The analysis of money-back guarantees in the presence of strategic consumers

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Abstract: This paper studies the benefits of money-back guarantees (MBGs) on the seller in the centralized supply chain under the presence of strategic consumers. Following that, supplier and supply chain performance are analyzed in the decentralized supply chain. In the presence of the strategic consumer behavior, the seller initially offers the MBGs in the selling season but may sell the leftover inventory at a salvage price without the MBGs at the end of the season. The strategic consumers choose the purchasing timing based on their expected surplus. We compare the models of the MBGs offer to no-MBGs in the selling season. By characterizing the rational expectation equilibrium, we find that the seller can charge a higher price in the case of the MBGs offer compared to no-MBGs. In contrast, the seller's stocking level is higher and thus the seller's profit has the corresponding result accordingly. The effects of the parameters in the model on the profit benefit are shown in the numerical analysis.
Key words: Money-back guarantees, strategic consumers, rational expectation

Introduction

20-40% of sales are returned from customers to the retailers and manufacturers in the US market (Guide et al. 2006, Dowling 1999, Vande Vate and Bedir 2005, and Mostard et al. 2005). Vande Vate and Bedir (2005) and Mostard et al. (2005) investigate the difference of return rates between direct and brick-and-mortar sales and find that the return rate is doubled in direct sales compared to that in brick-and-mortar sales. Mostard et al. (2005) shows that the bulk of returns usually happen in the second and third weeks.

An important problem on the ubiquitous sales return is whether and how the high return rate impacts the offering of money-back guarantees (MBGs) policy, which has been used as a major tool in modern retailing industry to promote sales and satisfy customers by making refund to the buyers who are not satisfied with the product or service. In his survey, Srinivasan (1995) shows that the MBGs can be expected to be offered by firms with high quality products which have a low probability of return after sale. Heiman et al. (2002) demonstrates that MBGs can help better satisfy customer needs if customers have uncertain fit with the products. Moreover, McWilliams (2012) shows that MBGs can help retailers with low quality products to gain profits in a competitive environment. However, the practical data on the Internet Retailer website (http://www.internetretailer.com/top500/list/), which gathers information about retails from the top 500 ranked business-to-consumer retailers in the U.S. and Canada based on the online sales including retail chains, catalogers, web-only merchants, brand manufacturers and digital content sellers, shows that the MBGs offers have been provided by all the sample retailers on all their products regardless of their consumer return rates. Obviously the ubiquity of MBGs in the practical business world of retailers cannot be well explained by these model studies.

Furthermore, some retailers do not make the MBGs offer during the entire process of market selling. For the products on sale with discounts, for example, MBGs are usually not

provided. The typical example is the hotel and air flight booking on www.hotwire.com, where sales are made with a lower price in the last minute but no money-back guarantees are offered. This policy of variable MBGs can have a high impact on the purchase plan of most customers, especially for those strategic customers who are usually educated and sophisticated, and willing to wait till the sales season to purchase the products with the possibly lowest price based on their expected larger surplus from the product (Cachon and Swinney 2009); but MBGs are often not offered for these products in the sales season.

From the customer's viewpoint, the possible opportunity of a deep discount price at the end of the selling season can provide a great benefit while MBGs at the start of the selling season with a full price also represents a practical benefit and convenience of the purchases. From the retailers' perspective, however, the MBGs offer increases the customer's willingness of purchasing the products at the full price and thus helps the retailer obtain a higher profit although the MBGs policy may increase the opportunity of product returns and thus reduce the sales and profit. Therefore, an important problem is whether to offer MBGs or not. The problem can be especially complicated when costs of product return on both sides of customers and retailers, product quality, sales price, original and residual values of the returned products are involved.

