A Delivery Time-based Competition Strategy for Community O2O e-tailer: A Study

Liu Chang

Management School, Guangzhou Open University, Guangzhou, China

Abstract—The community O2O e-tailer can offer the trade of life services within a five-kilometer radius of the community by building online and offline interactive e-tailer platforms between residents and businesses. However, the development of community O2O e-tailer has not been going as planned, failing many expectations. Hence, this paper investigates the two main influencers, namely price and delivery time, by taking the new e-tailers entering the online retail market as the research object. Through a Stackelberg model of community O2O e-tailer and B2C retailer, the competition strategies for the community O2O e-tailers are analyzed. The results revealed that the community O2O e-tailer could not gain any advantage under the homogenized competition. For the sustainable development of e-tailers, a thorough analysis of the community needs, and hence a differentiated competition strategy is required. The post-pandemic period offers a seamless opportunity to do that, which will allow the O2O e-tailer to transform and develop.

1. INTRODUCTION
The unexpected emergence of 2019 novel coronavirus (COVID-19) has developed new opportunities for the community O2O e-tailers. After the outbreak of the pandemic, people in China started responding to the call the government to minimize travel and buy daily necessities, including food, clothing, housing, and transportation, through e-tailers or via their local providers. This revived the wet markets, small-medium supermarkets, and community stores in the communities. According to the National Bureau of Statistics, China's online retail sales of physical goods grew 14.3% in the first half of 2020 [1]. The people across the country used the Internet more often to buy goods and services, and per capita spending on postage increased by 10.8% [2]. The number of users of the e-tailer apps, such as Dmall, Freshhema, and Missfresh, has suddenly increased from 8 to 12 million [3]. Wet markets, small-medium supermarkets, and community stores saw a 12% increase in passenger flow in February, while most of the brick-and-mortar stores lost in sales [4]. It is revealed that when the outdoor activity is limited, the regional advantages and convenience of community O2O e-tailers come to the forefront. Hence, by taking the B2C e-tailer dominated online retail market as the basis, this paper establishes a competition model for the community O2O e-tailer and analyzes the reasons for its success and failure. As a result, a guideline providing suggestions for the survival and development of community O2O e-tailer companies that are entering the market is provided.

2. PROBLEM DEFINITION AND THE ASSUMPTIONS MADE BY THE MODEL
Since the B2C retailers with stable market share already exist in the retail market, they provide commodity sales and distribution services to their customers through the self-established online shopping malls and distribution networks. The community O2O e-tailer companies that have recently entered the online retail market aim to deliver goods within the three to five kilometers of the
community through an online and offline e-tailer platform for the interaction between local merchants and residents. The providers of the community O2O e-tailers are responsible for the establishment, operation, and maintenance of the e-tailer platforms, purchasing goods from suppliers, and managing offline community merchants. The offline community businesses often refer to convenience, grocery, and mom-and-pop stores in the neighborhood. They cooperate with community O2O e-tailer companies to enter their platform, where the goods are bought and sold to the customers there as well as the offline stores. In general, when the customers place orders through a community O2O e-tailer platform, the closest community merchants are located and assigned with the orders. Once the orders are received, offline community merchants are responsible for the delivery of the goods.

**Figure 1.** The competition between B2C and O2O e-Tailers

Let $Q$ be the total demand of the online retail market, $P$ be the commodity price of the B2C e-tailer, $t_d$ be the delivery time, whereas $P_o$ be the commodity price of the O2O e-tailer, and $t_o$ be the delivery time that satisfies $t_o < t_d$. Both Liu [5] and Hua et al. [6] proved that, in a competition between two channels, customers from one channel are attracted to the other when the delivery time is reduced, and vice versa. Hence, if the community O2O e-tailers promise a shorter delivery time, they can attract the customers of B2C retailers. The rate of customers shifted from B2C retailers to community O2O e-tailers is named as $\alpha (0 < \alpha < 1)$. Considering the impact of price and delivery time, the linear demand functions of B2C retailers and community O2O e-tailer companies are determined by Hua [6], Huang [7], and Narenji [8] respectively as:

