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SHOULD DIGITAL PLATFORMS BE BANNED FROM THE DUAL MODE OPERATION?

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Abstract: Increasingly, e-commerce platforms like Amazon and JingDong serve not just as intermediary markets that facilitate transactions between third-party sellers and consumers but also function as sellers themselves, offering their self-operated products on their platforms. When platforms commence selling their self-operated products, they may replicate the offerings of third-party sellers or engage in self-preferential practices favoring their own products. Consequently, it is essential to investigate the market equilibrium and welfare implications of platforms' dual mode, and evaluate whether such the dual mode should be banned. This paper examines the equilibrium of platforms according to the Hotelling model across three operation modes: the pure marketplace mode, the pure seller mode, and the dual mode. Furthermore, we examine the selection of modes for platforms. Additionally, we investigate the welfare, profits of platforms, and social welfare in the context of banning the dual mode of platforms. Finally, we briefly examine the contemporary policy implications of platforms' dual mode. The findings indicate that: (i) the dual mode of platforms is advantageous for consumers, platforms, and social welfare; (ii) platforms may intrinsically implement the dual mode for profit maximization; (iii) When platforms are banned from the dual mode and their choices of operation modes are endogenous, they will choose the pure marketplace mode; (iv) Consumer surplus, profits of platforms and social welfare decrease in the ban the dual mode of platforms.
Keywords: Digital platforms; Dual mode operation; Self-preferencing; Competitive strategies

1 INTRODUCTION

In recent years, more and more e-commerce platforms, such as Amazon, Jingdong, Target, and Walmart, play the role of both intermediary marketplaces (i.e., facilitating transactions between third-party sellers and consumers), and sellers (i.e., selling products on the platforms on their own behalf); in other words, these platforms are not only referees but also players[1]. In practice, this dual mode strategy is known as the self-operation strategy. Particularly, the platforms which adopt the dual mode strategy are mostly dominant firms with a large market share. For instance, Amazon is the dominant e-commerce platform in the United States with a market share of 38.7% in 2020. Moreover, these platforms are referred to as “gatekeepers” due to their dominant position in the market. Besides its presence in e-commerce platforms, the self-operation strategy exists in many default applications, such as Apple's Appstore, Google's Playstore, Apps for Windows, Intuit's Quickbooks Apps, Salesforce's AppExchange, and the Nintendo Switch video game console. They provide third-party applications and their own applications.
The dominance and the dual model operation of platforms raise concerns for antitrust enforcers. At least two concerns may arise when platforms begin selling their self-operated products: One is product imitation, as the platform may imitate the products of third-party sellers. This is because platforms have easy access to third-party sellers' product information and can imitate the product successfully. The second concern is that self-preferencing platform companies may limit consumer access to third-party sellers' products and display their own products more prominently, then consumers will buy their own products. The European Commission and the U.S. House Judiciary Committee's Antitrust Subcommittee have found that Google directly manipulates search results by promoting its own contents in search results while ignoring competitors' content (even if Google's own content is inferior). Therefore, the dual model of platforms raises regulatory concerns about the lack of a fair competitive environment. Later on, the European Union and the United States conduct antitrust investigations against some famous firms such as Google, Apple, and Amazon. Moreover, they also put forward some legislative proposals to regulate large tech firms, such as the “Digital Markets Act” and “the Digital Services Act” proposed by the European Commission, and five bills in the United States[2-6]. The End Platform Monopolization Act, proposed by the United States in 2021, prohibits large technology companies from competing with third-party sellers by selling their products or applications on their own marketplaces.
In practice, countries such as European countries and the United States begin to adopt appropriate regulatory measures for platforms’ self-operation strategies. Nonetheless, academic research on this aspect lags behind practice, and is still an emerging topic[7]. Although some scholars have begun to evaluate the welfare of dual mode of platforms, no consistent conclusions have been reached, and further research on the strategy is needed to clarify whether dual mode of platforms should be banned.
Against the backdrop of the above phenomenon, this paper aims to address (1) How does the self-operation strategy of platforms affect pricing and the welfare of participants? (2) What are the implications of banning the dual mode of platforms, and what is the optimal mode for platforms? (3) What are the effects of current policies on platforms’

self-operation strategies?

This paper constructs a Hotelling model to analyze the market equilibrium and mode choice of the platform, followed by an analysis of the welfare implications of the ban on the platform's dual mode. Moreover, we briefly discuss the effects of the current policy on platform self-operated strategy, then we investigate whether antitrust regulation should be imposed on the dual mode. The results show that platforms' self-operation strategy is advantageous for consumers, platforms, and social welfare. When platforms adopt a dual mode, they benefit consumers through two mechanisms: the provision of cost-advantaged products or the enhancement of consumers' intergroup network externalities. Additionally, platforms' dual mode is an inherent decision in their pursuit of profit maximization. Furthermore, when platforms are banned from dual mode and their decision of operation mode is endogenous, they will opt for the pure seller mode if and only if platforms have a product cost advantage and the difference of the marginal costs between third-party sellers and the platform is larger than the profits of the intergroup network externalities that consumers obtained from the pure market mode; otherwise, the platform will shift to the pure marketplace model. Finally, consumer surplus, platforms' profits and social welfare will decrease with the ban on dual mode for platforms. Consequently, the structural separation policy that prohibits dual mode of platforms may not genuinely enhance consumer and social welfare.

The contribution of this paper is the focus on platforms' self-operation strategies. The previous researches on platforms' self-operation seldom consider intergroup network externalities, therefore, this paper introduces a Hotelling model that examines the distinctions between products offered by platforms and those provided by third-party sellers in both online platform channels and offline direct channels. We characterize the different patterns of operation modes of platforms by the intergroup network externalities between online consumers and third-party sellers. That is, the inter-group network externalities cannot benefit online consumers if platforms choose the pure seller model. On the contrary, the inter-group network externalities can benefit online consumers if platforms choose the dual mode. Moreover, owing to the increase in the number of sellers on the platform, the inter-group network externalities of the dual mode will benefit online consumers more than that of the pure seller operation mode. The presence of intergroup network externalities yields numerous new conclusions.

