Price Competition of Smartphones between Xiaomi and Huawei Based on Game Theory

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ARTICLE DETAILS

ABSTRACT

The Chinese smartphone market is intensively competitive. Huawei Honor copied the flash sales model of Xiaomi and sold products with E-Commerce. The analysis of Complete Information Static Games shows that the price competition between Xiaomi and Huawei has started. The main reason for the price war is that the products' horizontal differentiation is not significant. In addition, the price war has different impacts on producers, consumers and the middle-low end market. Xiaomi and Huawei Honor need to get a head start of 4G as soon as possible and constantly enhance product differentiation in order to achieve the final victory in Chinese smartphone market.

1. Introduction

Since fiercer competition in Chinese smartphone market, coupled with advances in production technology and lower production costs, the overall marketing behaviors of mainstream smartphone manufacturers started getting closer to the middle and low end market. In December 2013, as the leader in traditional mobile phone manufacturers, Huawei launched "Learn from Xiaomi" action and the brand of Honor operated independently. Honor and Xiaomi have a direct competition, which mainly displays in 2 aspects. (1) The product positioning is the middle and low end consumers who pursuit of cost performance. Under the similar configuration, Honor 3X (1888 yuan), Honor 3C (798 yuan), Honor 3X chang play edition (998 yuan) may be competition for Xiaomi 3 (1999 yuan), Red Rice (799 yuan), Red Rice note (999 yuan) respectively. (2) Honor copied Xiaomi "*flash sales model*" and sold with E-Commerce at the same data. Recently, they launched a series of competitive behaviors in the product prices and the new product release. With the deepening of China's market-oriented reform, price wars appear in several industries (G. Hua, Z. Liming, 2010; G. Huiling, 2015; H. Ying, 2015). As the vigorous development of Chinese mobile phone market, the mobile phone industry has become a new study hotspot (G. Rui, 2011; X. Wanli, W. Meijie & H. Junyuan, 2013; D. Jielin, C. Juan，2014; Z. Shuwei, L. Ping，2016; Z. Shuwei, L. Ping, 2017). Xiaomi and Honor competed intensified, particularly on pricing with similar configuration. The price war between Xiaomi and Honor will be launched? What causes and effects does the price war have on producers, consumers and the middle-low end market? Under the background of slower growth of smartphones and rapid expansion in the 4G phones in the long run, what strategies will Xiaomi and Honor choose? This article will focus on the above questions.

2. Model

2.1 Hypotheses

To study the competition between Xiaomi and Huawei clearly, some assumptions are necessary. (1) The price competition is often multiple times, so the price war is a t times repeated game $G(t)$. (2) The sales is the focal point for competing between Xiaomi and Honor, with sales R as the payoff. (3) Xiaomi and Honor compete mainly for middle-low end market in which the consumers pay more attention to cost performance. So price p is the decision the two players make. (4) Xiaomi's official website and Honor's official website shows weekly sales volume. In other

words, it is easy to obtain the payoff. The rationality of the hypotheses (2) is mainly manifested in two aspects. (a) Due to Xiaomi and Honor adopting hunger marketing model, the number of sales is mainly depends on the company's production capacity. (b) Xiaomi and Huawei can be regarded as the consolidator of industrial chain and the extension of the technical chain respectively, so the cost of Xiaomi and Honor is not comparable now. As a result, sales is a better indicator than quantity of sale and profits as the index of payoff. Therefore, the price war between Xiaomi and Honor is a repeated static games of complete information.

2.2 Demand for smart phones

The demanding function is the same in each period in the repeated game $G(t)$. As the demand for smartphones will remain growth in short time, the demanding curve in $t+1$ period shifts to the right section relative to that in t period. The demand of price p_t in t period is q_t, so q_{t+1} is equal to the demand of price p_{t+1} in $t+1$ period. Since taking the strategy of Not Cutting Price, $p_t = p_{t+1}$. $q_{t+1}^{'}$ is equal to the demand of price $p_{t+1}^{'}$ in $t+1$ period. As the smartphone is the normal goods, it is obvious that $p_{t+1} < p_t$ and $q_t < q_{t+1} < q_{t+1}^{'}$, if the player adopts the tactics of Cutting Price.

