Research on the Competitive Strategy of Duopoly E-commerce Enterprises from the Perspective of Platform Economy
Based on B2C Online Retail Market in China

Yang Yao, Mengru Shen*, Jin Zeng, Zixu Shen

yaoyang@bjtu.edu.cn, mrshen@bjtu.edu.cn*, jzeng@bjtu.edu.cn, 21120991@bjtu.edu.cn

Key Laboratory of Transport Industry of Big Data Application Technologies for Comprehensive Transport, Beijing Jiaotong University, Beijing, China

Abstract—In some market segments of e-commerce industry, a duopoly competition situation of platform-based e-commerce enterprises has been formed. Based on the theory of platform economy, this paper analyzes the bilateral characteristics of e-commerce market, and defines the composition of market members and market structure. Secondly, a duopoly e-commerce enterprise competition model is built by combining Hotelling model, and empirical analysis is made by collecting relevant data of B2C online retail market in China. Finally, based on the results of mathematical empirical analysis, the conclusion is summarized and the corresponding management enlightenment is given.

Keywords- E-commerce; Duopoly competition; Platform economy; Bilateral market

1. Research background

In the era of digital economy, High market concentration in the e-commerce industry is natural and effective [1]. The platform transformation of e-commerce industry is an important trend [2]. The rise of dominant e-commerce platforms and accompanying alleged abusive practices may impair competition and cause harm to on-line consumers [3]. E-commerce enterprises have created new development space for themselves by using platforms to connect upstream and downstream of the industrial chain and gather production factors. With the development of platform-based e-commerce model, the platform economy has become the focus of attention of all parties. At present, platform-based e-commerce enterprises show diversified development trends, and the e-commerce platform gradually evolves from a single bilateral market to a cross-platform multilateral market [4], which means that platform-based e-commerce enterprises use the platform to break through the original market for cross-border operations.

With the rapid development and cross-border operation of platform-based e-commerce enterprises, e-commerce platforms operated by different enterprises will inevitably collide in a certain market segment, resulting in fierce competition for market share. The result of competition is that at most two platforms can win and occupy the vast majority of the market (each platform occupies more than 30% of the market share, and all platforms occupy more than 80% of the market share cumulatively), forming a duopoly. Based on this, this paper analyzes the characteristics of the two-sided e-commerce market and constructs a duopoly e-commerce enterprise

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competition model, and explores what strategies the platform-based e-commerce enterprise should adopt to maintain its competitive advantage and cope with the challenge brought by another opponent when the platform-based e-commerce enterprise forms duopoly. At the same time, this paper collects the market data of B2C online retail market in China in recent years, applies it to the established model, and makes an empirical analysis to ensure that the conclusions obtained have strong practical significance.

2. Competition model of duopoly e-commerce enterprises based on Hotelling model

As the bilateral market is one of the most important core features of platform economy, the e-commerce platform itself is the most typical bilateral market. Therefore, by combining the theory of platform economy, analyzing the market members and market structure in the bilateral market of e-commerce, it will help to build a more scientific competition model of duopoly e-commerce.

2.1 Analysis of members of electronic bilateral market

E-commerce bilateral market is a transactional bilateral market, including consumers, producers and platform-based e-commerce enterprises. There are observable transactions between consumers and producers. Platform-based e-commerce enterprises play an intermediary role in the transaction process and may collect registration fees from consumers or producers.

As platform-based e-commerce enterprises break through the original field and start cross-border operations, consumers in the bilateral market of e-commerce show multi-attribution characteristics, that is, consumers can join two or more platforms of the same type at the same time. On the one hand, the multi-attribute feature of users can promote the continuous innovation of e-commerce platform [5], on the other hand, it also intensifies the competition of platform-based e-commerce enterprises. The relationship among market members in e-commerce bilateral market is shown in Figure 1.

