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1 Introduction

[Piquing reader's curiosity]Information provision about goods or trading partners is important for the efficiency of platforms that match buyers and sellers of products or services, such as platforms for house rental, labor contracting and transportation. Providing more information allows participants to identify and pursue the most valuable matches, and online platforms spend significant resources eliciting match-relevant information from users. However, sometimes this information is not fully revealed to the users. For example, Uber currently does not show drivers the passenger's destination until after the driver has accepted the ride, even once the passenger entered it into the application. Airbnb hosts who turn on the "Instant Book" feature commit to accepting all requests without knowing the details of prospective guests. Why do such platforms choose not to disclose all the relevant information fully? What is the optimal information intermediation policy for platforms that care about both sides of the market? What does it depend on?

[explain the setting I am working in, asymmetric treatment of buyers and sellers] I study the information intermediation problem in the context of the following model. Buyers seek sellers' services to complete their jobs. Buyers contact sellers, who then review buyer attributes and choose whether to accept or reject the buyer job. Buyers are short-lived, must match quickly, but are indifferent about which seller completes their task. Sellers are long-lived, are indifferent about the match speed, but have heterogeneous preferences over buyers. In particular, not all jobs are profitable. Sellers have limited capacity for serving buyers. If a seller accepts a job, he becomes unavailable for a fixed period of time and cannot accept new jobs. The platform designs an information disclosure policy that governs which buyer attributes are disclosed to sellers before deciding on buyer requests. I consider the general platform's objective of maximizing the weighted average of buyer surplus and seller profits. Note that in this model, buyers are sellers are asymmetric, which focuses the information disclosure problem on the seller side of the market. If buyers have preferences about a match, the disclosure problem would be two-sided.

[explain why full disclosure need not be optimal] In this model, a key tradeoff arises between match quality and match rate. Full information disclosure need not be optimal because information disclosure can negatively affect the match rate overpassing the positive effect on the match quality. Seller profit is a product of match quality and match rate, and buyer surplus is an increasing function of the match rate. Seller profit function does not align with the platform objective. Specifically, profit-maximizing sellers will *cream-skim* and reject inefficiently many jobs. The platform, unlike sellers, cares about welfare on both sides of the market, and so efficient disclosure is coarse if the negative effects of information disclosure on the match rate are strong. This paper considers how the optimal disclosure policy depends on the details of the seller side of the market.

[explain why there is a tradeoff between match quality/match rate] Efficiency requires that both match quality and match rate be high. Seller profit is larger when both are high, whereas buyer surplus is large when the match rate is high. Yet, match quality and match rate are in conflict. Enforcing higher match rates compromises quality because sellers are forced to accept more inferior jobs. Similarly, allowing sellers to cherrypick the most valuable buyers leads to higher rejection and lower match rates. For example, if Uber drivers reject passenger requests more often, passengers will have longer wait times. On Airbnb, if hosts reject guest inquiries more frequently, guests must spend more time searching.

[Explain the three effects of info disclosure]Optimal disclosure policy must balance

disclosure policy is coarse but has a simple form. It sends one of two recommendations to sellers, "accept" or "reject", which are chosen such that the sellers have incentives to follow them. The welfare maximizing policy is the intermediate case between the buyer-optimal disclosure and seller-optimal disclosure. To maximize the buyer surplus, coarsening is necessary because sellers underweight the match rate relative to buyers in their payoff functions. The higher are buyer search costs (and thus the costlier are rejections), the coarser is optimal disclosure. Perhaps more surprisingly, when maximizing the joint seller profits, the optimal disclosure is also coarse.

