Optimal Decision of Exploding Offer based on Consumer Search Model

Lei Wang
School of Economics Shandong University, Jinan, Shandong, China

Keywords: Exploding Offer, Free Recall, Consumer Search.

Abstract: Exploding offer becomes more and more popular business management strategy among firms. This paper studies firm's choices of price and strategy (whether to choose exploding offer) as well as the welfare implications in duopoly competition based on consumer search model. Through backwards induction method, we find that both firms choose free recall (an exploding offer) with a small (large) search cost; and with a moderate search cost, one firm chooses free recall while the other chooses an exploding offer. Consumer surplus reaches its maximum if the search cost is low (high) and therefore both firms choose an exploding offer (free recall). In addition, this paper extends the basic model with two extensions, considering the existence of consumer's observational learning and limited comparability of price. Our conclusions may offer practical suggestions about business management.

1 INTRODUCTION

Exploding offer is commonly observed in many business cases. For example, in door-to-door selling, a salesman often claims that he wouldn't visit again and customers will never get his products otherwise they buy now; many e-commerce platforms, such as Taobao and Jingdong in China and Gilt, Rue Lala, HauteLook and Vinfolio in America, often conduct the strategy of exploding offer about a variety of goods, which is also called as flash sales. Although, there are still many firms just conducting the strategy of free recall only or in most instances, which allows consumers to return to their products freely.

In this paper, we explore under what conditions a firm prefers an exploding offer to free recall based on a duopoly model with consumer search and investigate the logic behind the choice of firms as well as the welfare implications. In consideration of worries about prices of exploding offer in people's mind due to their quick decisions, we discuss whether products are cheaper indeed when offered without another chance than when people are allowed to reconsider products freely. Our analysis shows that in equilibrium firms' choice depends crucially on the value of the search cost. Specifically, with a small (large) search cost, both firms choose free recall (an exploding offer); and with a moderate search cost, one firm chooses free recall while the other chooses an exploding offer. Moreover, the price is higher when both firms choose an exploding offer than that when both firms choose free recall; however, when the two firms choose different strategies, the price of a firm with an exploding offer is lower than that with free recall. In addition, consumer surplus reaches its maximum if the search cost is low (high) and therefore both firms choose an exploding offer (free recall).

The literature about exploding offer in consumer search model is scarce. With respect to consumer search, there are many works assuming products are homogeneous or heterogeneous, analyzing firm's pricing strategy (Ellison, Wolitzky, 2012), advertising management (Moraga-Gonzalez, 2011), and so on. While they don't consider firm's strategies of exploding offer and free recall. Durmus *et al.* (Durmus, et al, 2015) shows that exploding offer can promote sales of luxury goods, however they don't analyze consumer's search behaviors and firm's strategic choice of exploding offer. In contrast, our model studies under what conditions a firm prefers an exploding offer to free recall in consideration of consumer's search and compare prices under different strategies.

Wang, L.
Optimal Decision of Exploding Offer based on Consumer Search Model.
DOI: 10.5220/0011160600003440
In *Proceedings of the International Conference on Big Data Economy and Digital Management (BDEDM 2022)*, pages 87-91
ISBN: 978-989-758-593-7

2 MODEL AND METHODS

The introductions of model are as follows:

Firms. There are two firms, firm 1 and firm 2, producing horizontally differentiated goods at zero marginal cost which are labelled as product 1 and product 2 respectively. The two firms need to choose one of two strategies from exploding offer and free recall, as well as pricing their product with p_i, $i=1,2$. If the firm chooses exploding offer, consumers can buy the product only in their first search of this firm and have no chance to return. If the firm chooses free recall, consumers can buy the product whenever they want.