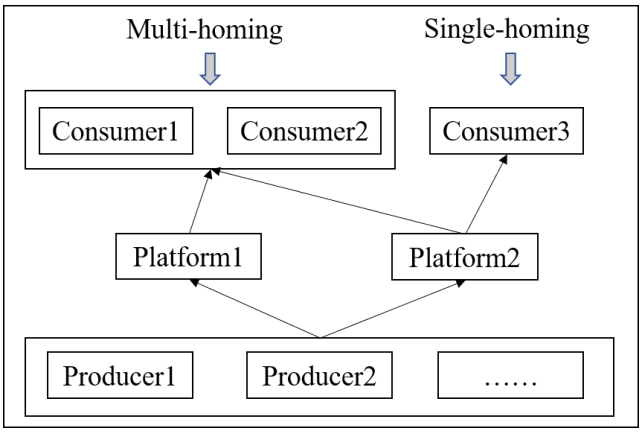

Figure 1. Membership relationship of bilateral market of e-commerce

As shown in Figure 1, in recent years, many governments have regarded the monopoly trading strategy as an uncompetitive means and prohibited platform-based e-commerce enterprises from implementing the monopoly trading strategy. Based on this, in the bilateral market of e-commerce, producers have the same multi-attribution characteristics as consumers, and producers can choose to settle in any platform according to their own wishes and strategies. Therefore, on the whole, the products and services on several e-commerce platforms in the bilateral e-commerce market can be regarded as being provided by a production cluster with multi-attribution characteristics. For consumers, although consumers generally have multiple attribution characteristics (such as Consumer 1 and Consumer 2), due to the network marketing strategy implemented by platform-based enterprises, some consumers (Consumer 3) become loyal users of a certain platform, resulting in inconsistent attribution behavior.

2.2 Analysis on the structure of e-commerce bilateral market

In the bilateral market of e-commerce, besides the e-commerce platform, the logistics service platform and payment platform are also an indispensable part to complete the transaction. The service platform and payment platform, like the e-commerce platform, also have obvious bilateral effects, connecting producers on one side and consumers on the other, thus realizing the closed loop of transactions. Based on this, the bilateral market structure of e-commerce is shown in Figure 2.

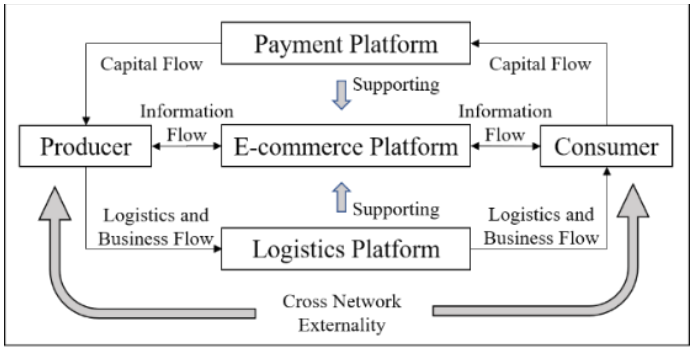

Figure 2. Electronic commerce bilateral market structure

As shown in Figure 2, the e-commerce platform, logistics platform and payment platform in the bilateral e-commerce market jointly support the completion of a transaction and realize the operation of logistics, business flow, capital flow and information flow in the market. In the traditional e-commerce market, e-commerce enterprises usually only focus on operating self-built e-commerce platforms, and then establish cooperation with other logistics enterprises and financial enterprises to ensure the integrity of services. However, with the platform economy gradually becoming the focus of attention in the industry, e-commerce enterprises begin to make platform transformation, expand cross-border businesses such as logistics and payment, and build their own logistics platform and payment platform to strengthen the network effect of enterprises and the control of industrial chain. In the bilateral e-commerce market, multiple platforms coordinate and overlap with each other, and the value spillovers caused by consumers will be transmitted among multiple platforms and market members, forming cross-network externalities together. The number of consumers will affect whether producers choose to join the

platform, and the number of producers will also affect consumers' choice whether to obtain goods or services in this platform.

2.3 Competition model of duopoly e-commerce enterprises

Through the analysis of the market members and market structure of the bilateral market of e-commerce, we have clearly demonstrated the relationship between the platforms and the market members in the market.

