Research on Price War of Payment Platform Based on Repeated Game-Taking Alipay and Wechat as Examples

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Abstract: Price war is an inevitable product of the market economy and is an important mean of stimulating market development. The development of the Internet financial market has brought about a new era of universal mobile payments. The price war between the two mobile payment giants - Alipay and WeChat - in this new era is of particular concern. As the battle between the two platforms gradually enters a white-hot stage, how they act to maximize their own interests has become a major focus of the Internet financial market. This paper explores the price war between these two payment platforms from the perspective of repeated games and makes preliminary assumptions based on the Bertrand model. Based on the findings and the context of the times, this paper suggests strategies for the development of both Alipay and WeChat which are aiming to promote the mobile payment platforms towards healthy competition in order to achieve a mutually beneficial and win-win market.

Keywords: repeated game, price war, prisoner's dilemma, mobile payment

1.   Introduction

With the further development and growth of the Internet financial market, the era of mobile payments and scenario-based consumption which is a new business operation have arrived. In the context of this new era, the battle about the mode of payments between the online giants WeChat and Alipay becomes even more intensifying. When mentioning online third-party payments, there is no doubt that Alipay is the traditional chief position and WeChat Payment as an up-rising star has risen rapidly in recent years. However, due to the huge amounts of users that WeChat itself comes with, WeChat Payment has influenced much on Alipay. Therefore, both of them are showing their strengths in order to attract users including the price war, a common tactic for both, which has become a focal point worth exploring. The main aim of both WeChat and Alipay is to enhance the stick of the users by a variety of discount rules that can benefit their users. However, price wars are not sustainable. The purpose of low-price competition is to cultivate consumer habits. But the key to getting users to develop habits and forming actual payment conversions is the construction of scenario capabilities, which is a key capability in the mobile internet era.

 There is currently a large amount of academic literature from both domestic and international scholars exploring the process and impact of price wars from a game theory perspective, mostly on

inter-firm competition and inter-state games. The game models created are quite personal. This report combines the research results of some domestic and international scholars in the past five years and analyses the price wars between the two giants, WeChat and Alipay, in the form of repeated games and their specific impacts.

Firstly, it is an analysis of foreign scholars on the application of game theory to price wars. Ryowska investigates the problem of optimal investment strategy for firms in a competition market by citing an example of a price war in which two competitors play a direct real options game [1]. Richie, based on the crude oil market heavily affected by the COVID-19 epidemic, uses the evolutionary game approach scientifically analyses the uncertain consequences of the Russo-Saudi price war and systematically analyses the impact of the crude oil price war through prices of daily futures and spot in three main crude oil markets [2]. Laszlo takes the gradual rise in recent years of 5G networks as the context. From the perspective of a consortium of partners established in multiple domains, Laszlo systematically analyses the factors to achieve reliable resource connectivity and the ability to deploy internally to achieve maximum coverage for users' volumes and uses theoretical knowledge of multiparty games to analyze the state in which the deployment of 5G networks reaches equilibrium modeled in terms of the interests of infrastructure providers [3]. On the other hand, Cardot and Boland rationally analyze the motivations that lead to price wars among well-educated price-setters through a more individual-specific perspective, learning that even though they all share a strong desire to avoid price wars, they often attribute aggressive pricing actions to competitors and that price-setters modify the definition of price wars in order to ensure that their behavior does not appear to constitute a price war [4]. Marta presents a theoretical framework of the price war phenomenon from a general equilibrium perspective, especially focusing on the production system, and explores whether its Nash-optimal production plan can eventually approximate a Nash-optimal production plan at the end of this war in response to changing price responses [5].

