Rural E-commerce Income Distribution Model Based on Big Data Analysis

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Abstract

With the rapid development of the platform economy, the platform model has been gradually integrated into the industrialization of agriculture, and a variety of agricultural e-commerce platforms have emerged as the times require. The significance of studying the competition strategy of agricultural supply chain e-commerce platforms is to improve the market competitiveness of agricultural supply chain e-commerce platforms and to avoid the monopoly of the agricultural market. Improving the competitiveness of the platform can also promote the prosperity and development of the two-way circulation of the agricultural products supply chain, realize economies of scale and reduce production and transaction costs. In this paper, the e-commerce revenue distribution model is expanded by incorporating network externalities and user base utility. The competition model of e-commerce platforms in the agricultural supply chain is constructed by considering the different attribution situations of users and platforms. Given the sale of agricultural products and the return of agricultural materials, this paper analyzes the impact of platform differentiation and user network externality strength on the platform competition strategy by combining with the competition model and puts forward the corresponding strategy suggestions to make the supply chain e-commerce platform of agricultural products develop healthily and orderly.

KEYWORDS: *Rural e-commerce, Big data, Income model, Distribution model, Competition strategy*

1.Introduction

In the Internet era, farmers' production and management decisions generally have the characteristics of locality, crudeness, and lagging. Effective market information, starting from consumers, is often difficult to be truly "timely and effective" when it is fed back to farmers after a long or short period and layers of filtering. Therefore, there are obvious information lag and distortion in farmers' production and management decisions [1]. With the advantages of the Internet, rural e-commerce has greatly increased the frequency of information flow, extended the breadth and depth of information coverage, made it more efficient and convenient for farmers to obtain information, and made the information grasped by farmers more timely, comprehensive and close to the real situation. As a result, agricultural production activities can be carried out according to market demand, and even "production based on sales" can be achieved, which especially ensures the stable income of perishable agricultural producers [2].

As a representative of the new economy in the Internet era, the development of e-commerce has an effect on increasing the income of both rural and urban residents, but this effect is not consistent [3]. On the one hand, the long-standing urban-rural dual structure in China determines the gap between rural and urban residents in terms of human resources accumulation, capital availability, and per capita ownership of public goods. In addition, the "digital divide" between urban and rural areas still exists in some areas. The endowment gap between rural and urban residents also determines that the dividends they share from the development of e-commerce can not be homogeneous and equal. Therefore, the imbalance between urban and rural areas in the development of e-commerce may lead to the widening of the income gap between rural and urban residents [4]. Rural e-commerce will raise the market price of agricultural products, open up the information circulation channels between urban and rural areas, optimize farmers' production decisions, promote the free flow of labor force, and improve the allocation of urban and rural resources, all of which will

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narrow the income gap between urban and rural areas [5].

Therefore, it is of great theoretical significance to study the competitive strategy of e-commerce platforms in the supply chain of agricultural products under the intensified changes of information technology to the traditional supply chain of agricultural products [6]. This paper uses big data analysis to build an e-commerce revenue distribution model, which is suitable for the competition model of e-commerce platforms in the agricultural supply chain and enriches the research of platform competition strategy. Based on the actual situation of the agricultural supply chain e-commerce platform, this paper distinguishes the network externality strength of bilateral users, and the model constructed has more practical significance.

2.Construction of Agricultural Products Competition Model

It is assumed that in a linear region, there are e-commerce platforms $i=1,2$ of agricultural products supply chain located at both ends of the linear region. The two sides $k\left(k=A,B\right)$ of the access platform represent leading enterprises and farmers respectively. The products or services provided by competitive platforms are homogeneous, and users are evenly distributed in the ***k*** region according to the relationship between supply and demand, and can choose any platform to trade [7]. Where n_k^i allows represents the number of ***k***-side users that belong to a single platform $i\left(1,2\right)$, and N_k represents the number of ***k***-side users that belong to two platforms. c_k^i represents that there is no difference between the utility of ***k***-side users who belong to the platform and those who belong to the platform $i=1,2$, so the distribution interval of ***k***-side users who belong to the platform is $\left[c_k^1,c_k^2\right]$ [8]. The multilateral relationship of the gricultural products supply chain e-commerce platform is shown in Figure 1.