When a platform-based e-commerce enterprise has an e-commerce platform, a logistics service platform and a payment platform at the same time, it will rely on cross-network externalities, occupy a huge market advantage and form a monopoly. The monopoly's platform is maintained because of the expected utility of consumers [6]. With the rapid development of information technology, the competition among platform-based e-commerce companies is fierce, and the monopoly position is easy to change. Hotelling model is one of the core methods used in industrial organization theory to analyze the differential competition between platforms. The competition model of duopoly e-commerce enterprises based on Hotelling model is shown in Figure 3.

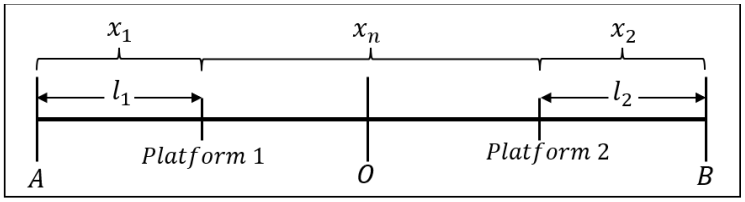

Figure 3. Competition model of duopoly e-commerce enterprises

As shown in Figure 3, suppose AB represents a certain market segment in e-commerce, and O is the center of the market. After a certain period of competition in the market, two platform-based e-commerce companies, which mainly operate Platform 1 and Platform 2, occupy most of the market share, forming a duopoly. l_1 represents the market share controlled by Platform1, and x_1 represents the loyal consumers owned by Platform 1; l_2 represents the market share controlled by Platform 2, and x_2 represents the loyal consumers owned by Platform 2. x_n represents the existing stock consumers with multi-ownership characteristics in the market, and it is also the core competition target of two platform-based e-commerce companies in the market. The symbolic assumptions of model-related variables in this paper are shown in Table 1.

Table 1 Variable hypothesis

Variable	Explain
n_c	Number of consumers on both sides of the platform
n_s	Number of producers on both sides of the platform
u_c	Consumer utility on both sides of the platform
u_s	Utility of producers on both sides of platform
α	Network externalities of consumers

$\acute{\alpha}$	Network externality of consumer's subordinate platform
β	Network externalities of producers
$\acute{\beta}$	Network externalities on producer's subordinate platform
v_c	Basic utility for platform producers
v_s	Basic utility of platform to consumers
P_s	Registration fees charged to platform producers
t	Indicates the degree of platform service differentiation.
t_c	Average consumption times of consumers
ρ_c	Average price of consumers shopping from the platform
f_c	Construction cost of platform access consumers
f_s	Maintenance cost to platform producers
R_a	Advertising revenue from platform operation
R_0	Other income from platform operation
R_1	Logistics revenue from platform operation
f_1	Average cost of logistics service providers per order
p_1	Average logistics price per order
r_a	Platform advertising revenue sharing ratio
r_0	Platform operating income rate of return

3. Empirical Research on B2C Online Retail Market in China

This paper mainly takes B2C online retail market in China as the observation object to study the competition strategy of duopoly e-commerce. As the earliest e-commerce market in China, B2C e-commerce market shows great vitality with flexible trading means, fast logistics and distribution, and low-cost and high-efficiency operation. 2019-2022Q3 China B2C online retail market share is shown in Figure 4 (Data source: www.analysys.cn).