To address these issues, we construct an analytical model based on the principle of maximizing the retailer's profit. Our focus is to answering the following specific questions: is it optimal for the retailer to offer MBGs with the involvement of strategic customers? If yes, how does the benefit of the MBGs justify the complication and intraorganizational efforts invested to offer? How will the product quality (return rates), product value, sales price and the combination of the residual value of the returned product and transaction costs of the retailer and customer affect the retailer's benefit from the MBGs? How will the MBGs benefit the supplier (manufacturer) and whole supply chain in the decentralized supply chains?

We find that the MBGs always benefits the retailer when the strategic consumers exist in the market. That is to say, it is always better off for the retailer to offer MBGs to gain higher profits regardless of the product's return rates. On one hand, this result is in accordance with the practice from the real retailer industry (http://www.internetretailer.com/top500/list/), which shows that the MBGs offers have been provided by all the sample retailers on all their products without considering their consumer return rates; on the other hand, it contributes to the extant literature where academic community does not show the rationale of the ubiquity of the MBGs.

The justification of the MBGs offer is based on the retailer's benefit from the MBGs which is affected by the parameters in the system. It will be decreasing in product quality r and product value v, while increasing in sales price s and the combination of the residual value of the returned product and transaction costs of the retailer and consumer $c_r - t - t_c$. More interestingly, our results show that MBGs offer does not hurt the retailer with low quality product. In contrast, the retailer with lower quality product enjoys more benefit increase compared to no-MBGs than the one with the high quality product. Conventional wisdom suggests that MBGs will not be offered by the retailer with low quality product. Our result shows that this is not necessarily the case when the strategic consumers exist in the market.

The remainder of this paper is organized as follows: the literature is reviewed, followed by the section describing the model and analyzing the retailer's profit function. Then the results from a numerical analysis are shown. Last section concludes with a summary of answers to our research questions.

Related Literature

The offer of MBGs and the factors of affecting strategic consumer behavior have already attracted the academic community's attention in supply chain management. Many models have emerged to solve the optimal inventory level in the offer of MBGs and / or the presence of the strategic consumers.

One stream of research is related to the investigation of strategic consumer behavior. The seminal work includes Cachon and Swinney (2011), Swinney (2011), Cachon and Swinney (2009), Jerath, Netessine and Veeraraghavan (2010) and Su and Zhang (2008). Cachon and Swinney (2011) and Cachon and Swinney (2009) investigate the effect of the operating system of quick response and enhanced design of the product on the behavior of strategic consumers. They find that quick response and enhanced design of the product can mitigate the customers' strategic behavior but in different mechanisms: quick response can better match supply with demand with a reduction of the chance of a clearance sale so that it induces the strategic customers to purchase the product at a full price; whereas the enhanced design of the product makes the customers less willing to wait for a clearance sale by offering them products they value more. Jerath, Netessine and Veeraraghavan (2010) investigate the last-minute selling and opaque selling under the strategic customers. Su and Zhang (2008) study the effects of strategic customers on supply chain performance. Our work considers the effects of the MBGs on strategic customers' behavior. Specifically the MBGs can induce the consumers to be willing to purchase the products at a higher full price and thus enhance the retailer's profit.

Another stream of research is related to the MBGs affected by return rates. Return rates directly decreasing in product quality has attracted much attention from the academic community due to its wide existence in the practical retailing industry. For example, Guide et al. (2006), Dowling (1999), and Mostard et al. (2005) investigate the high return rates in the retailing world including direct sales and brick-and-mortar. Considering the high return rates, some researchers investigated how the products' return rates affect the offer of the MBGs by the retailers. Srinivasan (1995) shows that the MBGs can be expected to be offered by firms with high quality products which have a low probability of return after sale. Heiman et al. (2002) demonstrates that MBGs can help better satisfy customer needs if customers have uncertain fit with the products from the policy implications without considering the return rates. Moreover, McWilliams (2012) shows that MBGs can help retailers with low quality products to gain profits in a competitive environment. Our work focuses on the benefits of the MBGs in the presence of strategic customers and finds that the MBGs should be always offered for the seller to obtain a higher profit regardless of the return rates. More interestingly, our results show that the degree of the MBGs' benefit does be affected by the return rates but in a way that deviates from the conventional wisdom: it is increasing in return rates while conventional wisdom implies that it is decreasing in return rates. These results contribute to the MBGs literature to some extent: 1) they explain the ubiquity of the MBGs in the real retailing industry; 2) they provide a new direction for the retailers to offer MBGs related to the return rates.