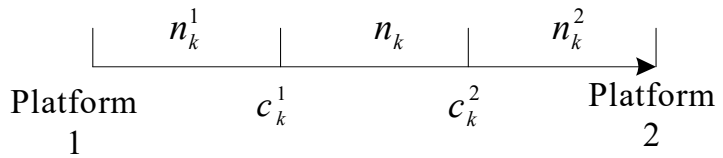

Fig. 1 Multilateral relationship of e-commerce platform competition

When agricultural products are sold, some farmers tend to belong to the self-marketing platform on the premise that they have joined the supply and marketing cooperative organizations. Because the self-selling platform charges registration fees for suppliers, to reduce transaction costs, farmers will not choose to join two platforms at the same time. Farmers are single ownership. Leading enterprises, as consumers of agricultural products, charge only transaction fees for the demand side of agricultural products on self-selling platforms and third-party platforms, so leading enterprises can choose e-commerce platforms at will. The attribution is partial multi-attribution. It is in line with the first case of the competition model of the agricultural product supply chain e-commerce platform [9].

3.Income distribution big data solution

According to the charging mode of the self-selling platform and the third-party platform, the platform competition model is substituted. Firstly, the net utility obtained by the leading enterprises on the e-commerce platform when they are partially multi-owned and farmers are single-owned is calculated. Secondly, the scale of users on the self-selling platform and the third-party platform is obtained through the no-difference formula of utility. Finally, when the revenue of the platform is maximum, the price set by the platform for users in equilibrium is calculated [10].

Firstly, the utility of different attribution behaviors of leading enterprises and farmers on the platform is calculated, and formulas (1) to (5) can be obtained after collation.

$$U_A^1=\theta_A^1U_0+\alpha_An_B^1-d_Ap_A^1-t_Ax_A \tag{1}$$

$$U_B^1=\theta_B^1U_0+\alpha_B(n_A^1+N_A)-r_B^1(n_A^1+N_A)-d_Bp_B^1-t_Bx_B \tag{2}$$

$$U_A^2=\theta_A^2U_0+\alpha_An_B^2-d_Ap_A^2-t_A(1-x_A) \tag{3}$$

$$U_B^2=\theta_B^2U_0+\alpha_B(n_A^2+N_A)-d_Bp_B^2-t_B(1-x_B) \tag{4}$$

$$U_A^{12}=\theta_A^1U_0+\theta_A^2U_0+\alpha_A(n_B^1+n_B^2)-d_Ap_A^1-d_Ap_A^2-t_A \tag{5}$$

Secondly, by using the formula $U_k^i=U_k^{ij}$ of utility indifference , C_A^1 can be obtained simultaneously by (1) and (5); C_B can be obtained by combining (2) and (4) ; C_A^2 can be obtained by combining (3) and (5) .

$$C_A^1=\frac{-\theta_A^2U_0+d_Ap_A^2-\alpha_An_B^2}{t_A}+1 \tag{6}$$

The scale of leading enterprises and farmers on self-marketing platform is as follows:

$$n_A^1 + N_A = \frac{\theta_A^1 U_0 + \alpha_A n_B^1 - d_A p_A^1}{t_A} \quad (7)$$

$$n_B^1 = \frac{(\theta_B^1 - \theta_B^2)U_0 + \alpha_B(n_A^1 - n_A^2) - d_B(p_B^1 + p_B^2)}{2t_B} + \frac{1}{2} \quad (8)$$

The scale of leading enterprises and farmers on the third-party platform is as follows:

$$n_A^2 + N_A = \frac{\theta_A^2 U_0 + \alpha_A n_B^2 - d_A p_A^2}{t_A} \quad (9)$$

$$n_B^2 = \frac{-(\theta_B^1 - \theta_B^2)U_0 - \alpha_B(n_A^1 - n_A^2) + d_B(p_B^1 + p_B^2)}{2t_B} + \frac{1}{2} \quad (10)$$

Revenue function of self-selling platform:

$$L_1 = d_A p_A^1(n_A^1 + N_A) + r_B^1(n_B^1 + N_B) + d_B p_B^1 n_B^1 \quad (11)$$

Third party platform revenue function:

$$L_2 = d_A p_A^2(n_A^2 + N_A) + d_B p_B^2 n_B^2 \quad (12)$$

Finally, with the goal of maximizing platform revenue, the simultaneous formula is used to calculate the partial derivatives of p_A^1 , p_B^1, p_A^2 and p_B^2, $\frac{\partial L_1}{\partial p_A^1} = 0$, $\frac{\partial L_1}{\partial p_B^1} = 0$, $\frac{\partial L_2}{\partial p_A^2} = 0$, $\frac{\partial L_2}{\partial p_B^2} = 0$.