2.3 Complete information static state games model

To investigate the case in $t+1$ period, some instructions are as follows. (1) Only Xiaomi and Huawei Honor adopt "*flash sales model*", so set player 1 and player 2. (2) The strategic space of Xiaomi and Huawei are {Not Cutting Price, Cutting Price}. (3) The payoff matrix is shown in table 1. The sales in $t+1$ period is the sum of the sales in t period and the incremental sales in $t+1$ period, namely $R_{t+1} = R_t + \Delta R_{t+1}$. $\Delta q_{t+1} = q_{t+1} - q_t$ denotes that the incremental demand under non-price factor. After Xiaomi or (and) Honor cutting price, the incremental demand is represented by $\Delta q_{t+1}^{'} = q_{t+1}^{'} - q_{t+1}$. δ indicates the percentage of Xiaomi's sales volume in the total of incremental demand under non-price competition and $\delta \in [0,1]$.

Table 1: The payoff matrix of Xiaomi and Honor in static games of complete information

		Huawei Honor $i=2$	
		Not Cutting Price	Cutting Price
Xiaomi $i=1$	Not Cutting Price	$R_2^{t+1} = R_2^t + [(1-\delta)\times\Delta q_{t+1}]\times p_{t+1}$ $R_1^{t+1} = R_1^t + (\delta\times\Delta q_{t+1})\times p_{t+1}$	$R_2^{t+1} = R_2^t + [(1-\delta)\times\Delta q_{t+1} + (q'_{t+1}-q_{t+1})]\times p'_{t+1}$ $R_1^{t+1} = R_1^t + (\delta\times\Delta q_{t+1})\times p_{t+1}$
	Cutting Price	$R_2^{t+1} = R_2^t + [(1-\delta)\times\Delta q_{t+1}]\times p_{t+1}$ $R_1^{t+1} = R_1^t + [\delta\times\Delta q_{t+1} + (q'_{t+1}-q_{t+1})]\times p'_{t+1}$	$R_2^{t+1} = R_2^t + (1-\delta)\times\Delta q_{t+1}\times p'_{t+1}$ $R_1^{t+1} = R_1^t + \delta\times\Delta q_{t+1}\times p'_{t+1}$

In general, smart phones can be used in a long time, especially for middle-low end consumers. As a result, the purchase frequency is low as long as the phones meet the basic functional requirements. Therefore, the smartphones of Xiaomi and Huawei Honor are the durable goods. Due to the higher cost and the low likelihood of switching brands, the main tactics of Xiaomi and Honor is whether cutting price or not to compete for the incremented demand in $t+1$ period. Thus, each stage in the whole game will appear the tactics of {Not Cutting Price, Cutting Price} or {Cutting Price, Not Cutting Price}. At last, the equilibrium is the tactics of {Cutting Price, Cutting Price}. In other words, the price war between Xiaomi and Huawei Honor will be launched.

3. Results

3.1 The causes of the price war

As Chinese smartphone industry has a high degree of market concentration, the main cause of the price war between Xiaomi and Huawei Honor is the strong homogeneity of products. In the smart phone market, technological advances are usually beyond the needs of most consumers. Thus, for the middle-low end consumers, there's no significant difference in product quality between Xiaomi and Honor series. Given both Xiaomi and Honor series take electric business channels, the main difference is the horizontal difference in similar price, namely the consumers' different preferences. The Bowley differentiation model and the Bertrand price competition are used to analysis below.

At present, only Xiaomi ($i=1$) and Huawei Honor ($i=2$) sell smart phones through electric business channels, which belong to a typical oligopoly market. Take Xiaomi 3 and Honor 3X as an example, which are 2000 yuan mid-level smart phones and have certain a degree of replaceability. The price of Xiaomi 3 and Honor 3X are p_1 and p_2 respectively, with the linear inverse demand functions to represent the demand.

$$p_1 = a - b(q_1 + \theta q_2) , \quad p_2 = a - b(q_2 + \theta q_1) . \tag{1}$$

Here both a and b are positive. Parameter θ indicates the degree of substitutability between the two smart phone models and the smaller of θ means the greater differentiation. To obtain the demand function of Bowley model, converte the inverse demand function (1):

$$q_1 = \frac{(1-\theta)a - p_1 + \theta p_2}{(1-\theta^2)b} ; \quad q_2 = \frac{(1-\theta)a - p_2 + \theta p_1}{(1-\theta^2)b} . \tag{2}$$