Consumers. Consumers search products sequentially and know their valuation u_i, $i=1,2$ about products in the search process. u_i is an i.i.d draw from the distribution function $F(u)$ on the support $[0,u_{\max}]$, and its density function is $f(u)$. The probability of consumers search firm 1 or firm 2 first is equally. When consumers reach a firm claiming exploding offer, they can buy this product at once, or continue to search another product without no chance to return the first firm. When consumers reach a firm claiming free recall, they can buy this product at once, or continue to search another product with the chance to return the first firm freely. Without loss of generality, we assume that the cost of the first search is zero and the cost of the second search is s.

The timing of the game is as follows. In the first stage, two firms choose exploding offer or free recall simultaneously and compete in prices. In the second stage, consumers begin to search and decide whether to buy and when to buy.

According to Armstrong and Zhou (2016), we define that

$$V(p_i) \equiv E_u[\max\{0, u_i - p_i\}] = \int_{p_i}^{u_{\max}} Q(u_i)du$$

$V(p_i)$ is the consumers' utility when consumers reach the product i, which is a decreasing function of p_i. If $V(a)=s$, $V(a)$ is the utility of the product i when consumers are indifferent to whether to continue searching or not.

When two firms choose the same strategy, the outcome is given as Armstrong and Zhou (2016). Specifically speaking, given the uniform distribution of $F(u)$, when two firms claim free recall together, the equilibrium price p_f satisfies $1-{p_f}^2=(1+a)p_f$, and when two firms claim exploding offer together, the equilibrium price p_{ex} satisfies the following equation: $p_{ex}(2-2s+{p_{ex}}^2)=1$.

Due to our analysis allowing for free choice for firms instead of prior strategy, we explore the asymmetry situation. When firm 1 chooses free recall and firm 2 chooses exploding offer, the equilibrium price p_{d1} and p_{d2} is decided by

$$\begin{cases} 1-{p_{d2}}^2=(1+a)(2p_{d1}-p_{d2}) \\ (1+p_{d1})(1-3p_{d2}+p_{d1}p_{d2})+2p_{d2}s=0 \end{cases}.$$

As depicted in Figure 1, p_f, p_{ex}, p_{d1} and p_{d2} are represented separately by thick dash line, dot dash line, fine dash line and full line.

Proposition 1. Compared to the price under free recall, the price under exploding offer is not cheaper all the time:

(a) The price when both firms choose exploding offer is higher than that when both firms choose free recall.

(b) In the asymmetric situation, the price under exploding offer is lower than that under free recall.

To understand the first point, we need to analyze the difference of consumers between free recall and exploding offer. When claiming exploding offer, firm i owns two groups of consumers: (i) who buy product i at once when reaching product i at the first time, (ii) who continue to search and buy product i after searching product j first. However, when claiming free recall, firm i owns three groups of consumers. Besides the two groups of consumers aforementioned, the third group is consumers who return to buy product i after searching product i and product j. Compared to the situation where both firms choose exploding offer, each firm has incentives to reduce price to attract the third group of consumers when both firms choose free recall so that the equilibrium price is lower. This point identifies with Armstrong and Zhou (Armstrong, Zhou, 2016). Nevertheless, Armstrong and Zhou (Armstrong, Zhou, 2016) assume two firms choose the same strategy ex-ante and explore whether a firm has incentives to deviate from the symmetry. In contrast, we allow for free choice for firms instead of prior strategy, discussing how firms choose strategies according to consumer search. As a consequence, we get the second point in the proposition 1.

The intuition of the second point is as follows. In the situation where firm i chooses exploding offer and firm j chooses free recall, firm i always has incentives to conduct price-off promotions because its consumers would never return back once they

decide to continue searching. Theoretically, firm j can also price lower than firm i .If firm j prices products in this way, it will face more demand but too lower price, which reduces its revenue and can't lead to an equilibrium outcome.

