

Application of Game Theory Analysis in E-commerce Platform Pricing

Yalei Jiang^{1, a}

¹School of Management, Xi'an Polytechnic University, Xi'an, Shaanxi 710000, China

^ajiang1214636@163.com

Abstract: The impact of pricing strategy on the profitability of e-commerce platform is studied. First of all, based on the e-commerce platform, considering the interests of the platform, the seller and the buyer in the transaction process, it is of practical and theoretical significance to explore the strategic choice of e-commerce platform pricing from the perspective of game theory. Then, through research, it is found that the operation of the e-commerce platform has distinct life cycle characteristics, that is, the initial use of various subsidy strategies to attract the entry of sellers and buyers, and the medium-term use of asymmetric pricing strategies combined with external response and demand elasticity to ensure the effectiveness of the platform. Finally, when formulating pricing strategies, e-commerce platforms should actively implement the strategy of market-oriented operation, reduce the intervention of sellers and buyers, and ensure the stable development of e-commerce platforms.

Keywords: E-commerce Platform, Pricing strategy, Game theory, Asymmetric pricing.

1. Introduction

With the continuous development of the Internet, more and more enterprises have carried out product transactions through e-commerce platforms such as Taobao, JD and Amazon. There are three main bodies in the transaction process, the e-commerce platform providing transaction services, the seller of the settled platform, and the buyer of product consumption. Among them, the e-commerce platform provides services that match the seller and the buyer. It is a network trading intermediary and plays a cornerstone role in technology, products and trading systems. Online sales models generally include distribution models such as Tmall Supermarket, platform models such as flagship stores of various brands, and two mixed models. However, regardless of the sales model, the pricing of the platform is often critical. This is related to whether the platform can continue to develop well and whether buyers and sellers are willing to use the platform for a long time. In the distribution mode, the e-commerce platform purchases the product by itself and then sells it. At this time, the e-commerce platform has the pricing decision-making power of the product and the total profit of the sales. At this time, the e-commerce platform needs to consider the price of the same type of product on other online or offline platforms when pricing the product. At the same time, it is necessary to consider the acceptance of the buyer while ensuring its own interests. In the platform model, the e-commerce platform obtains benefits by collecting commissions paid by the seller. Therefore, when recommending product pricing and commission ratios, it is necessary to consider both the seller's interests and the buyer's acceptance. At the same time, it is necessary to ensure that the platform itself can also obtain certain benefits. Therefore, the pricing strategy of e-commerce platform often plays a decisive role in the development of the platform. This paper takes e-commerce platform as the analysis object, and discusses the pricing strategy of e-commerce platform through game theory.

When discussing the pricing strategy of e-commerce platform, we must first consider the market nature of e-

commerce platform. From the seller's point of view, the platform for selling products is not unique, and the products sold by themselves are not unique; from the buyer's point of view, there are not only platforms to choose from when purchasing products, and the types of products purchased are not unique, so the e-commerce platform belongs to the transactional two-sided market. The value of the e-commerce platform is similar to the Metcalfe rule, that is, the value of the platform is proportional to the square of the number of users using the platform. Based on this rule, in order to achieve sound development, the platform needs to attract new users and maintain the stability of old users. Under the premise that users use the platform for consumption and profit, the research on pricing strategy has important practical significance.

Secondly, it is necessary to consider the transaction process of the e-commerce platform. On the one hand, the platform provides the seller with a trading place that is not limited by time and space to reduce the transaction cost of the seller. On the other hand, it provides buyers with alternative commodity information and third-party distribution services, so e-commerce platforms often adopt a tilt pricing strategy. However, this strategy is only an economic concept, and in practical applications, it is still necessary to adjust the pricing of products or services in time according to the actual situation.

2. Literature Review

This paper mainly considers the pricing strategy of e-commerce platform under the characteristics of bilateral subjects, so it mainly reviews the existing literature from this aspect. At the same time, considering the sales model of e-commerce platform and the impact of platform activities on platform users, some of these two aspects are also sorted out. Johnson [2] et al., Hao [3] et al., Lu [4] et al., based on the background of e-books and paper books, compared the distribution model and platform model to corporate profits, pricing strategies and consumer perceptions. From their research, it can be concluded that in the case of product price

reduction, the buyer's stickiness to the platform increases, but what follows is the reduction of corporate profits and consumers' doubts about product quality.