The remainder of the paper is as follows: In Section 2, we review the relevant literature. In Section 3, we set up a model between the platforms and third-party sellers. In Section 4, we present the equilibrium analysis of platforms' self-operation strategy. In Section 5, we investigate the welfare changes of banning platforms' dual mode. In Section 6, we evaluate the policy effect of platforms' dual mode. Section 7 concludes the paper.

2 LITERATURE REVIEW

Research on the self-operation strategy of platforms is an emerging topic[7], which involves the own operation mode of the platform, self-preferencing treatment of platforms, and the welfare analysis of dual modes of platforms.

2.1 The Self-Operation Strategy of Platforms

Platforms can either provide a marketplace for third-party sellers to sell products, or they can sell their self-operated products. Platforms can change their organization or ownership structure over time. Hagiu and Wright show examples of Amazon and Zappos[8]. Amazon starts as a one-sided retailer platform and gradually shifts to a two-sided platform, while Zappos is in the opposite. Thus, the organization structure of a platform is not fixed and it may change with the condition of the market.

In terms of the decision of the operation mode of the firm, Hagiu states that the pure seller model is strictly better than the two-sided platform model when the probability of adopting the platform model being unfavorable is positive[9]. Since coordination problems are alleviated in the pure seller mode, it is easier to persuade third-party sellers to sell their products directly than to sell their products on a platform. Therefore, there exists a trade-off between the pure seller model and the two-sided platform model. This suggests that intermediaries, especially for new products, typically start with the pure seller model, then they move to the platform model which is cheaper for each seller and allows intermediaries to offer a wider variety of products when there are enough sellers and they become affiliated.

The platform frequently needs to evaluate whether they should offer their own products or not. Hagiu and Spulber consider a platform that faces a coordination problem of whether the chicken or the egg should come first in user engagement[10], and they derive that the problem can be mitigated by bringing in third-party sellers' products and the platform's self-operated products. Farrell and Katz and Jiang et al. conclude that platform owners face a trade-off between capturing rents and incentivizing innovation of sellers on the platform by self-operation strategies[11-12]. Moreover, empirical research on this issue suggests that Amazon is more likely to compete with sellers on the platform in product categories where sales are more successful[13].

2.2 Self-Preferencing of Platforms

Platforms can be seen as "gatekeepers" since they can not only decide which sellers can enter the platform, but also decide the ranking of products recommended to consumers. When platforms select the dual mode, they have an incentive to recommend their own products to consumers first rather than those of third-party sellers. Scholars refer to this behavior as self-preferencing (own-content bias). De Cornie re and Taylor investigate the determinants of self-preferencing in search engines and its impact on website strategies[14]. Since intermediaries often do not recommend the most suitable goods to consumers when consumers need intermediaries to recommend goods, especially when intermediaries also sell their own products to consumers, De Cornie re and Taylor conclude that firms that benefit from the self-preferencing have incentives to offer better products than their competitors when the interests of sellers and consumers are aligned[15], and consumers are better off than that without the self-preferencing. However, when sellers and consumer interests are in conflict, firms that benefit from the self-preferencing offer worse products, which leads to a decrease in the consumer utility. That is, the self-preferencing may do harm to consumers. Furthermore, they find that the consumer welfare will increase as the separation of the self-operation and intermediary-acting business model under price competition (as opposed to quantity competition). Kittaka and Sato consider a scenario where the commissions from sellers and the distortion of the order of consumer searches which leads to the priority of the self-operated product offered by the platform themselves[7], they find that the distortion and self-operation strategy will weaken price competition, and social welfare improves with the ban of the dual mode. Zennyo examines how self-operation and self-preferencing interact in e-commerce platforms and concludes that self-preferencing is not necessarily anticompetitive[16], but rather pro-competitive. Etro investigates the choices of a platform between earning commissions from competing third-party sellers and offering private label products or third-party sellers' products[17]. When the platform enters, the platform completely eliminates competition between the platform and the third-party sellers through an extreme form of self-preferencing. They find that the entry incentives of the platform are aligned with the interests of consumers when all sellers are in perfect competition. On the contrary, when sellers have significant market power, the platform's entry is usually insufficient. Additionally, Hagiu et al. investigate whether the dual model of platforms should be banned and construct a model with platforms[18], innovative sellers, and third-party marginal sellers, then they find that self-preferencing and product imitation create inefficiency.

2.3 Effects of the Self-Operation Strategy of Platforms on Welfare

Researches concerning the effects of the self-operation strategy of platforms on welfare are emerging, and scholars have not yet reached a consistent conclusion. Some scholars believe that the dual mode of platforms is beneficial to consumers and social welfare[17-21]. Hagiu et al. find that consumer surplus or social welfare will decrease if the ban the dual mode of platform[18]. Therefore, policies that prevent platform imitation and biased recommendations are always better than those completely ban the dual mode of platform.

However, some scholars argue that dual mode of platform will do harm to social welfare[21-22]. Anderson and Bedre Defolie consider a scenario where platforms are price leaders and compete with third-party sellers who show horizontal differentiation from the platforms, and they derive that commissions in the dual mode are larger than those in the pure seller mode, which leads to a decrease in the number of sellers and the range of products. Therefore, the ban on the dual mode of the platform should be taken.

To sum up, researches on the self-operation strategy of platforms are still emerging, and scholars have not reached a consensus about the effects of the dual model of platform on welfare. Moreover, it is not clear whether the self-operation strategy should be banned, so further research is needed.