$$D_d = (1 - \alpha)Q - P_d t_d + \beta_2 t_o$$

$$D_o = \alpha Q - P_o t_o + \beta_2 t_o$$

Here, it is assumed that B2C retailers and community O2O e-tailers sell the same type of goods and are supplied by the same supplier. Now, let $W_d$ be the purchase price of B2C retailers, $W_o$ the purchase price of O2O retailers, and $C_p$ be the supplier’s unit production cost. Hence, the profit function of the supplier is:

$$\pi_m = (W_d - C_p)D_d + (W_o - C_p)D_o$$

It is usually believed that the shorter the delivery time, the higher the customer satisfaction. However, the faster distribution time is often achieved by either improving or optimizing one or more factors, such as personnel, capital, equipment and facilities, information level, and/or process required for distribution, which refers to an increase in distribution costs. Therefore, Hua et al. [6] claimed that the delivery time and costs are inversely proportional to each other, and one restricts another. Based on the study of Xu et al. [9], the unit delivery cost is $C_{t_i} (t_i > 0)$ when a product of e-tailer $i$ is delivered in time $t_i$. As a result, the unit delivery cost of B2C retailers is $C_{t_i}$. Neglecting the operational costs, the profit function of B2C retailers is given as:

$$\pi_d = (P_d - W_d - C_{t_i})D_d.$$
The delivery cost of the community O2O e-tailer has two components. The first is the cost of organizing the direct delivery of goods from suppliers to offline merchants in the community. For which, the unit delivery cost is \( C_l \). The second is the cost of offline community merchants delivering the goods to customers, which has the unit delivery cost of \( \frac{C_o}{t_o} \). Thus, the unit delivery cost of community O2O e-tailer is \( C_l + \frac{C_o}{t_o} \), where \( C_l + \frac{C_o}{t_o} < \frac{C_o}{t_o} \).

The community O2O e-tailer companies can make profits through two profit-sharing schemes. The first scheme is that the community O2O e-tailer only regards the offline merchants in the community as the downstream distribution station but not the profit-sharing partner. Hence, the income of community O2O e-tailer is composed of the platform sales revenue and the service fee income \( s_i \) of the community merchants using the platform. The cost includes the purchase cost of goods and the delivery cost of the offline merchants in the community. Hence, the profit function of the community O2O e-tailer in the first scheme is:

\[
\pi_{\text{O1o}} = \left( P_o - W_o - C_l - \frac{C_o}{t_o} + s_i \right) D_o. \tag{5}
\]

Besides selling community O2O e-tailer products (hereinafter referred to as platform products), offline community merchants will also sell other products (hereinafter referred to as self-purchased products). Hence, we suppose that every time customers purchase platform products, they will buy self-purchased products with a unit value of \( \epsilon \) from the community offline merchant. Furthermore, we assume that O2O e-tailer established a cooperative relationship with community offline merchants, hence the average profit function for each offline merchant is:

\[
\bar{\pi}_{\text{O2e}} = \left( \frac{C_o}{t_o} + \epsilon - s_i \right) \frac{D_o}{\pi}. \tag{6}
\]

The total profit function of the supply chain composed of community O2O e-tailer providers and community offline merchants can be obtained by combining (5) and (6) as:

\[
\pi_{\text{O1e}} = \left( P_o - W_o - C_l + \epsilon \right) D_o. \tag{7}
\]

In the second scheme, community O2O e-tailer providers consider offline community merchants as partners and share their profits with them. Compared to the first scheme, the community O2O e-tailer do not pay delivery fees to offline merchants but share a portion of their profits from commodity sales with the community merchants. The profit-sharing ratio is set to \( \gamma \), where \( 0 < \gamma < 1 \). Hence, the profit function of the community O2O e-tailer is:

\[
\pi_{\text{O2o}} = \left[ \gamma (P_o - W_o) - C_l + s_i \right] D_o, \tag{8}
\]

and the average profit function of each community offline merchant is:

\[
\bar{\pi}_{\text{O2e}} = \left[ (1 - \gamma)(P_o - W_o) + \epsilon - s_i \right] \frac{D_o}{\pi}. \tag{9}
\]

By combining (10) and (11), the total profit function of the O2O supply chain can be obtained as:

\[
\pi_{\text{O2o}} = \left( P_o - W_o - C_l + \epsilon \right) D_o. \tag{10}
\]

Based on the equality of \( \pi_{\text{O1o}} = \pi_{\text{O2e}} \), regardless of which profit distribution scheme is adopted by the O2O supply chain, the total profit is:

\[
\pi_o = \left( P_o - W_o - C_l + \epsilon \right) D_o. \tag{11}
\]