As mentioned in the ' Metcalfe rule ', the e-commerce platform in the early stage in order to attract users, or during the key holidays to obtain greater traffic, will hold some discount activities, such activities will make the platform for the user traffic increases, but once the pricing imbalance during the event, will make the seller or platform interests. Existing research shows that the preferential activities of the platform will have a direct impact on the pricing strategy and profit of each member in the sales process [5]. Therefore, when the platform holds activities, it is based on the tilt pricing strategy, comprehensively considers the discount strength, and formulates a reasonable pricing strategy to positively help the development of the platform.

Different from the traditional unilateral market, the model of the e-commerce platform is two-way. At the same time, facing the seller and the buyer, based on this feature, Rochet et al. proposed that the pricing structure of the platform affects the trading volume of the platform by affecting the behavior of the user [6]. In this study, it was found that the demand elasticity of the bilateral subjects of the platform and the charging method showed a reverse relationship. In fact, due to the particularity of the e-commerce platform, the pricing strategy of the platform is affected by many factors, such as the demand for products, the substitutability of goods, the characteristics of the platform network itself, etc. But in general, the e-commerce platform itself is a network platform, which needs to adopt different pricing models in different life cycle stages. Li Lei believe that the pricing strategy adopted by the platform should be based on the life cycle of the current platform, so that different pricing strategies can attract users to the platform at different stages [7]. Armstrong proposed that the pricing strategy of the platform should fully consider the size of the cross-network externalities of each subject in the transaction process [8]. On the other hand, considering that the e-commerce platform itself is to adapt to the times and long-term development, Tirole proposed that the platform should pay attention to the drainage of new users and the maintenance of old users when formulating the overall development strategy [9]. He Yong proposed that in the early stage of the development of e-commerce platforms, the platform needs to consider its own 'oligarchy' characteristics, and face up to and deal with the relationship between monopoly and competition in the development process [10]. Considering that the initial stage of platform development needs to attract users through various preferential activities. At this time, the platform side basically gives up profits. Therefore, Zhang Jiangyang et al. proposed that the e-commerce platform has a certain relationship with finance [11]. In the stage of platform development, the relationship between the two should be used to solve the financial problems faced in the development process. In different stages of development of the platform, Sun Xuemin et al. proposed to integrate the idea of game theory into the pricing strategy of the e-commerce platform, and classified the needs of different subjects in the transaction process [12]. Considering that large e-commerce platforms have certain characteristics of ' oligarchy ', Xia Dejian et al. consider a strategy for formulating the platform charging system in the oligarchy mode [13].

Based on the current academic research on pricing strategies and the particularity of e-commerce platforms, this

paper considers the demands of different subjects of trading platforms and buyers and sellers in the transaction process, and combines game theory to explore the pricing strategies of different subjects. The pricing mechanism in the development process of e-commerce platforms gives some help.

3. Pricing Strategy Based on The Behavior of Each Subject

The previous description of the entire transaction process of the e-commerce platform involves three subjects, namely the seller, the buyer and the platform itself. The platform is in a dominant position. The platform attracts buyers and sellers to settle in by setting different strategies. At the same time, the platform sets different pricing strategies for buyers and sellers to obtain certain benefits. Due to the different needs of buyers and sellers, the pricing strategies of the platform for buyers and sellers should also be different. The following will discuss the pricing strategies for different behaviors of buyers and sellers.

3.1. Pricing Strategy for Sellers

When formulating the seller's pricing strategy, the platform needs to consider two aspects: whether it can attract sellers and whether the platform can benefit from sellers. First of all, the e-commerce platform provides a place for sellers to trade, so it will collect a certain commission from the seller, which is also the largest way for the platform to obtain revenue. Secondly, consider whether the commission charged is reasonable, that is, it can attract sellers to settle in and the sellers will also make profits. Finally, in the charge of commission, but also consider the appropriate proportion of commission so that the seller can obtain a certain profit under the premise of commodity prices are also competitive. At the same time, the platform can also appropriately launch certain value-added services, such as product recommendation, store advertising, etc. In summary, the seller pricing strategy mainly includes two aspects, the normal seller settled and product sales commissions and specific value-added services.

3.1.1. Seller commission pricing strategy

Before entering, the seller will decide to enter or not to enter by comparing the commission of the platform and the expected profit. Therefore, the idea of game theory is used to establish a commission and profit model to give suggestions on the pricing strategy. Assuming that the platform has a good pricing strategy, there is an expected value L for the overall revenue of product sales. Assuming that the probability above the psychological expectation is P , the seller's sales profit is RU , and the probability under the psychological expectation is $1-P$, the corresponding seller's sales profit is RD . The seller's fee for entering the platform is a fixed value C , so the seller's expected profit for entering the platform can be expressed as:

$$P(RU-C) + (1-P)(RD-C)$$

That is, $P(RU-RD) + (RD-C)$, The result of $P(RU-RD)$ is positive. If $RD-C > 0$, the seller's expected profit after entering the platform is positive, and the seller will decide to enter the platform; on the contrary, when $RD-C < 0$, the seller will hesitate and calculate the overall expected profit value, that is, observe the relationship between $Abs(P(RU-RD))$ and $Abs(RD-C)$. In the early stage of platform development, due to the lack of buyer users, the network effect of the platform has not yet been exerted, that is, P infinitely approaches 0. At this time, if you want the seller to settle in, you must ensure that $RD-C$ is positive, that is, increase RD or decrease C .