3 MODEL

Suppose there is a platform A, two types of users, consumers, and third-party sellers in the marketplace. The platform facilitates transactions since it acts as an intermediary that connects consumers and third-party sellers. The operation model of the platform in this scenario is called the pure marketplace model. Additionally, there also exists a dual mode of the platform. That is, the platform can also sell its own products on the platform, which may be from the platform's own brand, such as "Made in Beijing" on Jingdong, "Amazon Basics" on Amazon, or it may be from the upstream manufacturer's product, which is not distinguished in this paper. Thus, profits of the platform are comprised of the commission from third-party sellers and profits earned from the sale of self-operated products. Moreover, the transaction between third-party sellers and consumers on the platform can generate intergroup network externalities, i.e., the positive network externalities increase in the number of sellers. For simplicity, we do not consider intra-group network externalities between consumers and third-party fringe sellers. Next, we characterize the behavior of platforms, consumers and third-party sellers, respectively.

3.1 Platforms

There exists a platform A with a certain dominant position, which can decide the operation type of the platform: the pure marketplace model, the pure seller model, or the dual model. When a platform adopts a pure marketplace model, it imposes a transaction fee of τ ($\tau \geq 0$) on third-party sellers for each transaction, while not charging any fees to consumers. These third-party sellers distribute their products through two channels: the online channel (the platform) and direct channels (the offline store). Consumers experience intergroup network externalities when purchasing from the platform, which are absent in direct channels. Moreover, product prices are often different between the two channels. Consequently, online and offline products offered by third-party sellers exhibit heterogeneity in consumer preferences, which is characterized by the Hotelling model. In this paper, we assume that the platform is positioned at point 0, while the offline store of third-party sellers is situated at point 1. Consumers are uniformly distributed along this unit, and each consumer can purchase only one product. For simplicity, the total number of consumers is normalized to 1.

When a platform adopts the pure marketplace model, its profit arises from the transaction fees charged to third-party sellers, expressed as $\Pi_A=\tau D(\cdot)$, where Π_A represents the platform's profit and $D(\cdot)$ denotes consumer demand on the platform. Given that each consumer purchases only one product, $D(\cdot)$ corresponds to the number of consumers engaging with platform A.

When a platform adopts the pure seller model, it will set a high enough transaction fee to prevent any third-party sellers from joining the platform. In this scenario, the platform exclusively sells its own products, which may be either produced internally or sourced from an upstream producer, with no distinction made in this analysis. Assume that the platform decides the product price p_A, and their marginal costs are c_A. Third-party sellers can only sell their products through offline stores, competing with the platform's offerings. The distinction between the platform's products and those of third-party sellers is still illustrated within the Hotelling model. In this pure seller model, the platform's profits generate from selling its products, expressed as $\Pi_A=(p_A-c_A)D(\cdot)$.

In the dual model, we assume that the platform can imitate and replicate third-party sellers' products with no cost, then the products of the platform are the same as those of third-party sellers. We denote the utility of each product as v, and we further assume that v is sufficiently large that each consumer will purchase one unit of product in equilibrium. Assume that when consumers perceive no differences between the platform's product and that of third-party sellers, they will opt for the platform's offering. The "gatekeeper" platform can prioritize its own products by displaying them more prominently in search results ceteris paribus. Consequently, when there is no discernible difference between the products, consumers are more likely to choose the platform's offerings, which is consistent with reality.

3.2 Third-Party Sellers

There are $N(N\geq2)$ symmetric competitive third-party sellers in the marketplace, each of which has two channels to reach consumers, i.e., the online channel (the platform) and direct channels (the offline store). Assume that third-party sellers decide the product price p, and their marginal cost is c. According to Bertrand competition games, third-party sellers will set the price equal to the marginal cost of products in the offline store, i.e., $p=c$. The price set by the third-party seller on the platform is the sum of the marginal cost of the product and the transaction fee, i.e., $p=c+\tau$. We assume that when a third-party seller's perception of the difference between joining the platform and not joining the platform makes no difference, it will choose to join the platform. This assumption is aligned with the reality that third-party sellers can get more channels to reach consumers by joining the platform, and even if the consumers do not transact with it on the platform, it has more channels to know the consumers.

3.3 Consumers

Consumers can choose to purchase products either on the platform or through the offline store of third-party sellers. When the platform A hosts a third-party seller, consumers experience intergroup network externalities regardless of whether they buy products from the third-party seller's online channel or platform A's self-operated products. If only third-party sellers' products are available on the platform, the benefit from intergroup network externalities is αN, where $\alpha>0$. However, if the platform offers both third-party sellers' products and its own self-operated products, the intergroup network externalities benefit is $\alpha(N+1)$. Since the platform also provides its self-operated products, the total number of sellers increases by one, resulting in greater intergroup network externalities under the dual model compared to the pure marketplace model, which aligns with existing literature on intergroup network externalities, such as Armstrong. Furthermore, the consumer's unit transportation cost is denoted as t ($t>0$). If the distance between the consumer and the platform is x, the transportation cost for purchasing a product from the platform is represented as tx.

In summary, if platform A chooses the pure marketplace model, the utility earned by a consumer x units away from platform A by purchasing a product from the third-party seller's online channel is $u=v+\alpha N-(c+\tau)-tx$. If platform A chooses the pure seller model, the utility of purchasing a product sold by platform A is $u=v-p_A-tx$. If platform A chooses the dual model, the utility of purchasing products from the third-party seller's online channel is $u=v+\alpha(N+1)-(c+\tau)-tx$, and the utility obtained from purchasing platform A's self-operated products is $u=v+\alpha(N+1)-p_A-tx$. The utility obtained from purchasing products from the third-party seller's direct offline channel under all three models is $u=v-c-t(1-x)$.

3.4 Game Timing and Equilibrium

Stage 1: Platform A chooses the operation model. If it chooses the pure marketplace model or the dual model, platform A also needs to decide the transaction fee τ.

Stage 2: The third-party seller and platform A set the prices of products p and p_A respectively.

Stage 3: Consumers make the purchasing decisions after observing the prices of the products on the different channels and their own preferences.

Since the game is a complete information dynamic game, the equilibrium of the game is a subgame-perfect Nash equilibrium. The equilibrium of this game can be obtained by backward induction.