3. MODEL ANALYSIS

3.1 The optimal pricing strategy of the community O2O e-tailer

Since the B2C retailers entered the retail market before the community O2O e-tailers, they are the dominant players in the market. The community O2O e-tailer is the follower of the B2C retailers, and the competition between them matches the characteristics of the Stackelberg game. In brief, B2C retailers determine the product price and delivery time first. The community O2O e-tailer providers decide the pricing and delivery time of the platform commodities to maximize the profits of the supply chain, where the community offline merchants deliver the platform orders. Thus, the optimal pricing of B2C retailers and the community O2O e-tailer providers satisfy \( P_o^* > P_o^* \). This shows that the community O2O e-tailer, the follower in the Stackelberg game, still needs to use low prices as a means
of competition to gain access to the retail market even if its delivery time is shorter than that of the B2C retailers.

**Corollary 1:** \( \frac{\partial D_0}{\partial \alpha} < 0 \), \( \frac{\partial D_1}{\partial \alpha} > 0 \), and \( \frac{\partial D_2}{\partial \alpha} > \left| \frac{\partial D_3}{\partial \alpha} \right| \)

As the pricing of the community O2O e-tailer is lower than that of the B2C retailers, some customers of the B2C retailers will switch to community O2O e-tailer to buy goods. When the customer transfer ratio \( \alpha \) gradually increases, B2C retailers will stimulate sales by lowering the prices. At the same time, community O2O e-tailer can increase the prices appropriately to increase the sales profit. According to the results comparing the absolute values of the first partial derivatives, the price reduction of the B2C retailers is higher than the price increment of the community O2O e-tailers. This suggests that the community O2O e-tailers are more cautious about price increase since the customers tend to leave easily. It also illustrates the attitude of the new entrants to the market in terms of prices.

**Corollary 2:** \( \frac{\partial D_0}{\partial \beta} < 0 \), \( \frac{\partial D_1}{\partial \beta} > 0 \), \( \frac{\partial D_2}{\partial \beta} > \left| \frac{\partial D_3}{\partial \beta} \right| \)

When everything is fixed, reducing the delivery cost will extend the delivery time. To ensure that the transfer rate of customers does not increase while the delivery time is extended, the B2C retailers compensate for their customers by lowering the prices of their goods. If the community O2O e-tailer provider also controls the delivery cost by extending the delivery time, it will gradually lose its advantage in delivery time. On the contrary, when the delivery time of the B2C retailers is shortened, the time advantage of the community O2O e-tailers will diminish. In that case, the community O2O e-tailer enterprises must reduce the prices to preserve their market share by retaining the customers.

### 3.2 The effect of pricing strategy on customers’ transfer behaviors for community O2O e-tailer

**Corollary 3:** \( \frac{\partial D_0}{\partial \alpha} < 0 \), \( \frac{\partial D_1}{\partial \alpha} > 0 \), \( \frac{\partial (D_2 - D_3)}{\partial \alpha} < 0 \), and \( \frac{\partial D_2}{\partial \alpha} > \left| \frac{\partial D_3}{\partial \alpha} \right| \)

The above analysis reveals that, due to the lack of visibility, the customer flow is low and during the community O2O e-tailer entering the market. To attract the customers, community O2O e-tailer companies launched the low-price strategy and the demand began to rise. The inequality of \( \frac{\partial (D_2 - D_3)}{\partial \alpha} < 0 \) shows that the demand difference between the B2C retailers and the community O2O e-tailer is getting smaller and smaller as the number of customer transfers increases. This also proves the effectiveness of the low-price strategy in attracting customers. The inequality of \( \left| \frac{\partial D_2}{\partial \alpha} \right| < \left| \frac{\partial D_3}{\partial \alpha} \right| \) indicates that the demand for B2C retailers drops slowly, which reflects the strong buying inertia of customers. Although the low-price strategy will arouse their willingness to try the new community O2O e-tailer, they still keep their shopping habits, which explains the slow drop in the demand for B2C retailers.

### 3.3 The influence of customers’ transfer behaviors on the pricing of the community O2O e-tailer

By comparing \( W_d^c \) and \( W_c^c \), the relation of \( W_d^c > W_c^c \) can be obtained.