Then comes the specific analysis of domestic scholars on game theory in price wars. Shen takes the market price war of China's OTA (Online Travel Agency) as an example and selects three travel companies as the research objects. By analyzing the game process of the three parties and establishing the game matrix of the three, he explains the internal causes of the price war in the OTA market and puts forward relevant suggestions [6]. Based on the background of the rise of online data, Chen analyses the ideal Nash equilibrium of price wars from a game theory model and the problems related to the cockfighting game, the tiger-riding game and the verbal game in price wars [7]. Huang and Pu, in response to the limited rationality of competition in the "Internet + timeshare" market, which is characterized by continuous imitation, learning and improvement, constructed an evolutionary game model to reveal the game process of car rental application entering and exiting the market and seizing the market [8]. Wang introduces game theory to cloud manufacturing from a novel topic, cloud manufacturing service platform, and constructs a game model between manufacturing service providers and cloud manufacturing service platform under the implementation of penalty and non-penalty strategies for cloud manufacturing service platform. And Wang achieves a sub-game perfect Nash equilibrium [9]. Luo starts from the definition of price war-price war is an inevitable product of market economy and is an important part of marketing. On the game theory perspective, he establishes the Prisoner's Dilemma model and the Bertrand model to personalize the price war between the two sides, and summarizes the impact of rational and vicious price wars on the market economy [10]. Based on the price war competition between the takeaway catering industry in the era of big data, Kong studies the price war between Meituan Takeaway and Hungry which is also a application providing takeaway services from the perspective of game theory, and solves the Nash equilibrium and Pareto optimality of vendor financing from the dynamic game of the two in combination with the impact brought by the barriers of oligopoly [11]. Yao and Chen analyze the causes of low-price competition on e-commerce platforms by constructing a single-stage game model and a repeated game model based on the

background of Amazon's "defeat" in the Chinese market, and conclude that price, cost difference and discount factor are important bases for regulators to regulate uncontrolled low-price competition on e-commerce platforms. It also provides concrete policy recommendations for international competition in e-commerce in China based on the game model [12].

Based on the research results of domestic and international scholars in the past five years, game theory has been widely applied to price wars, and the Bertrand model has been widely used in the theoretical analysis of the game between two parties. This paper analyses the pricing of Alipay and WeChat based on the Bertrand model, and obtains the conclusion that the participants can get out of the prisoner's dilemma by using cold strategies to repeat the game.

2. Methodology

2.1. Assumptions

Oligopoly market: Alipay and WeChat are the only two platforms in the electronic payment field, forming an oligopoly in the market.

Homogeneous goods: Alipay and WeChat offer consumers no difference in services, and they are perfect substitutes for each other.

No productivity constraint: both Alipay and WeChat have the ability to monopolize the market and there is no situation where capacity falls short of demand.

Same marginal cost: the marginal cost of providing the service by Alipay and WeChat is the same and is a fixed constant.

2.2. The Underlying Theories

Based on the above assumptions, it can be deduced that when there is a difference in the price of platform usage between Alipay and WeChat, all consumers will choose the lower price (i.e., buy the service provided by the lower price); when the price of Alipay and WeChat are equal, consumers randomly use both platforms, and in this game, it can be simply assumed that half of the consumers use each platform.

This report analyses the pricing strategies of Alipay and WeChat based on the Bertrand model. For the sake of convenience, "Platform 1" is used to refer to Alipay and "Platform 2" is used to refer to WeChat.

Let the number of users who enjoy services provided by Platform 1 and Platform 2 be Q_1, and Q_2 perspectively. then Platform 1 and Platform 2 have the same marginal cost $MC_1 = MC_2 = C$, in an oligopolistic market, Platform 1 and Platform 2 face a common demand curve.

$$P = K - Q \tag{1}$$

$$Q = Q_1 + Q_2 \tag{2}$$

Where K is a fixed constant; P is the market price----the lower pricing in the two platforms.

Clearly, neither Platform 1 nor Platform 2 would choose to continue operation with negative returns, so it is reasonable to assume in this project that both platforms are operating in a state of positive return, and that $P \geq C$ constantly holds.

2.3. Discussion and Model Setting

On this basis, all cases are divided into the following three categories and the Nash equilibrium that can be achieved by a single price game between two platforms is discussed in relation to the one-off deviation property.

If both platforms are priced the same and both are greater than their marginal cost. In this case, a slight reduction in pricing by either platform would allow it to capture the entire market at a small loss of profit per service, resulting in a larger total profit. Therefore, both platforms have an incentive to reduce their prices at this point, which does not constitute a Nash equilibrium.

If both platforms are priced the same and both are equal to their marginal cost, In this case, both platforms have zero profit, and neither can benefit more from a unilateral change in pricing. Therefore, a Nash equilibrium is formed when both platforms are priced equally and both equal to marginal cost.

If the two platforms are priced differently and neither is less than the marginal cost. In this case, there is always an incentive for the players to change their strategies, so it cannot form a Nash equilibrium.