The results show that the fees charged by the platform to two-sided users are depend on the level t_k of differentiation of the platform, the strength $\alpha_k (k = A, B)$ of network externalities and the average number d_k of transactions between users on different sides.

4.Experimental analysis

4.1. Experimental data

Third-party data monitoring agency (http://seo.chinaz.com) latest monitoring data shows that the self-selling platform and the third-party platform in the search platform includes data and Baidu estimated traffic value. Baidu estimated traffic, that is, Baidu estimated platform visits can be used as a reference value for the number of transactions between the two platforms. At the same time, the competition model is assigned with reference to the relevant literature on cross-network externalities and platform differentiation.

4.2. Analysis of experimental results

(1) Sale of agricultural products

The degree to which the platform differentiates its services to bilateral users is $t_A, t_B \in [1,2]$. Network externalities is $\alpha_A, \alpha_B \in [0,1]$. Transaction number is: $d_A = 200$, $d_B = 150$, and plug in P_A^2, P_B^2.

The trend of network externality intensity α_A and P_A^2 of leading enterprises is shown in Figure 2.

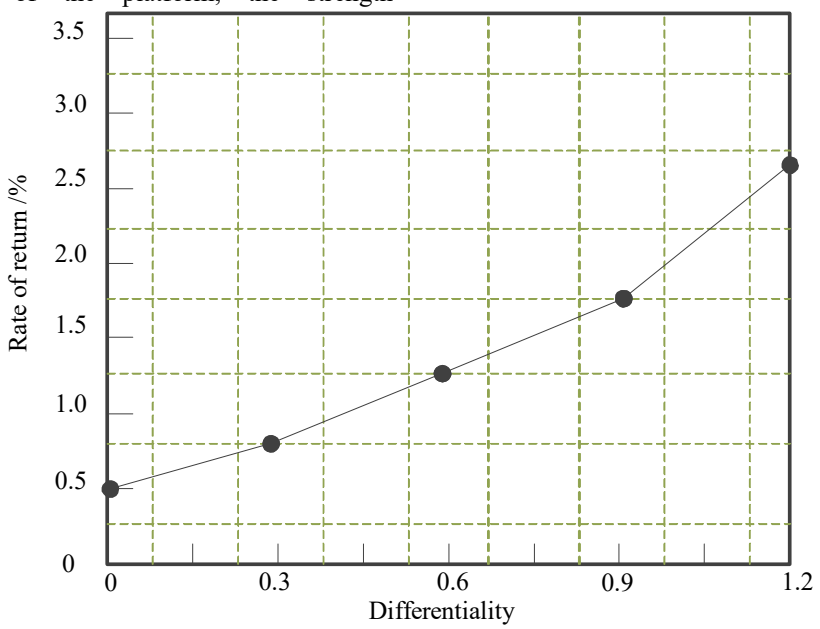

Fig. 2 Changing trend of network externalities

The transaction fee charged by the third-party platform to leading enterprises is positively correlated with the network externalities α_A of leading

enterprises. In a competitive market environment, the self-marketing platform and the third-party platform divide up the market through competition, and the strength α_A of network externalities of leading enterprises increases, which means that the utility of leading enterprises will increase due to the expansion of farmers'scale. The third-party platform will obtain higher profits by increasing the transaction costs of leading enterprises.

The degree t_A of platform differentiation perceived by leading enterprises and the trend P_A^2 change between them are shown in Figure 3.