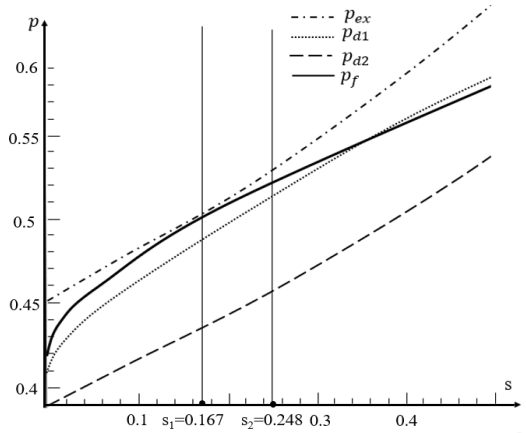

Figure 1: Price in different situation.

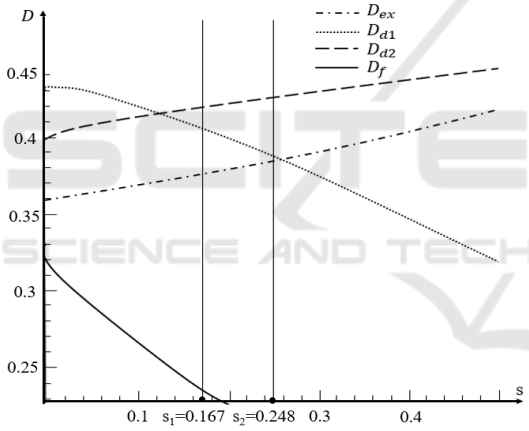

Figure 2: Demand in different situation.

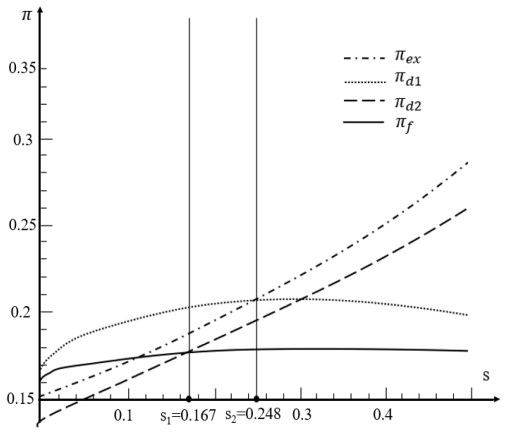

Figure 3: Profit in different situation.

Proposition 2. For horizontally differentiated firms, their choice of free recall or exploding offer relies crucially on the value of search cost. Concretely speaking,

(a) When $s \in [0, s_1]$, both firms choose free recall;

(b) When $s \in [s_1, s_2]$, one firm chooses free recall and another one chooses exploding offer;

(c) When $s \in [s_2, s_{\max}]$, both firms choose exploding offer.

To understand the first point in the proposition 2, we need to explain why firm i 's best response is always free recall no matter what firm j chooses when $s \in [0, s_1]$. When the search cost is very low, consumers incline to search more. If firm j claims free recall, firm i 's exploding offer will refuse these consumers who reach firm i first but continue searching, which is called the strategic effect of exploding offer. In order to attract more consumer to buy at once after their first search of product i , firm i must reduce its price so as to increase its demand. However, the promotion of demand can't compensate the loss caused by low price, which leads firm i not to choose exploding offer. If firm j claims exploding offer, the demand of firm i under exploding offer will be low because its high price (as depicted in figure 1) as well as the strategic effect of exploding offer aforementioned. The loss caused by low demand overweighs the promotion due to high price, which leads firm i not to choose exploding offer. In a word, firm i 's best response is always free recall no matter what firm j chooses when $s \in [0, s_1]$.

When $s \in [s_1, s_2]$ which is moderate, the consumers' motivation of searching is not too intense, which means that the strategic effect of exploding offer won't be too obvious. If firm j claims free recall, the price of firm i under exploding offer is lower compared to free recall, which will attract more consumers who buy at once as well as who continue searching firm i after visiting firm j . The promotion caused by high demand compensates the loss due to the strategic effect of exploding offer. If firm j claims exploding offer, the price of firm i under free recall is lower compared to exploding offer, which increases demand from the three groups of consumers aforementioned. The promotion of demand can't compensate the loss caused by low price. In a word, when $s \in [s_1, s_2]$, one firm chooses

free recall and another one chooses exploding offer.