Model Description

In this study, a single firm (retailer) sells product units to the market over two periods: the retailer sells the product at an endogenous full price with the MBGs in the first period, i.e., if the consumer is not satisfied with the product after purchase, it can be returned with full refund; following the first period, the retailer sells the product at a fixed markdown price s with no-MBGs in the second period if there are leftover products. We refer to the first period as the "MBGs" period and the second period as the "sales" or "salvage" period.

The retailer needs to decide the full price and initial stocking quantity to maximize his total expected profit, $\pi_r(p, q_r)$, where p is the announced full price and q_r the initial order stocking quantity, respectively. We assume that the production lead time is long enough that there is only one purchasing opportunity.

The unit procurement cost to the retailer is c $(c > s)$. The customer demand x is a random variable with distribution $F(.)$, complementary cumulative distribution function (cdf) $\bar{F}(.) = 1 - F(.)$, and density $f(.)$. Customers have homogeneous value v for the product.

Customers are strategic to the extent: they are willing to delay their purchasing if there is a possible discount price which helps them obtain a higher expected surplus. All customers arrive at the beginning of the selling season. Given the observed price and rational expectation of the initial stocking quantity, they make their decisions on whether to purchase the product immediately from the MBGs period or wait until the sales period based on the surplus obtained from each period, which is the function of the product's quality r and value v, announced full price p and the customer's return cost t_c and expressed as $r(v-p)-(1-r)t_c$ in the MBGs period; and is a function of the product's quality and value, the markdown price s, and the availability of the product in the sales period φ and expressed as $\varphi(rv-s)$ in the sales period, respectively. We assume that if consumers are indifferent between the two actions, then they purchase at the full price (Cachon and Swinney, 2011).

Benchmark Model

In this section, we will formulate the model with no-MBGs in the first period as our benchmark model. In this case, the customer's surplus from the first period is $rv - p_{nb}$, where p_{nb} is the price announced in the first period with no-MBGs, and from the sales period it is $\varphi(rv-s)$, respectively.

The following condition in (1) should be satisfied if the customer purchases the product in the first period:

$$rv - p_{nb} \geq \varphi(rv - s) \tag{1}$$

Now we turn to the retailer's point of view. When the retailer does not provide the MBGs, the per-unit revenue is p_{nb}. The retailer's profit function π_{nb} can be expected as follows:

$$\pi_{nb} = p_{nb}\left(\int_0^{q_{nb}} xf(x)dx + \int_{q_{nb}}^{+\infty} qf(x)dx\right) - cq_{nb} + s\int_0^{q_{nb}} (q-x)f(x)dx \tag{2}$$

Based on the first-order condition, the optimal quantity q_{nb}^* to maximize the retailer's profit will satisfy the following equation:

$$F(q_{nb}^*) = 1 - \frac{c-s}{p_{nb}-s} \tag{3}$$

The expression in (3) also represents the availability of the products in the sales period. Therefore the price announced by the retailer in the first period can be obtained as follows in (4) by inserting (3) into (1):

$$p_{nb} = s + \sqrt{(rv-s)(c-s)} \tag{4}$$

MBGs Model

When the retailer provides the MBGs, the customer has the opportunity to get money back if the product is not satisfying after its purchase in the first-period while there is no opportunity for the customer to return the unsatisfying product purchased in the sales period. In this case, the customer's surplus from the first period is $r(v-p)-(1-r)t_c$, and from the sales period it is still $\varphi(rv-s)$, respectively.