**Corollary 4:** \( \frac{\partial W_d^c}{\partial \alpha} < 0 \), \( \frac{\partial W_c^c}{\partial \alpha} > 0 \), \( \frac{\partial (W_d^c - W_c^c)}{\partial \alpha} < 0 \)

The B2C retailers established cooperative relationships with suppliers before the community O2O e-tailer as they entered the retail market first. Due to the certain purchase scale they have, it is often possible for B2C retailers to obtain competitive purchase costs from suppliers. For the community O2O e-tailers, however, it is difficult to obtain the same purchase cost due to their small purchase scale. Corollary 3 demonstrated that with the gradual increase in the number of customers and orders, the purchase scale of the community O2O e-tailers is also expanding, and their bargaining power with suppliers is getting better. This points out that the purchase cost advantage of the B2C retailers will gradually weaken. When the community O2O e-tailer companies obtain the same or similar purchase cost of the B2C retailers, the low-price strategy can be maintained and the hard-won market dominance can be prorated.
3.4 The optimal profit strategy of the community O2O e-tailer

The optimal profit is obtained as the following by Combing \( P^*_d > P^*_r \) with \( t^*_d > t^*_r \), which shows that both B2C retailers and community O2O e-tailer companies can make profits only if the e-tailer companies have more advantages in pricing and delivery time than the B2C retailers.

It can be proven that the community O2O e-tailer has a certain market share; however, it cannot make any profit when \( P^*_d > P^*_r, W^*_d > W^*_r \) and \( t^*_d > t^*_r \). In other words, the community O2O e-tailer must outperform the B2C retailers in purchase cost, sales price, and delivery time. The B2C retailers also responded by lowering the sales prices to keep pace with the low-price strategy of the community O2O e-tailer. Meanwhile, if the suppliers increase the purchase cost, the profit of the B2C retailers will drop significantly. Hence, there is no winner of this price/bargain war, i.e., either the retailers and the suppliers make a profit or both lose. This concludes that the low-price and short delivery time strategy of the community O2O e-tailer is not an effective way to compete with the B2C retailers in the online retail market under the circumstance of commodity homogenization.

Corollary 5: \[ \frac{\partial \pi^*_d}{\partial t^*_d} > 0, \quad \frac{\partial \pi^*_d}{\partial P^*_d} < 0. \]

One of the main advantages of the community O2O e-tailer is that the delivery time is significantly shorter than that of the B2C retailers. However, if the superiority in the delivery time cannot be maintained always, the customers that the community O2O e-tailer companies have hardly gained will shift back to the B2C retailers due to product range and purchase inertia. Thus, the loss in the market share of the community O2O e-tailer will pose a huge risk for its development, which may lead to the survival mode.

4. Competition strategies of the community O2O e-tailer

Based on the above results and the corollaries, in the context of commodity homogenization, the community O2O e-tailers can compete with online retailers and sustain long-term development in the online retail market only when their purchase cost, sales price, and delivery time are significantly better than the B2C retailers due to their market share. This means that in the early stage of development, e-tailers must establish a stable supply-demand relationship by purchasing large quantities of goods from suppliers and trying not to surpass the purchase cost of the B2C retailers. However, a large amount of purchase refers to a large amount of investment and backlog of funds for the community O2O e-tailers that are still in the platform promotion stage. Furthermore, they also need to attract customers and so increase the use of their platform by providing lower prices and better delivery times than B2C retailers. This also means that the community O2O e-tailer must go through a period of high investment and low return in the early stage of developing the market and striving for market share. Hence, offering low prices and fast delivery times are only short-term behaviors, which cannot keep the customers on the platform. In the long term, it is difficult for community O2O e-tailer companies to maintain low prices and lose profits. Once the prices start increasing, customers will return to B2C retailers where they formed a buying habit or move to a newly launched e-tailer platform.