When $s \in [s_2, s_{\max}]$, firm i 's best response is always exploding offer no matter what firm j chooses. If firm j claims free recall, the price of firm i under exploding offer is lower compared to free recall, which will attract more consumers who buy at once as well as who continue searching firm i after visiting firm j. The promotion caused by high demand compensates the loss due to the strategic effect of exploding offer. If firm j claims exploding offer, the demand of firm i under exploding offer doesn't decrease much because the high search cost deters consumers to continue to search. Considering the higher price under exploding offer compared to free recall, the promotion caused by high price compensates the loss of demand. As a result, firm i 's best response is always exploding offer no matter what firm j chooses.

Proposition 3. When search cost is low, the condition where both firms choose exploding offer is best for consumers; when search cost is high, the condition where both firms choose free recall is best for consumers.

The intuition of proposition 3 is as follows. When search cost is low, consumers feel more incentives to continue to search after the first visit. However, when both firms choose exploding offer, consumers will search less which avoids the decrease of consumer surplus. Although the price under both firms' exploding offer is high, the decrease of consumer surplus caused by high price is overweighed by the positive effect due to the search deterrence effect of exploding offer. When search cost is high, consumers will search little, which avoids the decrease of consumer surplus. What's more, the price competition is intense when both firms choose free recall together, which reduces the payment of consumers. The positive effect of low price compensates the weakly negative effect of consumer search.

3 TWO EXTENSIONS OF MODEL

3.1 The Existence of Observational Learning

In general, consumers' decisions are not always independent. For example, a consumer who plans to buy a new laptop, may begin his search with Dell if he observes his friend's purchase of a Dell laptop. In consideration of consumer's observational learning, how a firm and its competitor choose from free recall and exploding offer and how they price their products? Observational learning has received much attention in the study of firm's pricing strategy (Galeotti, 2010, Campbell, 2013, Kovac, Schmidt, 2014), while there are few studies investigating firm's choice from exploding offer and free recall under observational learning. In this part, we explore under what conditions a firm prefers an exploding offer to free recall based on a duopoly model with consumer search allowing for consumers' observational learning.

Firms. There are still two firms, firm 1 and firm 2, producing horizontally differentiated goods at zero marginal cost which are labelled as product 1 and product 2 respectively. The two firms need to choose one of two strategies from exploding offer and free recall, as well as pricing their product with p_i, $i = 1, 2$. with the goal of maximize their discount revenue with discount factor δ ($\delta \in [0,1)$). According to Daniel and Sandro (2018), nature chooses a state Ω from three possible states $\Omega = \{\Omega_0, \Omega_1, \Omega_2\}$ .The state $\Omega = \Omega_0$ is realized with probability $1-\rho$, in which the utility of product 1 and product 2 both draws from $G(u)$ (with associated density $g(u)$) on the support $[\underline{u}, \overline{u}]$. The state $\Omega = \Omega_1$ ($\Omega = \Omega_2$)is realized with probability $\frac{\rho}{2}$, in which the utility of product 1 (product 2) draws from $G(u)$ on the support $[\underline{u}, \overline{u}]$, while the utility of product 2 (product 1) is $u_b (u_b < \underline{u})$. That is to say, there are two states where one of the two products is worse than another.

Consumers. Consumer $i (i = 1, 2, 3...)$ arrives at the market sequentially, making his purchasing decision and leaving the market after observing his predecessor. Consumer $i (i = 1, 2, 3...)$ can only observe the predecessor's final decision without knowing his process of search and payment. Meanwhile, Consumer $i (i = 1, 2, 3...)$ can't know whether firms claim exploding offer or free recall unless he begins his search. The probability of the initial consumer search firm 1 (firm 2) first is $\frac{1}{2}$, while the probability of the rest consumers search firm 1 (firm 2) first is related with what they observe.

Proposition 4. Considering the existence of consumer's observational learning,

(i) compared to the price under free recall, the

price under exploding offer is not cheaper all the time, which is similar to proposition 1.