For the customer to purchase the product in the first period, the following condition should be satisfied:

$$r(v-p)-(1-r)t_c \geq \varphi(rv-s) \tag{5}$$

When the retailer provides the MBGs, the per-unit revenue is $p_r = rp+(1-r)(c_r-t)$, where t is the retailer's transaction cost for the customer to return the product, and c_r is the residual value of the product. We assume that the residual value c_r is higher than the sum of the transaction costs t_c from the customer and t from the retailer, respectively, i.e., $c_r - t - t_c > 0$; otherwise it is not worthy to offer the MBGs. The retailer's profit π_r can be formulated as follows:

$$\pi_r = p_r(\int_0^{q_r} xf(x)dx + \int_{q_r}^{+\infty} qf(x)dx) - cq_r + s\int_0^{q_r}(q-x)f(x)dx \tag{6}$$

where q_r is the quantity of the products. Based on the first-order condition, the optimal quantity q_r^* should satisfy the following condition:

$$F(q_r^*) = 1 - \frac{c-s}{p_r - s}. \tag{7}$$

Therefore,

$$\varphi = \frac{p_r - c}{p_r - s} \tag{8}$$

By inserting (8) into (5), the per-unit revenue can be expressed as follows in (9):

$$p_r = s + \frac{(1-r)(c_r - t - t_c) + \sqrt{(1-r)^2(c_r - t - t_c)^2 + 4(rv-s)(c-s)}}{2} \tag{9}$$

Let $\Delta = c_r - t - t_c$ represent the combination of the residual value of the returned product c_r, returning transaction costs of the retailer t and the customer t_c, respectively, then $p_r = s + \frac{(1-r)\Delta + \sqrt{(1-r)^2\Delta^2 + 4(rv-s)(c-s)}}{2}$.

The analysis of the MBGs and non-MBGs

Lemma 1 a) $p_r > p_{nb}$;

b) $q_r > q_{nb}$.

Proof. Suppose $p_r \leq p_{nb}$. Then based on (4) and (9), the following expression can be obtained:

$$\sqrt{(1-r)^2\Delta^2 + 4(rv-s)(c-s)} \leq 2\sqrt{(rv-s)(c-s)} - (1-r)\Delta \tag{10}$$

Based on (10),

$(1-r)\Delta \leq 0$,

which leads to a contradiction. Therefore, a) is proved. Following a), b) is proved based on equations (3) and (7).

Based on *Lemma 1*, *Proposition 1* is presented as follows accordingly.

Proposition 1 When strategic customers exist and there is no-MBGs offer in the sales period, it is always better off for the retailer to offer the MBGs in the full price period. That is to say, the MBGs offer will always help the retailer obtain a higher profit than no-MBGs.

Proof: Based on *Lemma 1*, the optimal quantity q_r^* and price p_r in the MBGs will be greater than q_{nb}^* and p_{nb} in the non-MBGs, respectively. Therefore the profit has the corresponding results, i.e., the profit will be higher in the MBGs.

Proposition 1 shows us the rationale that MBGs is ubiquitous regardless of the product quality or return rates since the profit is always better off in the MBGs.

MBGs offer under the strategic consumers

The major concern of the MBGs offer is whether the profit rise compared to no-MBGs is high enough to justify the invested effort and energy to coordinate the intraorganizations including the marketing, sales, operations and customer relation service. So the most interesting and challenging problem is posed by the degree of the benefit rise from the MBGs, η, which is defined as follows:

$$\eta = \frac{\pi_r - \pi_{nb}}{\pi_{nb}} \times 100\%.$$

In this section, we quantity the value of the MBGs offer based on our model. The goal of this analysis is to show the effects of product quality, product value, sales price and the combination of the residual value of the returned products and the transaction costs of the consumer and the retailer for the returns on the benefits of the MBGs offer, as opposed to no-MBGs by numerical examples.

We assume the demand follows a uniform distribution between 0 and 200, and set $c = 8, s = 5, r = 0.8, v = 20, c_r = 7, t = 2$, and $t_c = 3$.