4 EQUILIBRIUM ANALYSIS

This section evaluates three operation modes of platform , and subsequently endogenizes the model choice of the platform. Motivated by Hagiu et al.[18], in the first stage, platform A chooses one of the three models, and the choice is common knowledge.

4.1 The Equilibrium of the Pure Marketplace Model

If platform A chooses the pure marketplace model in the first stage, there exists only products of the third-party seller on platform . Moreover, products on the platform are different from those of the third-party seller's offline direct channels, which is reflected in the Hotelling model.

We assume that the marginal consumer z is the consumer for whom there is no difference between purchasing products from the third-party seller on the platform and buying it from the third-party seller's offline direct channel. This implies that the marginal consumer z receives the same utility from purchasing the product from both channels, i.e., $v+\alpha N-(c+\tau)-tz=v-c-t(1-z)$. Then we have

$$z=\frac{1}{2}+\frac{\alpha N-\tau}{2t} \tag{1}$$

This indicates that consumers in the interval $\left[0,\frac{1}{2}+\frac{\alpha N-\tau}{2t}\right]$ will purchase products from the online channel of the third-party seller, and consumers in the interval $\left[\frac{1}{2}+\frac{\alpha N-\tau}{2t},1\right]$ will purchase products from the offline direct channel of the third-party seller. When the sub-game equilibrium of the third stage of the game is obtained, the equilibrium of the second stage of the game is solved.

Since the prices of products on both the online channel and the offline direct channel of the third-party seller are known, it is only necessary to decide the transaction fee τ set by platform A in the first stage of the game under the pure marketplace model. The profit maximization problem of platform A is $\max_{\tau}\Pi_A=\tau z$, and substituting Equation (1) to solve for the first-order derivatives of Π_A with respect to τ and make it equal to 0, i.e. $\frac{\partial\Pi_A}{\partial\tau}=\frac{1}{2}+\frac{\alpha N}{2t}-\frac{\tau}{t}=0$. Then we have

$$\tau^{mkt}=\frac{t+\alpha N}{2} \tag{2}$$

where the superscript "*mkt*" represents the case where platform A chooses a pure market-based model.

From Equation (2), it can be seen that the equilibrium transaction fee of platform A under the pure marketplace model is determined by the consumer's unit transportation cost t and the total intergroup network externalities benefit αN obtained by the consumer. The equilibrium transaction fee τ^{mkt} charged by platform A increases in the consumer's unit transportation cost. When t becomes larger, the degree of differentiation between the third-party seller's online channel product and the offline direct channel product will become larger, then platform will charge a higher transaction fee. In addition, as the unit benefit of the intergroup network externality α increases, the platform can set a higher transaction fee. Similarly, as the number of third-party sellers on platform A increases, the platform can set a higher transaction fee.

Substituting Equation (2) into Equation (1) yields

$$z^{mkt}=\frac{1}{4}+\frac{\alpha N}{4t} \tag{3}$$

Since $0\le z^{mkt}\le 1$, $0\le z^{mkt}=\frac{1}{4}+\frac{\alpha N}{4t}\le 1$, $\alpha N>0$, we have

$$0<\alpha N\le 3t \tag{4}$$

Therefore, the equilibrium profit of platform A is

$$\Pi_A^{mkt}=\frac{(t+\alpha N)^2}{8t} \tag{5}$$

Proposition 1 (Pure marketplace model equilibrium): *When platform A chooses the pure marketplace model in the first stage, the equilibrium transaction fee is* $\tau^{mkt}=\frac{t+\alpha N}{2}$*, the marginal consumer is located at* $z^{mkt}=\frac{1}{4}+\frac{\alpha N}{4t}$*, and the equilibrium profit of platform A is* $\Pi_A^{mkt}=\frac{(t+\alpha N)^2}{8t}$.

4.2 The Pure Seller Model Equilibrium

Assume that platform A chooses the pure seller model in the first stage, meaning that the platform only sells its own products and there is no third-party seller on the platform. The products of the platform compete with those of third-party seller's offline direct channel, which is reflected in the Hotelling model.

We assume that the marginal consumer z is the consumer for whom there is no difference between purchasing products from platform A and purchasing products from the direct channel of the third-party seller, so the utility acquired from purchasing the product from both channels is the same, i.e., $v-p_A-tz=v-c-t(1-z)$. Then we have

$$z=\frac{1}{2}+\frac{c-p_A}{2t} \tag{6}$$

This suggests that consumers in the interval $\left[0,\frac{1}{2}+\frac{c-p_A}{2t}\right]$ will buy products from platform A, and consumers in the interval $\left[\frac{1}{2}+\frac{c-p_A}{2t},1\right]$ will buy products from the direct channel of the third-party seller.

The profit maximization problem of platform A is $\max_{p_A} \Pi_A=(p_A\text{-}c_A)z$. Substituting Equation (6) into the profit function of platform and solving the first-order derivative of the profit Π_A with respect to p_A, it follows that

$$p_A^{sell}=\frac{c_A+c+t}{2} \tag{7}$$

Where the superscript "*sell*" represents the case where platform A chooses the pure seller model.

From Equation (7), it can be seen that platform A will take into account the marginal cost of its own product c_A, the marginal cost of its competitors' third-party sellers c, and the per unit transportation cost t when it decides the product price under the pure seller model. Clearly, p_A^{sell} increases in c_A and c. Similar to the pure marketplace model, p_A^{sell} increases in t, i.e., the price of the platform's products increases in the degree of differentiation of platform A's products compared to third-party sellers' products.