(ii) both firms choose free recall when the search cost is low; duopoly firms choose asymmetric strategies when the search cost is high.

The intuition of part (i) of proposition 4 is similar to proposition 1. As for part (ii), we show that both firms won't choose exploding offer together when the search cost is high, which is different from the conclusion of proposition 1. If firms both choose exploding offer, they will cut down the price to increase their demand of prior consumers so that following consumers will increase because of less search after observational learning, while the loss caused by low price can't be compensated by the promotion due to increasing demand.

3.2 The Existence of Limited Comparability

It's common that consumers often face limited comparability of price in their search process, and a number of papers study the relationship between this phenomenon with firm's competition using different models (Dow, 1991, Chen, et al, 2010, Piccione, Spiegler, 2012, Kutlu, 2015). However, our contribution is to explore under what conditions a firm prefers an exploding offer to free recall based on a duopoly model with consumer search in consideration of the existence of consumer's limited comparability of price, which current works haven't discussed about.

In this part, when both firms claim free recall, customers can return to firms freely to compare prices accurately; when both firms claim exploding offer, customers will be confused when they search the second product and forget the first product's price due to no chance of return, and they will purchase at random; when duopoly firms choose asymmetric strategies, customers also face limited comparability of prices. There are two conditions that consumers will choose to continue searching: (i) when the utility of the first product they search is lower than its price, customers will be unsatisfied with the first product; (ii) when the utility of the first product they search is higher than the payment of price and search cost, customers will be prone to search another product.

Proposition 5. Considering the existence of consumer's limited comparability, duopoly firms choose asymmetric strategies when the search cost is low; both firms choose free recall when the search cost is high.

In this extension, duopoly firms won't choose exploding offer together. Because if consumers aren't satisfied with the second product they search, they can't return to the first firm so that they will leave the market without purchase, which decreases the total demand of the markets. The loss caused by demand surpasses the gain caused by price, which explains why duopoly firms won't choose exploding offer together.

4 CONCLUSIONS

In this paper, we explore under what conditions a firm prefers an exploding offer to free recall based on a duopoly model with consumer search. Our analysis shows that in equilibrium firms' choice depends crucially on the value of the search cost. Specifically, with a small (large) search cost, both firms choose free recall (an exploding offer); and with a moderate search cost, one firm chooses free recall while the other chooses an exploding offer. Moreover, the price is higher when both firms choose an exploding offer than that when both firms choose free recall; however, when the two firms choose different strategies, the price of a firm with an exploding offer is lower than that with free recall. In addition, consumer surplus reaches its maximum if the search cost is low (high) and therefore both firms choose an exploding offer (free recall).

REFERENCES

Armstrong, M., Zhou, J. (2016). Search deterrence. *Review of Economic Studies*. 83(1), 26-57.

Campbell, A. (2013). Word-of-mouth communication and percolation in social networks. *American Economic Review.* 103, 2466–2498.

Daniel, G., Sandro, S. (2018). Consumer search with observational learning. *RAND Journal of Economics.* 49(1), 224-253.

Durmus, B., Erdem, Y. C., Ozcam, D. S., Akgun, S. (2015). Exploring antecedents of private shopping intention: the case of the turkish apparel industry. *European Journal of Business and Management*. 7(12), 64–77.

Ellison, G., Wolitzky, A. (2012). A search cost model of obfuscation. *Rand Journal of Economics.* 43(3), 417-441.

Galeotti, A. (2010). Talking, searching, and pricing. *International Economic Review.* 51, 1159–1174.

Kovac, E., Schmidt, R.C. (2014). Market share dynamics in a duopoly model with word-of-mouth communication. *Games and Economic Behavio*r. 83, 178–206.

Morraga-Gonzalez, J.L., Petrikaite, V. (2013). Search costs, demand-side economies, and the incentives to merge under bertrand competition. *The RAND Journal of Economics.* 44(3), 391-424.