Analytics for X 2022: Extended Abstract

Title

The Effect of Platform Dynamic Pricing Competition on Sellers

Research Problem

Online platforms use aggressive price promotions to build a customer base and compete for market share during the start-up phase. Sellers pay fees when selling on platforms that compete with their own (direct) sales channel. They see an increase in sales but become more dependent on platforms and have less bargaining power as the online market grows. Raising the commission rate is one predictable action of the platform. Other downsides of the platform are mentioned in Hagiu and Wright (2021), e.g. platform siphoning, manipulation of recommendations, and price restrictions.

Our paper studies a fundamental research question. *What is the effect of platform competition on sellers?* More specifically, we answer the following counterfactual questions:

- First, what are the sellers' profits if there are no platform channels?

- Second, what if there is an increase in platform commission fees from 5% to 15%?

- Third, any effective ways to mitigate the platform's negative impact.

Key Conclusions

1. The seller is better off when the seller joins the platform with a low commission fee. The seller benefits from a larger marketplace and a subsidy from the platform.

2. The seller's profit is eroded when the platform has bigger market power so that platform is able to raise the commission fee.

3. Platform leakage is an effective way to mitigate the negative impact of the platform. The seller can "steal" customers from the platform by providing low prices exclusively on the direct sales channel.

Introduction

In order to study the questions, we develop a multi-category, multi-store demand model and a dynamic pricing game. The demand model allows rich customer heterogeneity, market evolution and category substitution, and complementarity relationships. The supply model features complex pricing patterns and captures the aggressiveness of the platform and seller in customer accumulation.

Demand Model

Our demand model originates from the framework developed by Thomassen et al. (2017). It is a discrete-continuous choice model, customers choose which channel to visit, either seller or platform, and decide the quantity of each category, zero purchase in any category is allowed. The model has the following features. First, the cross-category effect is considered to capture the substitute-complement relationship, which is an important factor mitigating suppliers' market power. Second, we innovatively add a time-varying channel fixed effect to capture the evolution of the channels, e.g. UI design, reputation, and user experience. Third, rich heterogeneities deal with unobserved preferences, including channel-specific price sensitivity, characteristics, and random taste.

The demand model estimation is based on GMM (Generalized Method of Moments). Moments to match are platform/direct channel choice and the quantity of each category. We also employ IVs (instrumental variables), like time dummy, channel dummy, customer info, price, and prices of other categories, to deal with the endogeneity.

Supply Model

A supply model has two forward-looking players, the seller and platform, who simultaneously choose the price for each category from 6 price levels, to maximize the expected discounted payoff, which includes short-run profit, switching cost, and customer share. Subsidization cost is included in the short-run profit and asymmetric switching cost is assumed when there is a price change. Customer share can be regarded as an important strategic resource or a guarantee for long-run profit. Different weights on customer share reflect how different players value the long-run profit, which corresponds to the actions observed. Our dynamic discrete game is based on the oligopoly framework, which can be estimated and solved based on the method from Aguirregabiria and Mira (2007) and Aguirregabiria, Collard-Wexler, and Ryan (2021).

Supply model parameters are identified in close form, we utilize parameter linear separability and use the least square method from Aguirregabiria, Collard-Wexler, and Ryan (2021). By employing machine learning, we can obtain the empirical equilibrium CCP (conditional choice probability), which shows excellent in-sample fit as well as prediction ability for unobserved action/states. Two main econometric challenges in the demand model are solved. First, zero expenditures at the category level lead to binding non-negativity constraints in the consumer's continuous category demand problem. Second, a consumer's unobserved channel-category tastes influence both his choice of channel and his category demands.

Results and Implications

We have three interesting findings from the demand estimates. First, customers are more price sensitive on the seller's channel. One unit price increase on both channels exhibits asymmetric results, that is, a consumer is less likely to buy from the direct channel and has fewer purchases compared to the change on the platform channel. Second, individual heterogeneities play an important role when a customer decides where and how many to buy, of which membership is the most dominating heterogeneity. Third, the cross-category effect is important when making a purchase decision.

The supply model estimation results uncover how platform and seller value their customer shares and the price adjustment costs. Seller puts more emphasis on developing direct channel customer share, and strategically conducts promotions to attract more customers. We find a significant difference in price adjustment cost between seller and platform, any changes in price will incur the costs in inventory, supply chain, and advertising for the seller whereas minor operation costs for the platform.

We find that online platforms benefit sellers in the short run through subsidization and a bigger marketplace. However, sellers' profit is eroded in the long run by the platform which has increased market power and strategic resource like customer data. Platform leakage is one effective way to "steal" customers from the platform to direct sales channel, thus mitigating the negative impact of platform market power.

Reference

Aguirregabiria, Victor, Allan Collard-Wexler, and Stephen P Ryan. 2021. "Dynamic Games in Empirical Industrial Organization." In *Handbook of Industrial Organization*, 4:225–343. 1. Elsevier.

Aguirregabiria, Victor, and Pedro Mira. 2007. "Sequential Estimation of Dynamic Discrete Games." *Econometrica* 75 (1): 1–53.

Hagiu, Andrei, and Julian Wright. 2021. "Don't Let Platforms Commoditize Your Business." *Harvard Business Review* 99 (3): 108–14.

Thomassen, Øyvind, Howard Smith, Stephan Seiler, and Pasquale Schiraldi. 2017. "Multi-Category Competition and Market Power: A Model of Supermarket Pricing." *American Economic Review* 107 (8): 2308–51.