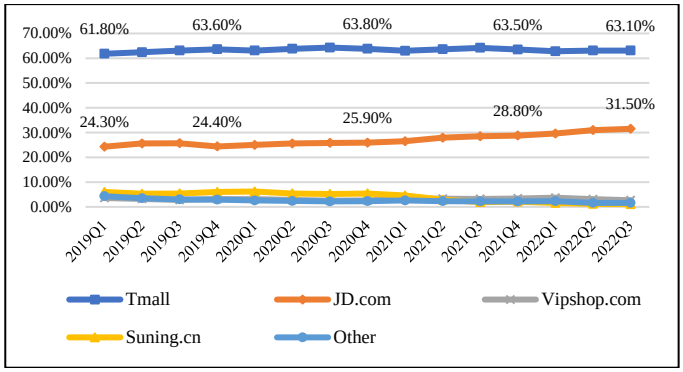

Figure 4. 2019-2022Q3 B2C online retail market share in China

As shown in Figure 4, in the B2C online retail market in China, Tmall and JD.COM jointly occupy more than 90% of the market share, forming an obvious duopoly. There are significant differences between Tmall and JD.COM. Tmall is an open third-party platform, which is mainly composed of goods sold by third-party brands. It basically has no trading activities, and its revenue sources mainly include advertising revenue, merchant registration fees and technical service fees. JD.COM is a self-operated platform, which mainly sells self-operated goods in JD.COM, and has a supporting logistics system. The income sources mainly include self-operated goods income, express logistics service income and advertising income. Based on the above model, it is assumed that Tmall is platform 1 and JD.COM is platform 2, which are distinguished by the upper right corner mark in the specific equation. Then the utility of customers and merchants of Tmall is calculated as shown in Equations (1)-(2); The utility of customers and merchants of JD.COM is shown in Equations (3)-(4), where $\delta = 0\ or\ 1$.

$$u_c^1 = n_s^1 \times (\alpha + \acute{\alpha}) - (\rho_c^1 + \delta p_1^1) t_c \quad (1)$$

$$u_s^1 = n_c^1 \times (\beta + \acute{\beta}) - p_s^1 \quad (2)$$

$$u_c^2 = v_c + n_s^2 \times (\alpha + \acute{\alpha}) - (\rho_c^2 + \delta p_c^2) t_c \quad (3)$$

$$u_s^2 = n_c^2 \times (\beta + \acute{\beta}) - p_s^2 \quad (4)$$

The advertising revenue R_a, other revenue R_0 and logistics revenue R_1 obtained from the operation of Tmall and JD.COM platforms are specifically shown in Equations (5)-(7), where $\delta = 0\ or\ 1$.

$$R_a = r_a n_c t_c \rho_c \quad (5)$$

$$R_0 = r_0 n_c t_c \rho_c \quad (6)$$

$$R_1 = \delta n_c t_c (p_1 - f_1) + (1 - \delta) n_s (p_1 - f_1) \quad (7)$$

To sum up, because there is a positive correlation between utility and the number of users, the number of producers and the number of consumers are replaced by corresponding utility.

Considering that the Hotelling model is balanced, it is concluded that the profit of Tmall platform is shown in Equation (8) and that of JD.COM platform is shown in Equation (9).

$$\begin{aligned}\gamma_1 = n_s^1 \times (p_s^1 - f_s^1) + (r_0 + r_a) n_c^1 t_c \rho_c^1 \\ = (p_s^1 \\ - f_s^1) \left\{ \left[\frac{1}{2} \right. \right. \\ \left. + \frac{t_1 (p_s^2 - p_s^1) + t_c (\beta + \acute{\beta})(\rho_c^2 - \rho_c^1 + \delta p_1^2 - \delta p_1^1) - v_c (\beta + \acute{\beta})}{2 t_1 t_2 - 2(\alpha + \acute{\alpha})(\beta + \acute{\beta})} \right] \\ + (r_0 + r_a) t_c \rho_c^1 \left[\frac{1}{2} \right. \\ \left. \left. + \frac{(\alpha + \acute{\alpha})(p_s^2 - p_s^1) + t_2 t_c (\rho_c^2 - \rho_c^1 + \delta p_1^2 - \delta p_1^1) - t_2 t_c}{2 t_1 t_2 - 2(\alpha + \acute{\alpha})(\beta + \acute{\beta})} \right] \right\}\end{aligned} \tag{8}$$