The effect of product quality r on the value of the MBGs offer

Figure 1 shows the effect of product quality on the value of the MBGs offer against no-MBGs. From the figure, it is clear that the percentage of profit improvement under the MBGs vs. no-MBGs is decreasing in the product quality. This result is in accordance with our intuition: when the product quality is high, customers will have high satisfaction with the purchased product and thus the return rates will be low. In this case, there is limited room for the MBGs to help the retailer gain higher profit. Therefore the percentage will be decreasing. More interestingly, this result shows us that the lower the product quality is, the more the retailer is willing to offer the MBGs, which deviates from our conventional wisdom that MBGs is more likely to be offered for the high quality products. Therefore, it provides a new direction for the retailer to offer MBGs in the presence of strategic consumers.

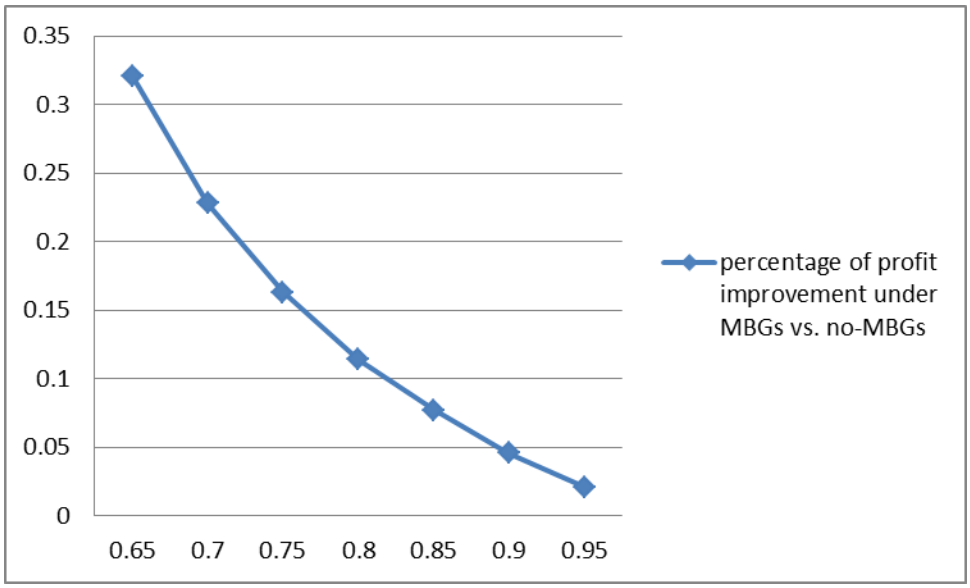

Figure 1 Effect of product quality r on the profit improvement under the MBGs vs. no-MBGs

The effect of product value v on the value of the MBGs offer

We use Figure 2 to show the effect of the product value v on the benefits of the MBGs offer against no-MBGs. The result shows that the percentage of profit improvement under the MBGs vs. no-MBGs is decreasing in the product value. It can be explained in this way: The higher the product value is, the more consumers would like to pay. Therefore, the retailer can charge more in both the MBGs and no-MBGs and thus gain higher profit. However, the no-MBGs will let the retailer achieve higher profit rise from the product value raise than MBGs, and thus the percentage of the profit improvement will be decreasing.

