Optimal Commissions & Subscriptions in Networked Markets

We consider a platform providing a marketplace for a group of sellers and buyers to trade with each other. For instance, one can purchase goods from others on eBay, arrange accommodation through Airbnb, and find temporary projects/workers on online labor markets such as Upwork. In exchange for facilitating trade, these platforms commonly obtain a commission from each transaction and/or charge subscription fees to sellers and buyers who access the platform. Moreover, these platforms cannot directly control the transaction prices, i.e., traders determine the prices at which the goods/services are exchanged. As such, their revenues depend both on the chosen commissions/subscriptions and on the prices at which buyers/sellers transact. How should the platforms design commission/subscription fees with the objective of maximizing their revenues under the constraint that prices cannot be directly controlled? Is it sufficient to charge these to only one side of the market or is it necessary to charge them to both sides? What is the role of the underlying compatibility structure, and which structures are more conducive to higher revenues? In which settings is price discrimination most valuable? What are the welfare implications of implementing revenue-maximizing commission/subscription fees?

In order to answer these questions, we study the platform’s revenue maximization problem. Potential buyers and sellers are divided into types; not all buyer and seller types are compatible with each other. We encode the compatibility among different types using a bipartite network. Our first
result is to establish that, for any given commissions/subscriptions, (under mild assumptions on value distributions) an equilibrium exists. Moreover, the equilibrium is effectively unique, i.e., different equilibria share same equilibrium prices and total transaction amounts for each buyer/seller type.

Second we provide a method for obtaining the optimal commission rates and the subscription fees in a networked market. Since for given subscriptions/commissions it may be necessary to solve a nontrivial optimization problem to even identify the corresponding equilibrium (and the revenues), optimizing over subscriptions/commissions initially appears to be difficult. We develop a tractable relaxation problem in the form of a min-cost network flow problem with convex edge costs, which can be efficiently solved. We show that this relaxation is tight, and optimal commissions/subscriptions that achieve this revenue upper bound can be constructed in a tractable way through the optimal dual solution (node potentials) of our network flow problem.

Third, we characterize the structure of the optimal commissions/subscriptions. We establish that revenues can be maximized by using only commissions or using only subscriptions. However, it is necessary to offer different commissions/subscriptions to different types. In fact, we show that the revenue loss of using the same commissions/subscriptions can be unbounded when agents have heterogeneous value distributions. Under homogeneous value distribution, the revenue loss can be lower-bounded by the level of supply/demand imbalance induced by the network structure. Perhaps more surprisingly, we show that, in general, charging subscriptions/commissions to only one side of the market (i.e., only to buyers or only to sellers) leads to lower revenues than optimal, even when different types on the same side are charged different subscriptions/commissions. Note that in the simpler setting where there is only one type of buyer and one type of seller, to maximize revenues it would suffice to charge payments only to one side. Thus, naively the same result may be expected to hold in general settings as well. Our finding illustrates that taking into account the underlying compatibility network leads to significantly different insights, and is fundamental for a platform’s commission/subscription design problem. Our observations are consistent with trending practice by
Amazon, Airbnb and Alibaba which charge heterogeneous commissions/subscriptions to sellers and buyers in their marketplaces.

Fourth, we explore the impact of the network on (1) the marginal valuation of each type of buyer/seller (which corresponds to the net payment made/received by the relevant types), (2) the sensitivity of the platform’s revenue on the mass of available traders at each node of the underlying network, (3) the revenues of the platform. We observe that the marginal valuation is the highest when the population of sellers is the scarcest relative that of the buyers, which further suggests that it is the most/least profitable to expand the corresponding seller/buyer types. We provide an upper bound on the platform’s revenues and show that this upper bound is achieved for network structures where each subset of buyers has access to “sufficient” amount of compatible sellers. We also define a partial order over network structures, and establish that this partial order allows for comparing different networks in terms of the revenues they induce for the platform.

Finally, we focus on the induced welfare when the platform uses revenue-maximizing commissions/subscriptions, and quantify the welfare loss relative to the socially efficient outcome. We show that when the agents have uniform valuations, the welfare induced under optimal commissions/subscriptions is at least 75% of the maximum achievable welfare. We also establish that, when same-side agents have homogeneous value distributions that are convex for buyers and concave for sellers, the welfare efficiency is at least 66.7%. However, the welfare loss can be arbitrarily bad under general distributions.

Overall, our results shed light on the design of revenue-maximizing commissions/subscriptions for platforms. They also highlight the importance of explicitly taking into account the structure of the compatibility network for this purpose. We establish that doing so leads to qualitatively different insights on the optimal commission/subscription structures (e.g., it is no longer revenue-maximizing to have agents only on one side pay for using the platform). At the same time, the underlying network structure has a direct impact on the revenue the platform can extract from its users, and exploiting this structure it is possible to characterize the revenues achievable in different settings.