Combined with the above discussions, it is clear that if only a single game is considered, both platforms would theoretically be in a prisoner's dilemma, ending up in a Nash equilibrium where pricing equals marginal cost. However, the reality is far from this, as both Alipay and WeChat have been profitable in the long run.

Therefore, this project continues to investigate how Alipay and WeChat can get out of the prisoner's dilemma by means of repeated games. This project divides merchants into three pricing scenarios, of which there are $P_h > P_l > C$. P_h is the high price that will be set when players choose the strategy "Cooperation", P_l is a lower price that will be set when players choose the strategy "Betrayal", and C is the lowest price that will be set when players choose the strategy "Penalty".

3. Results and Discussion

3.1. Model Solving

Based on the above information, the payoff matrix for a single game played between Platform 1 and Platform 2 can be derived as follows.

Table 1: Pay off matrix between Wechat (Platform 1) and Alipay (Platform 2).

		Platform 2		
		Cooperation	Betrayal	Punishment
Platform 1	Cooperation	$(K - P_h)(P_h - C)/$ $2, (K - P_h)(P_h - C)/2$	$0, (K - P_l)(P_l - C)$	0, 0
	Betrayal	$(K - P_l)(P_l - C), 0$	$(K - P_l)(P_l - C)/$ $2, (K - P_l)(P_l - C)/2$	0, 0
	Punishment	0, 0	0, 0	0, 0

When the game is repeated, it is assumed that both parties adopt a cold strategy: "cooperate at the beginning of the game, and once betrayal is detected (including one's own betrayal), use a punitive strategy thereafter". Since the game is infinitely repetitive, we can choose any stage to calculate the conditions for reaching cooperation by deviating once from the nature of the game. Let the discounting factor be δ. Consider Platform 1, if all previous histories are (cooperative, cooperative), then the results are as following:

Benefits from the continued cooperation of Platform 1 can be calculated as:

$$(K - P_h)(P_h - C)/2 + \delta(K - P_h)(P_h - C)/2 + \delta^2(K - P_h)(P_h - C)/2 + \dots \tag{3}$$

Gains from the choice of betrayal in this game by Platform 1 can be calculated as:

$$(K - P_l)(P_l - C) \tag{4}$$

Therefore, Platform 1 remains cooperative on the condition that

$$(K - P_h)(P_h - C)/2 + \delta(K - P_h)(P_h - C)/2 + \delta^2(K - P_h)(P_h - C)/2 + \dots \geq (K - P_l)(P_l - C) \tag{5}$$

The solution is:

$$\delta \geq 1 - (K - P_h)(P_h - C)/\ (2(K - P_l)(P_l - C)) \tag{6}$$

In this model, the K, P_h, C, P_l are all constant values. Therefore, it can be concluded that when the discounted value is greater than a certain value, i.e., when the participants are all patient enough, the participants can get out of the prisoner's dilemma by playing a repeated game using a cold strategy.

3.2. Numerical Modeling

From the above, it is clear that there are nine combinations of pricing strategies adopted by both Platform 1 and Platform 2 (Alipay and WeChat): (cooperation, cooperation), (cooperation, betrayal), (cooperation, punishment), (betrayal, cooperation), (betrayal, betrayal), (betrayal, punishment), (punishment, cooperation), (punishment, betrayal) and (punishment, punishment).

In an efficient market, the two facts are clearly: Firstly, when one party adopts a cooperative attitude, the other party gains more by choosing betrayal than by choosing cooperation; Secondly, when both parties are priced equally, the higher the price, the greater the gain for both parties.

Accordingly, a numerical simulation of the payoff matrix for both parties can be carried out as follows.

Table 2: Numerical pay off matrix between Wechat and Alipay.

		Platform 2		
		Cooperation	Betrayal	Punishment
Platform 1	Cooperation	8, 8	0, 12	0, 0
	Betrayal	12, 0	6, 6	0, 0
	Punishment	0, 0	0, 0	0, 0

Bringing the real numbers into the above model (Figure 5-1) for solution shows that if both parties adopt a cold strategy, the conditions under which both parties can remain cooperative and get out of the prisoner's dilemma in an infinitely repeated game are

$$8 + 8\delta + 8\delta^2 + \dots \geq 12 \tag{7}$$

The solution is:

$$\delta \geq 1/3 \tag{8}$$

It can be concluded that when the discount factor is not less than 1/3, both sides can maintain cooperation in an infinitely repeated game, i.e., sufficient patience is the key to enable both sides of a price war to get out of the prisoner's dilemma in an infinitely repeated game.