Substituting Equation (7) into Equation (6) yields the location of the marginal consumer in equilibrium

$$z^{sell}=\frac{1}{4}+\frac{c\text{-}c_A}{4t} \tag{8}$$

Since $0\leq z^{sell}\leq 1$, we have $0\leq z^{sell}=\frac{1}{4}+\frac{c\text{-}c_A}{4t}\leq 1$, then

$$\text{-}t\leq c\text{-}c_A\leq 3t \tag{9}$$

Therefore, the equilibrium profit of platform A is

$$\Pi_A^{sell}=\frac{(t+c\text{-}c_A)^2}{8t} \tag{10}$$

Proposition 2 (Pure seller model equilibrium): *When platform A chooses the pure seller model in the first stage, the equilibrium price of platform A is $p_A^{sell}=\frac{c_A+c+t}{2}$, the marginal consumer is located at $z^{sell}=\frac{1}{4}+\frac{c\text{-}c_A}{4t}$, and the equilibrium profit of platform A is $\Pi_A^{sell}=\frac{(c+t\text{-}c_A)^2}{8t}$.*

4.3 Dual Mode Equilibrium

Assume that platform A chooses a dual model in the first stage, acting both as a market intermediary carrying third-party sellers and as a seller selling its own product. The marginal cost of platform A's self-operated products is c_A. Platform decides the transaction fee τ in the first stage and the product price p_A in the second stage. Then consumers make the purchase decision in the third stage.

According to the previous assumptions, platform A can imitate the third-party seller's products with no cost. That is, the utility that each product brings to the consumer, whether it is a self-owned product of platform A or a product of a third-party seller, is v. A consumer x who chooses to purchase a product through the platform obtains a utility of $u=v+\alpha(N+1)\text{-}p_A\text{-}tx$ if he purchases a self-operated product of platform A. If he purchases a product from a third-party seller's online channel, he obtains a utility of is $u=v+\alpha(N+1)\text{-}(c+\tau)\text{-}tx$. This implies that when $v+\alpha(N+1)\text{-}p_A\text{-}tx\geq v+\alpha(N+1)\text{-}(c+\tau)\text{-}tx$, i.e., $p_A\leq c+\tau$, the online consumer will purchase only the self-operated products of platform A. When $v+\alpha(N+1)\text{-}p_A\text{-}tx<v+\alpha(N+1)\text{-}(c+\tau)\text{-}tx$, i.e., $p_A>c+\tau$, online consumers will purchase only products from the online channel of the third-party seller. The selection of the equal sign in the inequality is determined by the rule in the hypothesis that consumers will choose the product of platform A when there is no difference between platform A's self-operated product and the product of the third-party seller's online channel.

Platform A expects online consumers to buy its self-operated products, so the minimum price it can set for its self-operated products will be equal to the marginal cost of the products, i.e., $p_A=c_A$. In addition, in the dual model, platform A sells its self-operated products to all online consumers while it also carries third-party sellers due to the existence of the intergroup network externalities that attract more consumers. Therefore, platform A will set the lowest transaction fee, i.e., $\tau=0$. From the previous assumption, it follows that third-party sellers will still join the platform even if their demand in the online channel is zero.

As a result, the condition $p_A\leq c+\tau$ for online consumers to buy only platform A's self-operated products will become $c_A\leq c$, and the condition $p_A>c+\tau$ for online consumers to buy only the third-party seller's online channel products will become $c_A>c$. These two conditions imply that, when platform A's self-operated products have a cost advantage over the third-party seller's products, the dual mode will make the demand for the online channel products of the third-party sellers on the platform zero, and online consumers will only buy the self-operated products of platform A. When platform A's products do not have cost advantages, even though platform A chooses to operate in the dual mode and sells its self-operated products, its demand is 0 and online consumers only buy products from the online channel of the third-party seller. The above conditions of product cost advantage can also be replaced with other conditions such as product quality advantage. Therefore, the equilibrium conditions of platform A choosing the dual mode in the first stage of the game will be related to the size of c_A and c.

First, consider the first scenario where platform A has a product cost advantage, i.e., $c_A\leq c$. Online consumers only purchase platform A's self-operated products. There is a difference between platform A's self-operated products and the products of the third-party seller's offline direct channel, which is still reflected in the Hotelling model.

Let the marginal consumer z be the consumer who purchases platform 's self-operated product and purchases the product from the third-party seller's direct offline channel without any difference, i.e., $v+\alpha(N+1)\text{-}p_A\text{-}tz=v\text{-}c\text{-}t(1\text{-}z)$. Then we have

$$z=\frac{1}{2}+\frac{c+\alpha(N+1)-p_A}{2t} \tag{11}$$

The profit maximization problem of platform A is $\max\limits_{p_A}\Pi_A=(p_A-c_A)z+\tau z$. From the previous analysis, we have $\tau=0$. Substituting Equation (11) into the profit function, solving the first-order derivative of profit Π_A with respect to p_A, then we can obtain the equilibrium price of platform A

$$p_A^{dual}=\frac{c_A+c+t+\alpha(N+1)}{2} \tag{12}$$

where the superscript "*dual*" represents the case where platform A chooses the dual model.

From Equation (12), it can be seen that when platform A chooses the dual mode and has cost advantages, the price p_A^{dual} is positively affected by c_A, the marginal cost of third-party sellers' products c, the transportation cost t, and the intergroup network externalities gain $\alpha(N+1)$.

Substituting Equation (12) into Equation (11) yields

$$z^{dual}=\frac{1}{4}+\frac{c+\alpha(N+1)-c_A}{4t} \tag{13}$$

The equilibrium profit of platform A is

$$\Pi_A^{dual}=\frac{[c+t+\alpha(N+1)-c_A]^2}{8t} \tag{14}$$

Comparing the equilibrium prices of the dual mode and the pure seller mode, i.e., Equations (12) and (7), it can be seen that $p_A^{dual}>p_A^{sell}$ since $\frac{\alpha(N+1)}{2}>0$. This suggests that when platform A switches from the pure seller mode to the dual mode, online consumers need to pay higher prices for the same self-operated products of platform A. However, since consumers can obtain the intergroup network externalities benefits $\alpha(N+1)$ (which does not exist in the pure seller mode) when platform A operates in the dual mode, which is greater than the loss of utility $\frac{\alpha(N+1)}{2}$ due to the increase in the price of platform A's self-operated products. Thus, the total utility of the online consumers will still increase, and the number of consumers who choose platform A in equilibrium will also increase. Compared to the pure seller model, the marginal consumer will be located further away from the platform. Therefore, the increase in the price and the quantity demand will result in higher equilibrium profits of platform A in the dual model than those in the pure seller model.