Since the RD value is strongly affected by the network effect, it is necessary to reduce the cost C of the seller's entry in the early stages of voucher development. This is the strategy of free entry and even subsidy generally adopted when the platform was established. With the development of time, the platform network effect plays a role, and the P value gradually increases. The platform begins to increase the C value in order to make a profit, that is, the seller's entry fee strategy.

Through the use of game theory analysis, it is found that the seller's pricing strategy has obvious periodicity, that is, in the initial period, the platform needs to give up its own profits or even lose money to attract users to settle in, and the direct network effect will have positive benefits after reaching a certain standard.

3.1.2. Pricing Strategy of Value-added Service

When the platform develops steadily, the seller's entry rate begins to decrease. In order to obtain more benefits, the platform will launch some value-added services, which are collectively referred to as membership services. After the seller opens the membership service, it will obtain services such as product recommendation and top setting. The seller will increase his income by obtaining this service.

Assume that the income of the member seller is R_1 , the fee paid by the opening member is C_1 , the overall income of the member seller is $L_1 = R_1 - C_1$; the ordinary seller's income is recorded as L_2 . Only when $L_1 > L_2$, the seller will open the value-added service. With the decrease of C_1 , the number of sellers opening value-added services will gradually increase, but the corresponding platform policy will reduce the value-added fee for single sellers; on the contrary, with the increase of C_1 , the number of sellers opening value-added services will gradually decrease, but the corresponding platform policy will increase the value-added fee for single sellers. Therefore, when setting the value-added cost, it is necessary to consider the income of the single seller and the overall number of sellers opening the value-added service. The relationship curve is shown in Figure 1.

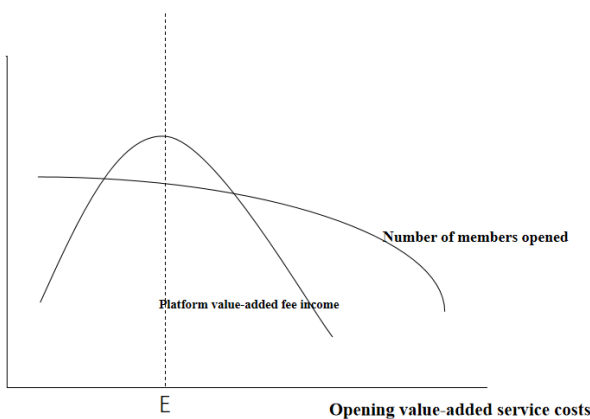


Figure 1. Changes in platform revenue and value-added service fees

Based on the above analysis, it can be concluded that providing value-added services to sellers is a way for the platform to obtain additional revenue, and also a way for sellers to obtain more revenue. Therefore, when formulating value-added service fees, it is necessary to consider the acceptance of sellers and make it reasonable. At the same time,

the value-added service content and the number of opened members also need to be limited, and it is necessary to follow the laws of the market to prevent too much.

3.2. Pricing Strategy for Buyers

When the platform formulates the buyer's pricing strategy, it also needs to consider two aspects: whether it can attract the buyer to register and use the platform for shopping, and whether the buyer can obtain a better shopping experience from the platform. Firstly, the e-commerce platform provides buyers with a full range of shopping places. In order to stabilize the user group, the platform commodity price must be competitive. Secondly, buyers must have a more efficient shopping experience when using the platform, such as the type of goods, product delivery, after-sales service, etc. Finally, also need some common promotions, coupons, etc. to attract users to shop. At the same time, the platform can also launch a certain value-added service, such as annual membership fees, members in the purchase of specific goods when the price is more favorable. In summary, the pricing strategy for the buyer mainly includes two aspects, platform service policies and specific value-added services that normally attract users.

3.2.1. Platform service strategy

When the platform formulates a pricing strategy for the buyer, it often does not directly benefit from the buyer, but rather sacrifices its own interests to provide services to the buyer, and the purpose of doing so is to retain users while attracting users to consume on the platform. In this paper, all the benefits obtained by the buyer from the platform are called utility values, which are mainly affected by the diversity of goods, the convenience of the platform website, and the price of goods. The premise that the buyer is willing to use the platform is that the utility value is high enough. Similarly, in order to improve the utility value, the benefits that the platform needs to pay will gradually increase.

