $r^* = 2k(h_0 + p - 1)/\theta^2$, and the optimal expected profits are $E[\pi^*(r^*)] = L(p\theta^2 - 2h_0k - 2kp + 2k)(h_0 + p - 1)/\theta^2$.

Proposition 2 If $\theta^2 \geqslant (3h_0k + 3kp - 3k)/p$, the optimal bonus is $r^* = (p\theta^2 + h_0k + kp - k)/(2\theta^2)$, and the optimal expected profits are $E[\pi^*(r^*)] = (L(p\theta^2 - h_0k - kp + k)^2/(4\theta^2k)$.

Proof It can be verified that the SOC of the firms' expected profits is $\frac{\partial^2 E[\pi(r)]}{\partial r^2} = -\frac{2L\theta^2}{k} < 0$, which shows that $E[\pi(r)]$ is negative definite. Therefore, the Lagrangean is

$$\begin{aligned} Z(r;\lambda) = {} & L\left(\frac{r^2\theta + k - pk - kh_0}{k} \right)(p - r) + \\ & \frac{r(r\theta^2 - 2h_0k - 2kp + 2k)}{2k}\lambda \end{aligned} \tag{5}$$

Since the expected profits function is concave, the necessary and sufficient conditions for optimality are as follows:

1) $\frac{\partial Z(r;\lambda)}{\partial r} \leqslant 0$, $r \geqslant 0$, $r\frac{\partial Z(r;\lambda)}{\partial r} = 0$;

2) $\frac{\partial Z(r;\lambda)}{\partial \lambda} \geqslant 0$, $\lambda \geqslant 0$, $\lambda\frac{\partial Z(r;\lambda)}{\partial \lambda} = 0$.

The first-order conditions of the Lagrangean are

$$\frac{\partial Z(r;\lambda)}{\partial r} = \frac{r\lambda\theta^2 - h_0k\lambda - kp\lambda + p\theta^2 - 2r\theta^2 + h_0k + kp + k\lambda - k}{k} \tag{6}$$

$$\frac{\partial Z(r;\lambda)}{\partial \lambda} = \frac{r(r\theta^2 - 2h_0k - 2kp + 2k)}{2k} \tag{7}$$

In order to solve the problem, we have to discuss the value of parameter λ.

Case 1 $\lambda = 0$. In this case, let $\frac{\partial Z(r;\lambda)}{\partial r} = \frac{p\theta^2 - 2r\theta^2 + h_0k + kp - k}{k}$ be zero and solve the equation, we obtain $r^* = (p\theta^2 + h_0k + kp - k)/(2\theta^2)$. Substituting r^* into the constraint $\frac{\partial Z(r;\lambda)}{\partial \lambda} \geqslant 0$, namely, $\frac{\partial Z}{\partial \lambda} = \frac{(p\theta^2 + h_0k + kp - k)(p\theta^2 - 3h_0k - 3kp + 3k)}{8\theta^2k} \geqslant 0$. Due to $p\theta^2 + h_0k + kp - k \geqslant 0$, we have to hold $\theta^2 \geqslant \frac{3h_0k + 3kp - 3k}{p}$ to ensure that this case is valid. Substituting r^* into Eq. (3), we can obtain the optimal expected profits $E[\pi^*(r^*)] = \frac{L(p\theta^2 - h_0k - kp + k)^2}{4\theta^2k}$.

Case 2 $\lambda \neq 0$. In this case, combining $r\frac{\partial Z}{\partial r} = 0$ with $\lambda\frac{\partial Z}{\partial \lambda} = 0$ and solving the equations, we obtain $r^* = \frac{2k(h_0 + p - 1)}{\theta^2}$, $\lambda = \frac{-p\theta^2 + 3h_0k + 3kp - 3k}{k(h + p - 1)}$.

At the same time, we also need to impose $\lambda \geqslant 0$ to sat-

isfy the constraint. So, this case will be valid if $\theta^2 < \frac{3h_0k+3kp-3k}{p}$. Substituting r^* into Eq. (3), we can obtain the optimal expected profits $E[\pi^*(r^*)] = \frac{L(p\theta^2-2h_0k-2kp+2k)(h_0+p-1)}{\theta^2}$. Here, we also need to hold $\theta^2 \geqslant \frac{2h_0k+2kp-2k}{p}$ to ensure the profits are positive. Integrated with two cases, Proposition 1 and Proposition 2 can be proved.

From Proposition 1 and Proposition 2, we can find out whether to implement the SRP on social media and how much reward should be offered to the inductors are dependent on users' social relationships. If the social relationship is weak ($\theta^2 < (2h_0k+2kp-2k)/p$), there is no need to adopt the SRP on social media. However, there are two strategies for offering a reward when the users' social relationship is strong enough . If the social relationship $\theta^2 < (3h_0k+3kp-3k)/p$, the firm will set the optimal sharing-reward with $2k(h_0+p-1)/\theta^2$; otherwise, the inductors will be offered a reward of $(p\theta^2+h_0k+kp-k)/(2\theta^2)$.