Next, consider another scenario where platform A does not have product cost advantages, i.e., $c_A>c$. Online consumers only buy products from the online channel of the third-party seller, and the demand for platform A's self-operated products is 0. There is a discrepancy of products between the online channel and the direct channel of the third-party seller, which is still reflected in the Hotelling model.

Denote z as the location where there is no difference between purchasing products from third-party sellers' online channels and purchasing products from direct offline channels. That is, $v+\alpha(N+1)-(c+\tau)-tz=v-c-t(1-z)$, by rearranging the equation, we have $z=\frac{1}{2}+\frac{\alpha(N+1)-\tau}{2t}$. Similar to the analytical steps of the first scenario, the equilibrium transaction fee is given as

$$\tau^{dual}=\frac{t+\alpha(N+1)}{2} \tag{15}$$

Substituting Equation (15) into the expression for the location of the marginal consumer yields

$$z^{dual}=\frac{1}{4}+\frac{\alpha(N+1)}{4t} \tag{16}$$

The equilibrium profit of platform A is

$$\Pi_A^{dual}=\frac{[t+\alpha(N+1)]^2}{8t} \tag{17}$$

Comparing the equilibrium transaction fees in the dual mode and the pure marketplace mode, i.e., Equation (15) and Equation (2), it can be seen that platform A will set higher transaction fees when it selects the dual mode. It is that the number of firms on the platform will increase by one when platform A switches from the pure marketplace mode to the dual mode, which in turn increases the intergroup network externalities gains for consumers. Moreover, due to the fact that the price of the third-party seller's online channel product remains unchanged at $c+\tau$, there is no utility loss for consumers, then consumers' utility of choosing the online channel product increases, which in turn makes the increase in the number of consumers on the platform. This makes platform charge a higher transaction fee to third-party sellers. Therefore, in equilibrium the marginal consumer will be located further away from platform A, and the equilibrium profit of platform A in the dual mode is higher than that of the pure marketplace model on account of the increase in the number of consumers on the platform and the volume of transactions. As a result, even though platform A's demand for its own product is zero, it is still more willing to choose in the dual model.

By comparing the equilibrium profits $\Pi_A^{dual}=\frac{[c+t+\alpha(N+1)-c_A]^2}{8t}$ and $\Pi_A^{dual}=\frac{[t+\alpha(N+1)]^2}{8t}$, we find that $\frac{[c+t+\alpha(N+1)-c_A]^2}{8t}>\frac{[t+\alpha(N+1)]^2}{8t}$ when $c_A\leq c$, meaning that platform A obtains higher profits from selling self-operated products. On the contrary, when $c_A>c$, we have $\frac{[c+t+\alpha(N+1)-c_A]^2}{8t}<\frac{[t+\alpha(N+1)]^2}{8t}$, meaning that platform A earns more profits from selling products of the third-party sellers in the online channel. Therefore, the previous condition can still be verified in equilibrium.

The above equilibria in the dual mode can be summarized by Proposition 3.

Proposition 3 (Dual mode equilibrium): When platform A chooses the dual mode in the first stage, there exist two equilibria:

(1) If $c_A \leq c$, i.e., platform A has cost advantages, we drive the transaction fee $\tau^{dual}=0$, the equilibrium product price $p_A^{dual}=\frac{c_A+c+t+\alpha(N+1)}{2}$, and the equilibrium profit $\Pi_A^{dual}=\frac{[c+t+\alpha(N+1)-c_A]^2}{8t}$. The marginal consumer is located at $z^{dual}=\frac{1}{4}+\frac{c+\alpha(N+1)-c_A}{4t}$. In equilibrium all consumers on platform A will purchase platform 's self-operated products, and the demand for products of the third-party seller's online channel is zero.

(2) If $c_A>c$, i.e., platform A does not have cost advantages, we have that the equilibrium transaction fee $\tau^{dual}=\frac{t+\alpha(N+1)}{2}$ and the equilibrium profit $\Pi_A^{dual}=\frac{[t+\alpha(N+1)]^2}{8t}$. The marginal consumers are located at $z^{dual}=\frac{1}{4}+\frac{\alpha(N+1)}{4t}$. In equilibrium all consumers buy the third-party seller's products and the demand for platform A's self-operated product is zero.

From Proposition 3 and the previous analysis, it is clear that when platform A chooses a dual mode, they will always choose to sell products that have cost advantages with intergroup network externalities, which ultimately benefits consumers. Despite considering the assumption of costless imitation of third-party sellers and the self-preferencing behavior by platforms, we still find that the platforms' self-operation strategy benefits consumers through two channels: offering cost-advantaged products or increasing the benefits of consumers' intergroup network externalities.

4.4 Mode Selection

In this section, we explore the endogenous decision of the operation mode. Platform A will compare the equilibrium profits of the three models and choose the optimal operation model.

From the previous analysis, we find that the equilibrium profits of platform A in the pure marketplace model are $\Pi_A^{mkt}=\frac{(t+\alpha N)^2}{8t}$, the equilibrium profits of platform A in the pure seller model are $\Pi_A^{sell}=\frac{(t+c-c_A)^2}{8t}$, and the equilibrium profit of the dual model is related to c_A and c. If platform A has cost advantages over the third-party seller, i.e., $c_A \leq c$, the equilibrium profit of platform A in the dual model is $\Pi_A^{dual}=\frac{[c+t+\alpha(N+1)-c_A]^2}{8t}$. If platform A has no cost advantages over the third-party seller, i.e., $c_A>c$, then the equilibrium profit of platform A in the dual model is $\Pi_A^{dual}=\frac{[t+\alpha(N+1)]^2}{8t}$. The above equilibrium profits of platform A need to satisfy both Equation (4) and Equation (9). The decision of the operation model for platform A can be summarized in Proposition 4.