It is believed that the product differentiation strategy was a breakthrough for the community O2O e-tailers while entering the online retail market. As analyzed above, the platforms with homogeneous products and services can hardly be long-term competitive to the top B2C e-tailers in the market. However, for the products and services that have not yet been involved in the B2C e-tailer platform or formed absolute advantages, there is a huge room for development. During the period of home quarantine in 2020 because of COVID-19, most of the daily necessities were purchased through the online retail platforms or brick-and-mortar stores, such as wet markets, supermarkets, grocery and convenience stores in the residential community. Hence, community business districts have become crucial in meeting the daily needs of the residents. This increased the sales of offline businesses, especially the small and medium-sized supermarkets, and chain stores of fresh meat and vegetables. However, since the offline business companies usually did not have self-built e-tailer platforms, they needed to meet the needs of online display and sales with the help of external e-tailer platforms. This was a great opportunity for the transformation of the community O2O e-tailers.
The community O2O e-tailers can transform from two directions. The first one is to explore the cooperation opportunities with offline merchants in the community, adjust the distribution model, and build a mobile O2O platform. This direction aims to mitigate the shortcomings of the merchants in online sales via the mobile O2O platform. It is committed to assist small and medium-sized offline merchants to virtualize their physical stores on the mobile platform so that the functions of order processing and logistics tracking can be implemented online. The mobile O2O platform offers several services to small and medium-sized merchants, such as commodity launching, order processing, electronic payment, order allocation, and delivery tracking.

The second direction is the implementation of product differentiation strategies. The community O2O e-tailer shall organize the purchase of goods by itself, where the selection shall focus on the goods that meet the needs of the people's livelihood in the community. The community O2O e-tailer can assess the needs of residents through the community offline merchants and determine the types of differentiated products. The unified negotiation and the purchase from suppliers for cooperative community offline merchants can reduce the cost of purchasing from single merchants. The community O2O e-tailer will support the offline community merchants to sell their products online, besides building a mobile O2O e-tailer platform integrating the procurement, sales, and delivery.

5. CONCLUSION

The COVID-19 pandemic is expected to have a great impact on the global economy and social life. Macroscopically, the global supply-demand relationship of resources will be rebalanced through the redistribution of the supply chain, which is bound to affect the purchase and sales of the community O2O e-tailer. Microscopically, the community O2O e-tailer needs to transform from the B2C’s community-based model to truly meet the needs of offline businesses and the residents in the community. Hence, it is in urgent need to take a root in the community and explore the characteristics of community business ecology. Furthermore, it is necessary to understand the purchasing behavior of residents, analyze the online retail market, and build a mobile O2O platform to meet the needs of the community based on the supply chain formed by the community business circle. These are the main requirements that the community O2O e-tailers should focus on in the future.

ACKNOWLEDGMENT

This research was funded by the 10th teaching reform research projects for universities run by Guangzhou Bureau of Education, China, grant number 2019JG219.

REFERENCES

[1] National Bureau of Statistics of China. Total retail sales of consumer goods were declined by 1.8% in June 2020. [EB/OL]. http://www.stats.gov.cn/tjsj/zxfb/202007/t20200716_1776198.html, 2020-07-16/2020-08-01.

[2] LIN Tao. Market sales continue to pick up, and consumption patterns innovate[EB/OL]. http://www.ce.cn/xwzx/gnsz/gdxw/202007/17/t20200717_35346642.shtml, 2020-07-17/2020-08-01.

[3] Technology as you can see. Explosive during the epidemic, whether fresh food retailing will be silent because of the epidemic?[EB/OL]. https://baijiahao.baidu.com/s?id=1665648488545082779&wfr=spider&for=pc, 2020-05-03/2020-08-01.

[4] ZHUANG Shuai. Market performance review and industry data analysis of retail trade under the epidemic period[EB/OL]. http://column.iresearch.cn/b/202003/885409.shtml.

[5] Liu L, Parlar M, Zhu S X. Pricing and lead time decisions in decentralized supply chains[J]. Management Science, 2007, 53(5): 713-725.

[6] Hua G, Wang S, Cheng T C E. Price and lead time decisions in dual-channel supply chains[J]. European journal of operational research, 2010, 205(1): 113-126.
[7] Huang Y S, Chen S H, Ho J W. A study on pricing and delivery strategy for e-retailing systems[J]. Transportation Research Part E: Logistics and Transportation Review, 2013, 59: 71-84.

[8] Narenji M, Fathian M, Teimoury E, et al. Price and delivery time analyzing in competition between an electronic and a traditional supply chain[J]. Mathematical Problems in Engineering, 2013.

[9] Xu H, Liu Z Z, Zhang S H. A strategic analysis of dual-channel supply chain design with price and delivery lead time considerations[J]. International Journal of Production Economics, 2012, 139(2): 654-663.