The reasons that affect the buyer's utility value are expressed as (X_1, X_2, \dots, X_n) , and the probability that the above reasons affect the user is (P_1, P_2, \dots, P_n) . Among them, $P_1X_1 + P_2X_2 + \dots + P_nX_n = 1$. The model in which the buyer pursues utility maximization can be expressed as:

$$\text{Max } U(X_1, X_2, \dots, X_n)$$

In the early stage of the establishment of the platform, due to the small number of settled sellers, so the type of goods and personalized can not meet the needs of buyers, while the platform website early convenience and completeness is also insufficient. Therefore, in order to attract new users and retain old users, the platform needs to adopt a policy of subsidy to the buyer, so that the buyer's utility value reaches a certain threshold in the commodity price. With the increase in the size of the platform, the increase in the number of buyers and sellers makes the network effect is improved, the overall transaction is gradually market-oriented, the platform needs to pay more attention to the convenience of the platform website, making the transaction process more efficient buyers and sellers.

3.2.2. Pricing Strategy of Value-added Service

Different from the seller, the value-added service provided by the platform to the buyer is generally a membership package year, with a fixed annual fee. Within 1 year, the buyer can obtain a certain coupon or other service. On the whole, as long as the buyer consumes more on the platform, it can obtain more utility value than the annual fee. The way

the platform gains revenue is not a direct annual fee, but through this way to stimulate the buyer to generate more transactions on the platform.

When formulating the cost of value-added services, the overall strategy is consistent with the seller's value-added service fee. That is, when the annual fee is too high, the number of users purchased will decrease. When the annual fee is too low, the platform needs to pay. The benefits will become higher and more than the losses for the platform. The overall relationship curve is shown in Figure 2:

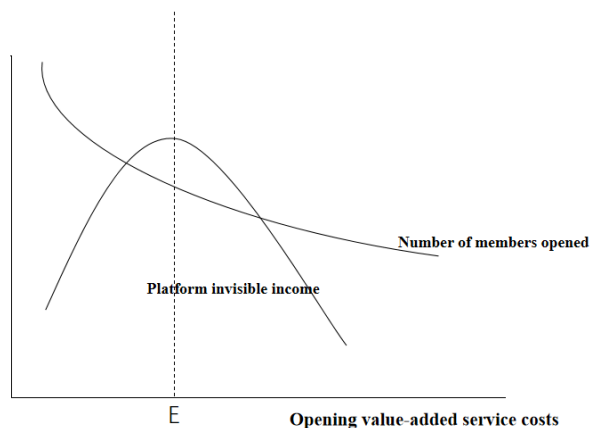


Figure 2. Changes in platform revenue and value-added service fees

4. Conclusion

With the continuous growth of online shopping users, e-commerce platforms have developed rapidly. At the same time, in practice, the sales model of e-commerce platforms faces many problems. Through the above discussion, the pricing strategy of the platform is not only related to the life cycle of the platform, but also to the main needs of each platform. In the initial stage, in order to attract users to enter, the platform enterprises often adopt free or subsidy policies. At this time, the pricing strategy gives priority to whether the types of goods in the platform are complete and whether the prices are favorable, and the profits of the platform itself need to be temporarily abandoned. In the growth stage of the platform, in the face of the two-sided subjects on the platform, the pricing strategy that the platform should adopt for each subject is related to the network externality, the demand elasticity and the substitutability of the subject. At this time, an asymmetric pricing strategy is implemented, that is, mainly from the seller to obtain profits, and at the same time, part of the profits is tilted to the buyer to do the corresponding preferential activities.

When formulating pricing strategies, e-commerce platforms should fully consider factors such as externalities, demand elasticity, and market competition, and then formulate exclusive pricing strategies for each subject in the transaction process. At the same time, in improving product exposure, provide product ranking, member recharge and other value-added services, e-commerce platform enterprises

should adhere to the principle of moderation.

Finally, the platform in the normal operation process needs to follow the laws of the market, especially when the buyers and sellers have adapted to the platform's trading rules, should minimize the platform's redundant operations, such as excessive advertising, limit some goods, the overall market should follow the law of survival of the fittest. Therefore, the platform should provide a more fair and just trading environment. Driven by profits, sellers will strive to improve the quality of their products and services, which will not only help to improve the reputation of the platform, but also attract more users, and provide favorable conditions for the platform enterprises to expand more diversified profit sources.

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