Proposition 4 (Model choice of platform A): Comparing the equilibrium profits under different models, we have:

(1) $\Pi_A^{mkt}>\Pi_A^{sell}$ when $c_A> c$, or $c_A \leq c$ and $c-c_A \leq \alpha N$;

(2) $\Pi_A^{mkt}<\Pi_A^{sell}$ only when $c_A \leq c$ and $c-c_A>\alpha N$;

(3) $\Pi_A^{dual}>\Pi_A^{mkt}$;

(4) $\Pi_A^{dual}>\Pi_A^{sell}$.

Therefore, platform A will choose the dual model.

From Proposition 4, when the platform's self-operated products do not have cost advantages over third-party sellers' products, i.e., $c_A> c$, the platform will choose the pure marketplace model. Even if platform A's products have cost advantages, platform A will choose the pure marketplace mode if its cost advantage is smaller than the intergroup network externalities, i.e., $c-c_A \leq \alpha N$. Only when platform A not only has cost advantages, but also its cost advantages are greater than the intergroup network externalities, i.e., $c-c_A>\alpha N$, then platform A will choose the pure seller model.

Comparing the dual model to the pure marketplace model, the profits of platform in the dual model are more profitable than those in the pure marketplace model, regardless of whether it has cost advantages or not. The economic intuition behind this is that platform A can choose whether to sell its self-operated products or products of third-party sellers on the platform due to the market dominance of platform A. Platform maximizes profits by choosing products with cost advantages. When $c_A> c$, platform does not have cost advantages and will choose to sell the third-party seller's products on the platform, this indicates that profits of platform A in the dual model are higher than those in the pure marketplace model due to the existence of intergroup network externalities according to the previous analysis. When $c_A \leq c$, platform has cost advantages and will sell its self-operated products on the platform in the dual model. The marginal revenue of each product is $p_A^{dual}-c_A=\frac{c+t+\alpha(N+1)-c_A}{2}$, while the transaction fee under the pure marketplace model is $\tau^{mkt}=\frac{t+\alpha N}{2}$, then we derive that the marginal revenue of the product is greater than the transaction fee. On the other hand, compared to the pure marketplace model, although online consumers in the dual model have to pay higher prices which results in a loss of utility, the consumer utility increases as the intergroup network externalities improve. Since the increase in utility is greater than the decrease in utility, consumers on the platform are more than those in the pure marketplace model, meaning that there is a larger transaction volume. These two items lead to higher profits for platform A in the dual model than in the pure marketplace model. Therefore, platform 's profits in the dual model are higher than those in the pure marketplace model, regardless of whether it has product cost advantages or not.

Consider the dual model and the pure seller model: when $c_A> c$, platform A in the dual model only sells the products of the third-party sellers on the platform, and acquires profits by charging a transaction fee $\tau^{dual}=\frac{t+\alpha(N+1)}{2}$. In contrast, in the pure seller model, the marginal profit of each product is $p_A^{sell}-c_A=\frac{c+t-c_A}{2}$. Since $c_A> c$, the platform obtains a higher transaction fee in the dual model than that in the pure seller model. In addition, due to the existence of intergroup network externalities, the volumes of transactions in the dual model are larger than those in the pure seller model. These two items result in higher profits for platform A in the dual model than those in the pure seller model. On the contrary, when $c_A \leq c$, profits of platform A in the dual model are higher than those in the pure seller model according to the previous analysis. Therefore, profits of platform A in the dual model are higher than those in the pure seller model, regardless of whether there are product cost advantages or not.

In conclusion, platforms achieve the highest equilibrium profits in the dual mode under the three modes, which suggests that it is an inherent choice for platforms to maximize their profits by adopting a self-operation strategy to some extent.

5 WELFARE OF BANNING DUAL MODE OF PLATFORMS

This section analyzes the welfare of platforms and consumers when the antitrust authority or the corresponding policymaking department introduces a policy that bans platforms from operating in a dual mode. When a platform is banned from operating in a dual mode, it can only choose from a pure marketplace mode or a pure seller mode which depends on the profits. Since profits of third-party sellers are always zero, the ban on dual mode of platforms has no effect on them.

Based on Proposition 4 and the previous equilibrium analysis of the three models, the impact of the dual mode ban of the platform on the platform's profit (Π_A), consumer surplus (CS), and social welfare (W) are obtained in Proposition 5.

Proposition 5 (Welfare effects of a ban on dual modes): The effect of the ban on the dual mode of platforms on platforms' profits, consumer surplus and social welfare is shown in the Table 1:

Table 1 Welfare of Banning Dual Mode of Platforms

	Platform A's model selection	CS	Π_A	W
If $c_A > c$	pure marketplace model	↓	↓	↓
If $c_A \leq c$ and $c-c_A \leq \alpha N$	pure marketplace model	↓	↓	↓
If $c_A \leq c$ and $c-c_A > \alpha N$	pure seller model	↓	↓	↓

Note: where "↓" stands for decline.

From Proposition 5, it can be seen that banning dual mode of platforms, whether by switching to a pure marketplace model or a pure seller model of operation, the profits, consumer surplus and social welfare of platform A will decrease. The reasons for the decrease in platform A's profits are explained later in Proposition 4, and the reasons for the decrease in consumer surplus and social welfare can be explained as follows.

When the dual mode is banned, if $c_A > c$, platform A will choose the pure marketplace mode, and consumer surplus will decrease. When platform A shifts from the dual mode to the pure marketplace model, the number of third-party sellers on the platform decreases, then the intergroup network externalities which can benefit online consumers also decrease. Although the product price decreases, the decrease in the utility due to the decrease in the intergroup network externalities is greater than the increase in utility due to the decrease in price. Thus, online consumer surplus will decrease. In contrast, offline consumer surplus remains unchanged, so the total consumer surplus decreases. Since both platforms' profits and the total consumer surplus decrease, social welfare decreases.