The profits of two products are:

$$\Pi_1 = (p_1 - c)\frac{(1-\theta)(a-c) - (p_1 - c) + \theta(p_2 - c)}{(1-\theta^2)b} ;$$
$$\Pi_2 = (p_2 - c)\frac{(1-\theta)(a-c) - (p_2 - c) + \theta(p_1 - c)}{(1-\theta^2)b} . \tag{3}$$

By the first order condition of maximize (3), the price response curves can be calculated.

$$p_1 = \frac{(1-\theta)a + \theta p_2 + c}{2} ; \quad p_2 = \frac{(1-\theta)a + \theta p_1 + c}{2} . \tag{4}$$

when $\theta \to 1$ in formula (2), namely Xiaomi and Honor are homogeneous, the mobile phone performance and the subjective feeling of consumers are the same:

$$q_1 = \frac{p_2 - p_1}{b} ; \quad q_2 = \frac{p_1 - p_2}{b} . \tag{5}$$

If products are replaced, namely $\theta > 0$ in formula (3) and formula (4), the mix partial derivative is positive, namely $\frac{\partial^2 \Pi}{\partial p_1 \partial p_2} = \frac{\theta}{(1-\theta^2)b} > 0$. Thus, the price displays strategic complementarity, which means Xiaomi should adopt the corresponding strategy of lower prices if Honor cuts price. Then the equilibrium price is calculated:

$$p_1^* = p_2^* = c + \frac{1-\theta}{2-\theta}(a-c) . \tag{6}$$

In the formula (6), when Xiaomi and Honor are homogeneous, namely $\theta \to 1$ and $p_1 = p_2 \to 1$, the price of the two companies is closer to the marginal cost and appears as the Bertrand price competition. When there is differentiation between Xiaomi and Huawei Honor, namely $0 < \theta < 1$ and $a - c > 0$, p_i is greater than c. In other words, the market equilibrium price is greater than the marginal cost and the companies have a positive profit under the condition of product differentiation.

As Xiaomi and Honor produce a variety of products, the solutions (prices, output, profits, etc.) are simple average. But this does not affect the results that product homogeneity leads to the price war.

3.2 The effects of the price war

The price war has different impacts on producers, consumers and the middle-low end market.

First of all, the price war brings more positive impacts to Xiaomi and Honor. In the short term, the price war stimulates the part of the potential demand and splits the market share of Samsung, Lenovo, Meizu and other mobile phone manufacturers.

Secondly, consumers benefit the most from the price war obviously, which makes the consumers enjoy the high cost performance of smartphones. In addition, Xiaomi and Honor continuously launch new products to increase the choice space of consumers. Assuming that the demand curve is $q_t = D_t(p_t)$, the consumer surplus is $\int_{p_t}^{\infty} D_t(x)dx$ in t period. In the $t+1$ period, the consumer surplus is $\int_{p_{t+1}}^{\infty} D_{t+1}(x)dx$ without cutting price or $\int_{p'_{t+1}}^{\infty} D_{t+1}(x)dx$ with cutting price. It's obvious that the price war increases the consumer surplus, namely $\int_{p_t}^{\infty} D_t(x)dx < \int_{p_{t+1}}^{\infty} D_{t+1}(x)dx < \int_{p'_{t+1}}^{\infty} D_{t+1}(x)dx$. Social welfare is the sum of the consumer surplus and the producer profits. The current price war is still in the initial stage in the middle and low end smartphone market. The degree of price competition is in the acceptable range of Xiaomi and Huawei. In a word, social welfare increases.

In the short term, the price war expands market shares of Xiaomi and Huawei and improves the concentration of Chinese middle-low end smartphone market. However, as user experience is more important and products are homogeneous seriously, the difficulty and the cost of company's innovation are increasing, which bring enormous pressure on the medium and small enterprises.

4. Conclusion

In fact, the price war between Xiaomi and Huawei Honor has begun, which is in accordance with the theoretical analysis. In the short term, the price war has more positive impacts on Xiaomi and Huawei, which makes enterprises gain more profit. However, cutting price is not the whole price war, which includes the technical costs, the scale cost, the channels, the services, the brands, related marketing strategies, etc. Xiaomi and Huawei still have their own concerns and the price war is just the start of the long-term competitiveness. As 4G phones are coming, Xiaomi and Huawei Honor need take 4G opportunities as soon as possible. Furthermore, the success of *flash sales model* will attract the entry of new firms continually. It's impossible for Xiaomi and Huawei to enjoy the profits alone from E-commerce. Only enhance product differentiation, can the enterprise achieve the final victory in homogeneous smartphone market.

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