$$\begin{aligned}\gamma_2 = n_s^2 \times (p_s^2 - f_s^2) + (r_0 + r_a) n_c^2 t_c \rho_c^2 - n_c^2 f_c^2 + \delta n_c^2 t_c (p_1^2 - f_1^2) + (1 - \delta) n_s^2 (p_1^2 - f_1^2) \\ = \left[\frac{1}{2} + \frac{v_c (\beta + \acute{\beta})}{2 t_1 t_2 - 2(\alpha + \acute{\alpha})(\beta + \acute{\beta})} \right] \left[t_2 - \frac{t_2 v_0 (\beta + \acute{\beta})}{t_1 t_2 - (\alpha + \acute{\alpha})(\beta + \acute{\beta})} \right] \\ + \left[\frac{1}{2} + \frac{t_2 v_c}{2 t_1 t_2 - 2(\alpha + \acute{\alpha})(\beta + \acute{\beta})} \right] (r_0 + r_a) \left[\frac{t_1 t_2 - (\alpha + \acute{\alpha} + \beta + \acute{\beta})}{t_2} \right. \\ \left. - \frac{\beta + \acute{\beta}}{r_0 + r_a} + \frac{(\alpha + \acute{\alpha})(\beta + \acute{\beta}) v_c}{(r_0 + r_a)[t_1 t_2 - (\alpha + \acute{\alpha})(\beta + \acute{\beta})]} \right] - r_0 n_c^2 f_c^2 \\ + \delta n_c^2 t_c (p_1^2 - f_1^2) + (1 - \delta) n_s^2 (p_1^2 - f_1^2)\end{aligned} \tag{9}$$

Based on equation (8) and equation (9), the profit of Tmall platform and JD.COM platform is shown in equation (10):

$$\frac{\gamma_1}{\gamma_2} = \frac{t_1 + t_2 - (\alpha + \acute{\alpha} + \beta + \acute{\beta}) + r_a + 2 t_2 r_0}{t_1 + t_2 - (\alpha + \acute{\alpha} + \beta + \acute{\beta}) + 2 t_2 r_0} \tag{10}$$

The following conclusions can be analyzed through equation (10):

1) If t_1 and t_2 are increased, the profit of the platform will be further increased, indicating that the degree of service differentiation of the platform can significantly affect the revenue;

2) If a new profit model is introduced while keeping the externality of the cross-network unchanged, the profit of the platform will be greatly increased;

3) If the externality of cross-network changes, the greater the externality of cross-network, the higher the platform yield will be.

Based on the theory of platform economy and Hotelling model in industrial organization theory, this paper studies the competitive strategy of duopoly e-commerce enterprises in e-commerce industry, and selects B2C online retail market in China for empirical analysis. Through the competition model of duopoly e-commerce enterprises, it is concluded that service differentiation, cross-network externalities and profit model are the influencing factors that platform e-commerce enterprises need to pay special attention to under the duopoly competition pattern.

4. Conclusions and management implications

Based on the theory of platform economy and Hotelling model in industrial organization theory, this paper studies the competitive strategy of duopoly e-commerce enterprises in e-commerce industry, and selects B2C online retail market in China for empirical analysis. Through the competition model of duopoly e-commerce enterprises, it is concluded that service differentiation, cross-network externalities and profit model are the influencing factors that platform e-commerce enterprises need to pay special attention to under the duopoly competition pattern.

At the same time, combined with the mathematical empirical analysis based on B2C online retail market in China, it can be concluded that under the premise of duopoly, for an open platform similar to Tmall, more attention should be paid to the influence of cross-network externalities on the platform's profit margins, and the network externalities can be enhanced by enhancing the matching rate of users of the platform, so as to realize the transformation of multi-homed consumers with the help of network externalities and ensure the core competitiveness of the platform. For self-operated platforms like JD.COM, we should pay more attention to the service quality of the platform and the quality of the goods sold, so as to further improve our own brand advantages, thus enabling the platform to maintain a high profit margin. However, if we want to further expand the profit margin, we need to implement full coverage of commodity business categories, re-integrate and optimize our own supply chain capabilities, control operating costs, increase profit channels, and then enrich the profit model and improve the core competitiveness of the platform.

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