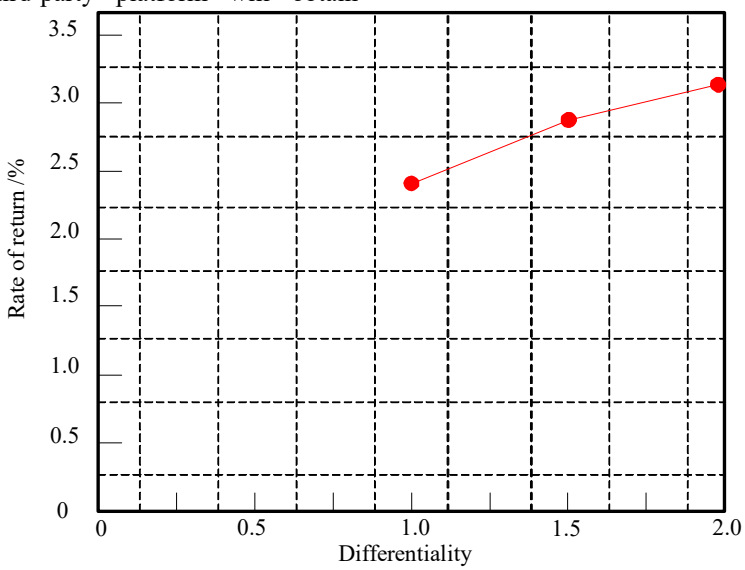

Fig. 3 Change trend chart of platform differentiation degree t_A and P_A^2

The transaction fees charged by third-party platforms to leading enterprises are positively correlated with the degree t_A of differentiation perceived by leading enterprises between platforms. The transaction fees P_A^2 charged by platforms to leading enterprises increase with the increase of t_A. Third-party platforms adopt the strategy of high quality and high price for leading enterprises, that is, to improve the quality of products and services while charging higher prices to form a good reputation, and then to expand the scale of users.

According to the model assumptions, each parameter is assigned a value. The degree $t_A, t_B \in [1,2]$ of differentiation of services is provided by the platform to bilateral users; network externalities $\alpha_A, \alpha_B \in [0,1]$, number of transactions $d_A = 200$, $d_B = 150$ and substitution P_A^1 and P_B^1.

Figure 4 shows the trend changes between the network externality strength α_A and P_A^1 P_B^1 of the leading enterprises.

(2) Agricultural capital collecting

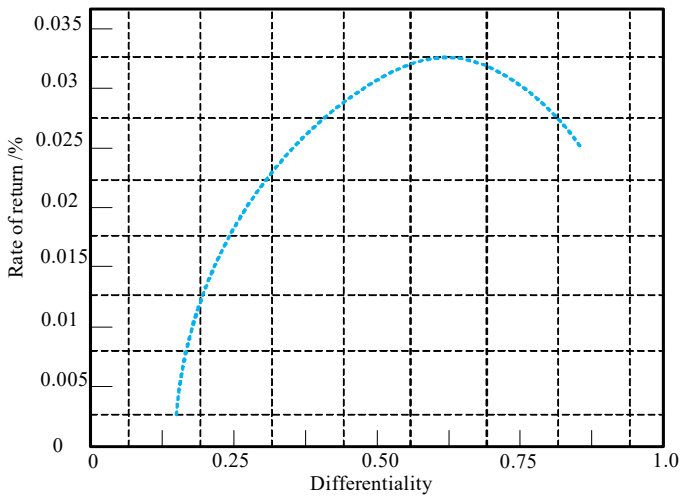

Figure 4 Trend diagram of network externalities α_A , P_A^1 and P_B^1

There is a positive correlation between the pricing P_A^1 of self-marketing platform to leading enterprises and the network externalities α_A of leading enterprises. The pricing P_B^1 of self-marketing platform to farmers and the network externalities α_A of leading enterprises show a trend of first increasing and then slowly decreasing. In a competitive market environment, self-selling platforms and third-party platforms divide up the market through competition. The supplier users rely more on the exposure of the platform and the flow of users on the other side, so the platform has a strong bargaining power for business users. It can be seen from the figure that when the network externality strength α_A of leading enterprises is between 0.6 and 0.8, the platform's pricing for bilateral users reaches a stable state.

The degree t_A and P_A^1 of platform differentiation perceived by leading enterprises and the trend change between them are shown in Figure 5.

