The optimal pricing strategy for two-sided platform delivery in the sharing economy

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ABSTRACT

Nowadays many platforms emerge to provide delivery services by having independent shoppers to deliver groceries from independent retailers to consumers. To understand how to price this service, we formulate a two-sided platform's profit maximization problem by considering network externality. We focus on three pricing strategies, membership-based pricing, transaction-based pricing, and cross subsidization. When time discounting is absent and consumers' order frequency is price-insensitive, it is shown that these three strategies are equivalent. As membership-based pricing collects money the earliest and maximize price-sensitive order frequency, our analysis explains some platforms' promotion of it.

1. Introduction

Traditionally, a delivery service provider delivers goods from self-owned warehouses to its consumers using its own trucks and employees. In the grocery delivery industry, companies like AmazonFresh adopt this operation model. Owing to the advances in technology, however, different types of delivery services spring up in recent years. In particular, some companies build Internet platforms for consumers to order groceries and food materials online. Instead of building a centralized logistics system, the platform assigns these consumer orders to independent contractors, often called shoppers in this business model, for them to buy the ordered goods from independent brick-and-mortar retailers and ship to consumers. As the central service enabler presents as a two-sided Internet platform connecting consumers and shoppers, we call it *platform delivery* in this study.

As of 2016, one of the most successful platform deliverer is Instacart, a San Francisco-based startup founded in 2012. Valued more than two billion dollars, Instacart was listed as top one in *Forbes America's most promising companies list* in 2015 (Soloman, 2015). Another famous platform deliverer is UberEATS. As one expansion service operated by the Uber group since 2014, it utilizes part-time deliverers to deliver meals made by partner restaurants to doors in more than twenty countries. Besides startups, big companies also enter this industry in the same way. For example, Google founded Google Express in 2013 to be another platform for grocery delivery service. An obvious advantage of this operation model is that the delivery service can be provided without owning any warehouse, trucks, and full-time shoppers. A huge initial investment can then be saved. Nevertheless, because the shoppers are not full-time employees, sufficient incentives must be provided to prevent shortage of shoppers. This is a key issue faced by all platforms in the sharing economy.

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In general, the success of a platform delivery company (and most multi-sided Internet platforms) relies on its installed base. A higher number of shoppers attracts more consumers to join the platform, and vice versa. This feature is documented as the positive cross-side network externality. Obviously, more shoppers attract more consumers, as it will become easier and faster for a consumer to find a shopper to complete the delivery. Similarly, more consumers attract more shoppers, as it will be more likely to get assigned an order. Therefore, for a platform, the most critical problem is to provide sufficient incentives for both sides to be large enough. In the design of an incentive system, pricing is clearly crucial. The most challenging part of this problem is that, even though the platform faces two sides of users, the pricing problems for the two sides are never independent due to the cross-side network effect. The two pricing problems must be considered together to optimally provide incentives for shoppers and consumers to stay connected to the platform. This brings new challenges and a great potential values to the investigation of platform pricing.

In practice, almost all the platform deliverers allow one to place an order by paying a per-transaction fee. Instacart, Google Express, and UberEATS are all examples. This pay-by-transaction option is necessary to allow new consumers to try the service. Interestingly, some platform deliverers also offer subscription-based membership programs. As of December 2016, one may pay $149 to Instacart or $95 to Google Express to enjoy free shipping (by meeting some minimum order amount) for one year. Obviously, there must be some reasons behind this strategic decision. This motivates us to examine the economic value of a membership program and the general pricing problem for a delivery platform.

While in theory all kinds of pricing plans can be adopted, complicated policies are hard to execute and incurs implicit management costs. Therefore, in industry some simple strategies are popular. If a company adopts the *membership-based pricing* strategy, the platform sustains losses in every transaction but charges every consumer a fixed membership fee at the beginning of each membership period. On the opposite, the platform may charge a per-transaction fee but no fixed fee. This is the *transaction-based pricing* strategy. Note that, at least for the platform delivery business, it is less natural to subsidize a shopper a fixed fee before she/he provides any services. However, whether it is more profitable to charge membership fees, transaction fees, or both from consumers is not so clear. In either case, the platform needs to decide the amount paid to the shopper in each transaction. This introduces the third strategy, which we call it the *cross-subsidization* strategy, under which the platform simply subsidizes the shopper exactly the amount collected from the consumer in each transaction (and therefore earns revenues only from membership fees). It is worthwhile to investigate which pricing strategy may generate the highest profit for the platform.[1]

In this study, we construct a game-theoretic model featuring sharing economy and network externality to examine a grocery delivery platform's two-sided pricing strategy. There are three types of players in the market, a platform, a group of potential consumers, and a group of potential shoppers. The major purpose of our work is to study the profitability of the three pricing strategies mentioned above, whether any of them can be globally optimal, and figure out factors that affect their profitability. On one hand, we aim to theoretically explain the economic rationale behind these pricing mechanisms popularly adopted in practice. On the other hand, we also hope to provide a good reference for platforms in industry to design their pricing plans to efficiently incentivize users to join the platform.

Our main findings are as follows. When time-discounting of revenues is absent and consumers' order frequency is insensitive to price, the three strategies are equivalent. They are equally good in incentivizing the players in this system, in a sense that all of them result in the same number of consumers, shoppers, and platform profits. This finding is valid regardless of the functional form of service quality, existence of negative same-side network externality among consumers, distributions of users' types, and magnitude of marginal cost. Nevertheless, when the platform is impatient in receiving revenues or consumers' order frequency is affected by the per-transaction fee, membership-based pricing is the most profitable strategy due to its capability of collecting money early and maximizing the price-sensitive order frequency. Our analysis provides an explanation of why in practice some platforms would promote its membership program.

In the next section, we review some related works with respect to sharing economy, delivery service, and two-sided platforms. In Section 3, we develop a game-theoretic model that describes the interaction among the platform, consumers, and shoppers. The analytical results of the basic model are then presented in Section 4. We examine extensions about time discounting and price sensitivity in Section 5 to draw more fruitful implications. Section 6 concludes. All proofs are in the appendix.

2. Literature review

In the transportation industry, many companies are eager to find out critical success factors making Uber a classic paradigm shift and follow similar business models. Many people attribute the success of Uber to "sharing economy," which emphasizes how to make good use of idle resources spread in the market. For instance, Santi et al. (2014) claim that the cumulative trip length could be reduced by roughly 40 percent when using ride sharing like Uber as opposed to using traditional taxis. Andersson et al. (2013) investigate ways ride sharing could improve the use of idle resources, and classify the

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[1] It is admittedly true that some platforms in practice adopt membership-based and transaction-based pricing simultaneously for a consumer to self-select. In this study, however, we do not study such a menu of offers for two reasons. First, if we can show that pure membership-based pricing may be better than pure transaction-based pricing and pure cross subsidization, we are able to provide at least one justification for the membership programs we observe in practice. Second, the analysis is difficult, if not impossible, as most platform studies in the economic literature does not consider a menu of contracts. Nevertheless, our analysis does provide a good foundation for future studies about menu design for a multi-sided platform.