In practical terms, there are many types of social media in the market, such as WeChat, Weibo, QQ, BBS, etc. The social relationship among users on different platforms also varies significantly. For example, the users' social relationship on BBS or forums is usually weak[16], since the users have not met in real life and cannot establish strong trust with each other. As a result, it seldom occurs to firms to implement SRPs on social media. We find that neither Mobike's nor Didi's SRPs have the sharing option for the "weak ties" social media.

However, the social network on Wechat mainly reflects real relationships in everyday life, which results in a relatively stronger relationship among users. Many firms' SRPs allow users to share information through Wechat. It suggests that when making the optimal reward strategy, the firm needs to take the type of social media and users' social relationship into consideration.

Meanwhile, we differentiate r^* and $\pi^*(r^*)$ with respect to social relationship θ and obtain the following proposition.

Proposition 3 The optimal sharing bonus is negatively correlated with the social relationship, and the firm's expected profits are positively correlated with the social relationship.

Proof If the social relationship is weak, we can find $\frac{\partial r^*}{\partial \theta} = -\frac{4k(h_0+p-1)}{\theta^3} < 0$ and $\frac{\partial \pi^*}{\partial \theta} = \frac{4Lk(h_0+p-1)^2}{\theta^3} > 0$. If the social relationship is strong, $\frac{\partial r^*}{\partial \theta} = -\frac{k(h_0+p-1)}{\theta^3} < 0$, $\frac{\partial E[\pi^*(r^*)]}{\partial \theta} = \frac{L(p\theta^2-h_0k-kp+k)(p\theta^2+h_0k+kp-k)}{2\theta^3k} > 0$. Integrated with two cases, Proposition 3 is proved.

Proposition 3 shows that the stronger the social relationship between the inductor and the inductee, the fewer bonuses the firm will offer to the inductor. In the SRPs, each inductor becomes a temporary salesman and is delegated to persuading his or her friends to buy the goods. It can be understood that the closer the inductor and the inductee, the stronger the persuasion effect of bonus per unit. Moreover, the stronger the social relationship, the great the purchasing possibility will be, which will bring more profits to the firm. As a result, the firm has no need to pay a high bonus to the inductor if the SRP is implemented on the social media where the users' relationship is very strong. The firm may also obtain more profits at the same time.

Proposition 3 provides the implication for managers that the SRPs should be implemented on the social media where users are familiar with each other. In China, WeChat and Weibo are the best choices. Also, it indicates that the loyal customers' social network can be viewed as a kind of social capital. This is the reason why Alibaba invests much money on e-commerce socializing. For example, at the recent China Spring Festival Gala, Alipay developed the "Lucky Card Collection" campaign to encourage the users on Taobao to make friends. Then, social capital can be converted into economic capital. So, the firms should take full advantage of social media when doing promotions.

4 Conclusion

With the popularity of social media, more and more firms have adopted sharing reward programs to enhance sales. The social relationship among users may have an impact on the SRPs. In this paper, we use the nested Stackelberg game model to find the optimal sharing bonus. Some interesting observations are given. First, the higher the bonus, the more effort the inductor will make to persuade his friends. Secondly, the optimal sharing bonus depends on the social relationship between the inductor and the inductee. Moreover, the stronger the social relationship, the smaller the sharing bonus should be offered to the inductor, and the higher the expected profits will be.

In future research directions, two issues are worth considering. First, when adopting SRPs, many firms also use mass advertisement to attract potential customers. So, a comparison between the mass advertisement strategy and the SRP can be made in future study. In addition, sharing business information also makes friends feel distrust. Consequently, the negative impact of sharing behavior should also be taken into consideration.

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用户间社交关系对企业分享奖励策略的影响

魏 尉 梅姝娥 仲伟俊

(东南大学经济管理学院, 南京 211189)

摘要: 为了帮助企业进行分享奖励计划的战略决策,建立了嵌套 Stackelberg 博弈模型刻画了用户的分享行为以及企业的奖励策略,同时计算出分享奖励计划的最优奖励金,分析了用户间社交关系强度的影响.研究发现,当奖励金越高时,分享者会更加努力地说服朋友购买商品.同时,企业在决策最优奖励金时应考虑用户间社交关系强度的影响.若社交关系强度较弱,则没有必要采用分享奖励策略;反之,企业有 2 种方式奖励分享者.此外,社交关系强度越强,企业给予分享者的奖励金越低,而此时获得的期望收益越高.因此,企业应该在用户之间相互比较熟悉的社交媒体平台开展分享奖励计划.

关键词: 社交关系;分享奖励策略;激励机制;社会化商务

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