Therefore, according to the model's conclusion, both Alipay and WeChat should work together for long-term benefits. Instead of competing intensively at home, they should take the easy way out and moderately explore foreign markets to implement the concept of open development. In the opening up of the fin-tech sector to the outside world, platforms can combine the way of bringing in and that of going out. By fully integrating advanced technology systems around the world with own payment methods in order to achieve high-quality transformation and upgrading, platforms could find user groups and expand their own scale while expanding trade in emerging markets globally. On the premise of stabilizing the domestic market platforms could also vigorously enhance digital innovation to develop service trade. By maintaining cooperation in an infinitely repetitive game, platforms could promote the flow of commodity elements, broaden financial openness and leading the opening up of new payment systems. It could maximize the interests of both sides while providing an important catalyst for China to build a high-level open economic system.

4.   Conclusion

Through the model design and solution results, the impact of the price war between Alipay and WeChat can be analyzed from three aspects: the enterprises, consumers and the surrounding industries.

Firstly, it is about the impact on the enterprises. This project can divide it into 2 categories, if Rational price wars occur, it will compress the normal profit of goods but increase the volume of payment transactions, bringing higher profits to both parties, and the habitual use of Alipay and WeChat by consumers increases the visibility of both parties. On the other hand, if extreme price wars just occurs, it can lead to a decline in the quality of payment methods on both sides, which can lead to zero or negative profits in the long term, constraining the development of both sides and disrupting the market order.

Secondly, it is about the impact on consumers. Rational price wars allow consumers to feel that the price is reasonable and the service is reliable, which effectively increases the competitiveness of both parties. Extreme price wars, on the other hand, will have a negative impact on consumers, as the low cost of products will reduce the quality of payment and service, delay information updates, thus reducing the consumer experience and damaging consumer interests.

Lastly, it is about the development of surrounding industries. The main aspect of a price war is to stimulate demand and increase consumption so as to further expand market share. Alipay and WeChat have thus continued to improve the internet financial market. In terms of consumer credit, Alipay launched Hua Chant and WeChat launched WeChat White Stripe; in terms of investment, Alipay launched BalancePay and WeChat launched Zero Money. The expansion of the branch industry has allowed Doublefa to expand each other's market power, while also driving a series of financial industries namely wealth management and funds to prosper and flourish.

To sum up, in order to avoid extreme price wars between Alipay and WeChat, this paper puts forward the following three suggestions based on the market situation in recent years.

Promoting product differentiation could increase the stickiness of consumers thus increasing consumer loyalty. Since the premise of a price war is product homogeneity, if one wants to avoid extreme price wars, a war with low profitability and high costs. On the one hand, manufacturers must try to make their products as distinctive as possible, starting with the various aspects of the product and focusing on the consumer, so that consumers are more attracted to the product's features than to the

price when choosing a product. On the other hand, manufacturers should cultivate consumers' loyalty, establish consumers' brand awareness and solidify consumer groups.

Additionally, platforms need to develop effective pricing strategies. Alipay and WeChat can develop corresponding product combinations and bundle sales with discounts above the cost price according to their own product characteristics. Through this strategy can not only promote some of the products that are not selling well, but also make the price of the products will not be affected too much, forming a cycle of healthy competition.

Lastly, both platforms which aim to promote technological innovation and improve business mechanisms could reduce the costs. In order to avoid sudden price wars on the other side, to cope with the needs of the future market and to maximize profits, both sides should always keep up with technological innovations and changes in operating mechanisms to reduce production costs. Through this action, in the face of a sudden price war by the other party, the costs will not have to be borne excessively and they will have the courage to face the provocations of the other party.

To sum up, for mobile payment platform, the price war, not only need effective strategies for keeping pace with the market development enterprise itself, the government also needs a stable macroeconomic regulation and control, through the policy method plan "red line", the development of the enterprise under the premise of guarantee the stable in market economy, appropriate use of price war to stimulate the economy forward, boosting economic development with high quality.

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