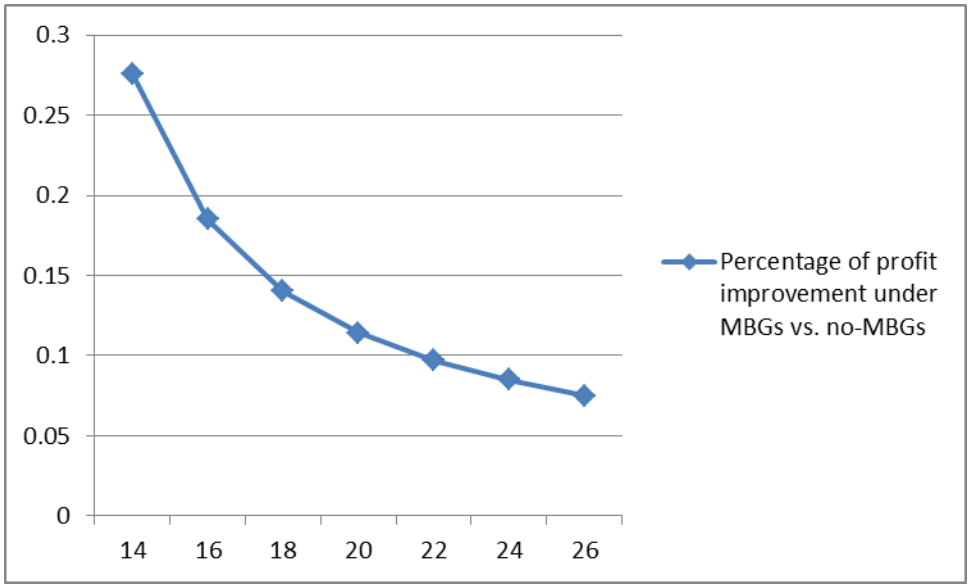

Figure 2 Effect of product value v on the profit improvement under the MBGs vs. no-MBGs

The effect of the sales price s on the value of the MBGs offer

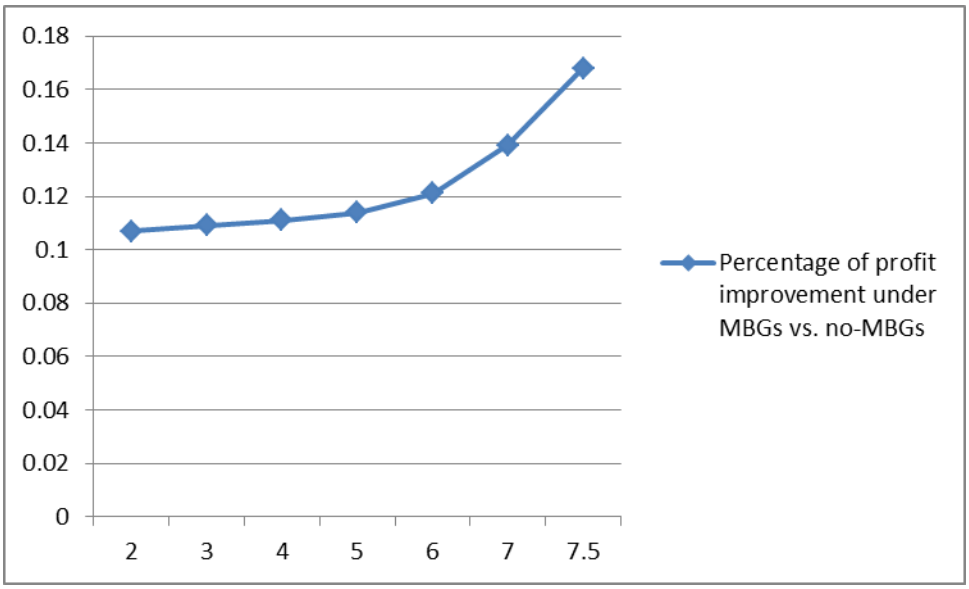

Figure 3 Effect of the sales price s on the profit improvement under the MBGs vs. no-MBGs

Figure 3 shows the effect of the sales price s on the benefits of the MBGs offer against no-MBGs. The percentage of profit improvement under the MBGs vs. no-MBGs is increasing in s. This result is because the higher sales price will induce the consumers to be willing to purchase the product in the full price period. From (2) and (9), we can see that the retailer can charge higher prices both in the MBGs and no-MBGs and thus gain higher profit. However, the MBGs will help the retailer gain a higher profit rise in the sales price than no-MBGs, and thus the percentage of the profit improvement will be increasing.