If $c_A \leq c$ and $c-c_A \leq \alpha N$, platform A also chooses the pure marketplace model in the ban of the dual model. Since platform A has cost advantages $c_A \leq c$, the online consumers will buy only the platform's self-operated products for $p_A^{dual} = \frac{c_A+c+t+\alpha(N+1)}{2}$ and get the benefits of $\alpha(N+1)$ from the intergroup network externalities without the ban of the dual mode. On the contrary, when the dual model is banned, due to the fact that platform 's cost advantage is smaller than the benefits obtained from the intergroup network externalities, i.e., $c-c_A \leq \alpha N$, platform A will choose the pure marketplace mode. Online consumers buy the third-party seller's products for $c+\tau^{mkt} = c+\frac{t+\alpha N}{2}$, and they obtain benefits αN from the intergroup network externalities. Compared to the dual mode, the net surplus of online consumers will decrease in the pure marketplace mode. As a result, both the total consumer surplus and social welfare will decrease. Even though the platform has product cost advantages, the platform will not choose the pure seller model under the ban of the dual model, and consumers can no longer access products with cost advantages.

If $c_A \leq c$ and $c-c_A > \alpha N$, the platform will shift from the dual model to the pure seller model in which the dual model is banned. Before the ban on the dual mode, the platform will only sell its self-operated products without any third-party sellers on the platform since the platform has cost advantages. When the platform transforms the dual mode to the pure seller mode, the price of the platform's products decreases from $p_A^{dual} = \frac{c_A+c+t+\alpha(N+1)}{2}$ to $p_A^{sell} = \frac{c_A+c+t}{2}$. The decrease of consumers' utility that the intergroup network externalities bring is more than the increase of utility that the decrease of the product price brings, then the net surplus of online consumers will decrease. Therefore, both the total consumer surplus and social welfare will decrease.

To sum up, under the ban of the dual model, benefits obtained from the intergroup network externalities will diminish, and the platform can no longer have cost advantages, leading to a decrease in the consumer surplus, profits of platforms and social welfare.

6 THE POLICY EFFECT OF DUAL MODE OPERATION OF PLATFORMS

This section analyzes the effectiveness of the main policies about the dual mode of platforms. There are two types of policies against the dual mode of platforms: One is structural remedies (vertical separation), which prohibits platforms from operating in a dual mode; the other is behavioral remedies, which permits platforms to operate in a dual mode but takes remedial measures against unfair competition or behaviors detrimental to consumers' interests.

6.1 Structural Separation

The structural separation policy involves the ban on dual mode operation of platforms. The European Commission raised the policy during its antitrust investigation against Google in 2019. India also banned Amazon from the dual mode in 2019.

From Proposition 5, even in situations where platforms are allowed to imitate the products of third-party sellers and to perform self-preferencing, both the consumer surplus and social welfare will decrease in the ban on the dual mode operation. Since consumers cannot obtain products with cost advantages and benefits that intergroup network externalities bring, structural separation policies do not improve consumers' situation. In addition, profits of platforms will decrease in the structural separation policy, which may not be conducive to the sustainability of platforms.

6.2 Behavioral Remedies Policy

The behavioral remedial policy involves the ban of copying and imitating from the products of third-party sellers, the ban of self-preferencing to platforms' self-operated products, or both. When the platform is banned from imitating the third-party seller's products, the self-operated and the third-party seller's products bring different utilities to consumers, i.e., v in this paper will be different. Moreover, the platform will sell both its self-operated products and third-party sellers' products in the equilibrium of the dual mode. This may intensify the price competition between the platform and third-party sellers, which may benefit consumers.

When self-preferencing of the platform to its self-operated products is banned, consumers will randomly choose the products of platforms or third-party sellers if there is no difference between the products of platforms and those of third-party sellers. Given the existence of the self-preferencing, consumers will purchase the platform's self-operated products rather than products from third-party sellers. The ban on self-preferencing of the platform can improve the market environment, which is beneficial to consumers and can increase social welfare.

Therefore, policies that implement behavioral remedies against unfair competition arising from dual modes of platforms may behave better than structural separation policies that directly prohibit the dual mode of platforms [18].

7 CONCLUSION

As platforms achieve market dominance, more and more giant platforms adopt the dual mode. They serve as both the intermediary marketplaces and sellers of self-operated products. As "gatekeepers", platforms may engage in unfair competition, which leads to investigations by antitrust authorities. However, researches on platforms' self-operated strategies are emerging, and there is no consistent conclusion concerning the welfare effects and whether platforms' dual mode should be banned. In this paper, we utilize the Hotelling model to explore the equilibrium of platforms under three modes, i.e., the pure marketplace mode, the pure seller mode, and the dual mode. Furthermore, we endogenize the model selection of platforms and analyze the impacts of the ban on the dual mode of platforms on consumer welfare, profits of platforms, and social welfare. Finally, we briefly discuss the current policy effects of the self-operation strategy of platforms. We conclude the following :

(1) The platform's self-operation strategy benefits consumers, the platform and social welfare. When platforms adopt the self-operation strategy and operate in a dual mode, they benefit consumers through two mechanisms: offerings of products with cost advantages and benefits of intergroup network externalities.

(2) Compared to the pure marketplace model and the pure seller model, platforms achieve the largest profits in the dual model, which indicates that platforms will endogenously choose the self-operation strategy and the dual mode for profit maximization.

(3) When platforms are banned from the dual mode and enable them to endogenously choose their operation mode, they will choose the pure seller mode only when platforms have cost advantages and the difference between the marginal cost of third-party sellers and that of the platform is larger than benefits that intergroup network externalities bring; otherwise, the result is reserved, they will choose the pure marketplace model.

(4) Consumer surplus, profits of platforms and social welfare will decrease in the ban of the dual mode of platforms. Therefore, the structural separation policy that directly prohibits the dual mode of platforms cannot improve consumer surplus and social welfare.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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