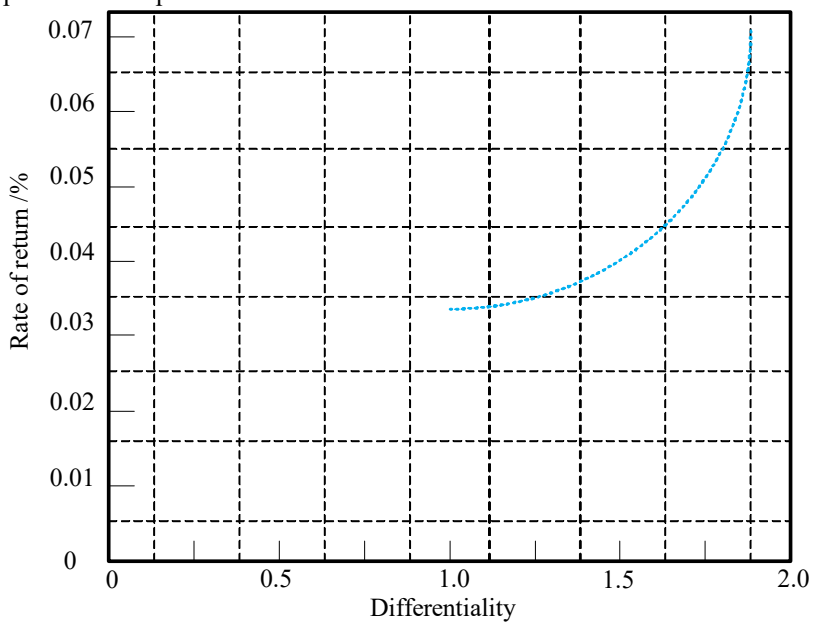

Fig. 5 Change trend chart of platform differentiation degree t_A and P_A^1

The transaction fees P_A^1 charged by self-selling platforms to leading enterprises are positively correlated with the degree t_A of differentiation perceived by leading enterprises between platforms. When the degree of differentiation of products and services increases, the platform tends to charge higher transaction fees to leading enterprises. By increasing the degree of differentiation, the platform attracts leading enterprises to join the platform with better products and services, and gradually increases the fees charged to leading enterprises after expanding the scale of users.

5.Conclusion

This paper takes the e-commerce supply chain platform of agricultural products as the research object. Through the establishment of the platform competition model, a comprehensive analysis is done to the competitive strategy of the e-commerce platform of the agricultural products supply chain. For the self-selling platform and the third-party platform of the integrated agricultural products supply chain, the interest equilibrium state of the two business sectors of the agricultural products sales and agricultural materials return is calculated respectively. Based on the conclusions of the model, this paper puts forward the corresponding competitive strategies for the e-commerce platform of the agricultural supply chain in the competitive market from the perspective of platform differences, network externalities, and bilateral user attribution. Through the results of this study, it is concluded that the level of platform differentiation is proportional to the benefit of using the platform, which proves that platform differentiation management is an effective way to increase platform revenue.

In future work, in the process of establishing a mathematical model for derivation and solution, a perfect multilateral competition model of agricultural supply chain e-commerce platform is established. The optimal decision is made considering the different stages of development of the platform.

References

[1] Mazalov V V, Chirkova Y V, Zheng J, et al. A Game-Theoretic Model of Virtual Operators Competition in a Two-Sided Telecommunication

Market[J]. Automation & Remote Control, 2018, 79(4):737-756.

[2] Sellitto, M. A., Vial, L. A. M., Viegas, C. V.. Critical Success Factors in Short Food Supply Chains: Case Studies with Milk and Dairy Producers from Italy and Brazil. Journal of Cleaner Production, 2018, 170: 1361-1368.

[3] Paul Belleflamme, Martin Peitz. Price disclosure by two-sided platforms[J]. International Journal of Industrial Organization,2019,(67).

[4] Tian L, Vakharia A J, Tan Y, et al. Marketplace, reseller, or hybrid: strategic analysis of an emerging E-commerce model[J]. Production and Operations Management, 2018, 27(8): 1595-1610.

[5] Andrei Hagiu, Julian Wright. Multi-sided platforms[J]. International Journal of Industrial Organization, 2015, (43).

[6] Shiying Wang, Huimiao Chen, Desheng Wu. Regulating platform competition in two-sided markets under the O2O era[J]. International Journal of Production Economics,2019,(215).

[7] Li Zhiwen, Han Ji, Xiongqiang. Effects of service quality differences on bilateral pricing strategies and social welfare under Internet Platform [J]. Journal of Cultural Comments, 2018,9 (04): 30-41.

[8] Wang Wei, Li Xiaoxuan. Study on Interest Mechanism of E-commerce Poverty Alleviation Based on Bilateral Market [J]. Journal of Langfang Teachers College (Natural Science), 2020, 20 (03): 57-61.

[9] Xia Dejian, Wang Yong. Study Bilateral Pricing and Influence of E-Commerce Platform in Different Trading Types [J]. Soft Science, 2018,32 (07): 118-121

[10] Li Shijie, Liu Qiong, Gao Jian. Relationship in Embedding, Interest Alliance and "Company + Farmers" - Based on Seayuan Corporation Case Analysis [J]. China Rural Economy, 2018 (02): 33-48.