The effect of $c_r - t - t_c$ on the value of the MBGs offer

Figure 4 shows the effect of the combination of the residual value of the returned product c_r, returning transaction costs of the retailer t and of the customer t_c, i.e., $c_r - t - t_c$ on the benefits of the MBGs offer against no-MBGs. We see that the percentage of profit improvement under the MBGs vs. no-MBGs is increasing in $c_r - t - t_c$. It can be easily understood: From (4) and (9), we can know that the retailing price in the MBGs will be increasing in $c_r - t - t_c$ while it will be constant and not be affected by $c_r - t - t_c$ in the no-MBGs. Therefore the retailer's profit has the corresponding result accordingly. So the percentage of the profit improvement will be increasing.

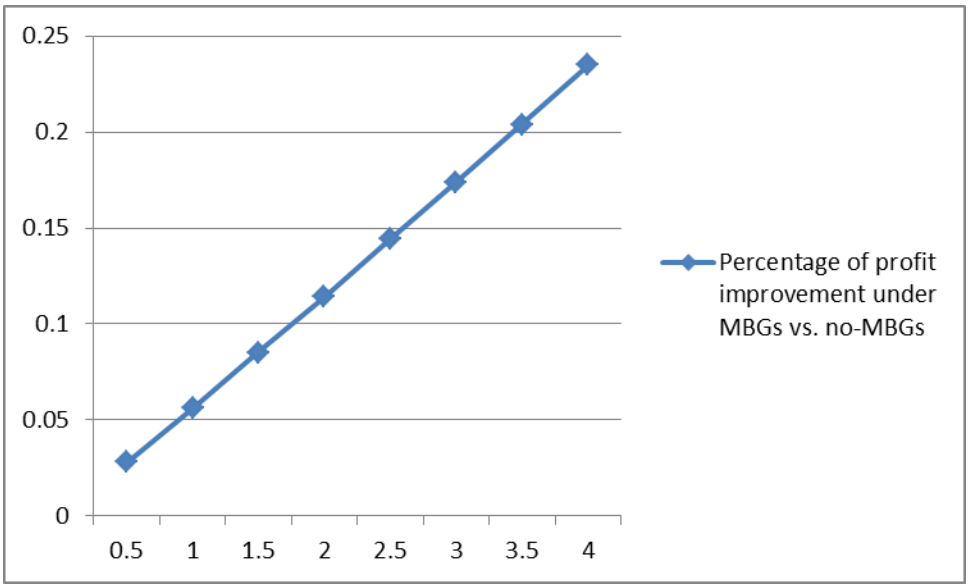

Figure 4 Effect of $c_r - t - t_c$ on the profit improvement under the MBGs vs. no-MBGs

Conclusion

Strategic consumer behavior and MBGs have attracted much attention recently. This can be seen from the literature review. However how the MBGs affects the seller's profit and then reversely affect the retailer's offer of MBGs in the presence of the strategic consumer have been overlooked in the supply chain management literature. This paper tries to fill this gap. Our basic premise is that the MBGs is offered when the strategic consumer purchases the product in the full price while it is not when purchasing it in the sales period. By doing so, the MBGs can induce the strategic consumer to purchase the product at the full price and not wait until the sales period to take the risk of stocking out. From the newsvendor seller's point of view, the MBGs can help the seller to charge the strategic customer a higher price although it may lower the revenue per unit. Therefore the seller can benefit from the offer of the MBGs when there are strategic consumers in the market.

Our line of inquiry can be extended in several directions in the future research. First, this research can be extended to the competition scenario when there are two retailers who provide different satisfying products to the strategic consumers. In this case, how will the MBGs affect the strategic consumers' behavior? Second, our work can investigate the complements and/or substitutes of MBGs and quick response. Quick response is widely used in the chain when there are strategic customers. If the MBGs are adopted together along with quick response, whether will the profit be higher or lower than the sum of the profits obtained from the cases adopting them separately? If higher, we call them complements; otherwise, they are substitutes. In general, we believe that the MBGs and strategic consumer behavior are fruitful research topics.

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