[Seller coordination failure]The adverse effect of disclosure on joint seller profits is a form of seller coordination failure. In a marketplace where sellers act independently, each seller keeps his schedule open by rejecting low-value jobs to increase his own chances of getting high-value jobs. As a result, sellers spend significant time waiting for high-value jobs. Collectively, this behavior is suboptimal because all profitable jobs have to be completed to maximize the joint profits. I attribute the source of the coordination failure to what I call the *cream-skimming externality*: By rejecting a job, a seller remains available on the marketplace and attracts a fraction of subsequent buyers, who otherwise would move to other sellers. As a result, the other sellers face fewer profitable jobs and obtain lower profits. The cream-skimming externality arises only when sellers have limited capacity and are forward-looking. When this externality is present, sellers underestimate the effect of their own acceptance rate on the platform-wide match rate and collectively resolve the match quality-match rate tradeoff sub-optimally. Coarsening information decreases opportunity cost of rejecting and can increase the match rate to the seller-optimal level.

[Heterogeneous sellers]When sellers are unobservably heterogeneous, the optimal disclosure is finer than in the case of identical sellers. With heterogeneous sellers, the match quality effect of information disclosure is stronger, but there are important subtleties. Coarse disclosure tailored to increase one seller's acceptance rate can drive another seller's average profit below zero and violate his individual rationality constraint. If any coarsening is optimal, the degree is now not obvious. The optimal policy should accommodate the possibly opposite reactions of sellers to disclosure and will depend on the shape of the seller type distribution.

[Linear payoff environment]To understand how seller heterogeneity affects optimal disclosure policy, I study a linear payoff environment, with vertically differentiated buyers and sellers. In this case, the optimal disclosure policy depends on the shape of seller type distribution, the intensity of buyer traffic, and the tightness of seller capacity constraints. In this case, the seller match payoff is linear in buyer and seller characteristics, and buyer match payoff is constant. I first consider the case of uniform distribution of seller types, where I can fully characterize the optimal disclosure policy. A key result with a uniform distribution of sellers, is that the match-rate maximizing disclosure policy is *upper-coarsening*: high buyer types are pooled and low buyer types are revealed truthfully. This is in stark contrast with the case of unconstrained sellers, in which information disclosure does not affect the match rate (cf. KLMZ-wp ?). When buyer-to-seller ratio is high or when the sellers are more capacity constrained, the efficient disclosure is also upper-coarsening. In the converse case, the full disclosure is efficient.

Turning to a general (non-uniform) distribution of sellers, I find that optimal disclosures can have a variety of qualitatively different shapes depending on the distribution. The

heuristic in the case of unconstrained sellers is to pool buyer type on the increasing part of buyer probability density function g, and reveal buyer type on the decreasing part of g. With capacity constrained sellers, this heuristic should be further qualified with seller utilization rates. Despite the complexity I find the first-order condition for the general case in **??**.

[applications]The model is mainly motivated by the matching problems of digital marketplaces. To use Airbnb as an example again, guests (buyers) are differentiated by age, gender, race, personality, etc. Hosts (sellers) have preferences over the number of guests, their gender, race, lifestyle, etc. While guests prefer to minimize time spent searching and book a listing instantly, hosts want to avoid offensive or inconvenient guests. Airbnb introduced InstantBook feature to satisfy the guests' demand for convenience. In my model, it corresponds to the no disclosure policy. However, one could imagine a finer tool that allowed a host to specify guest types that were permitted to use the InstantBook. The problem of optimal guest segments is equivalent to the problem of the optimal information disclosure, and, as argued above, has important tradeoffs. Uber's matching system is another notable example. Uber directs passenger (buyer) requests to drivers (sellers), and the requests include information about the passenger. In the current version of UberX, the passenger's destination, though relevant to the driver payoff, is not shown. One final example is on-demand labor platforms, such as TaskRabbit. On this platform, freelancers (sellers) commit to an hourly rate over a broad category of tasks, such as Moving. The problem of the optimal category breadth is equivalent to the problem of the optimal disclosure policy of client task characteristics, and can also be analyzed with the framework outlined.

[contributions]There are two primary contributions of this paper relative to the existing literature. First, the paper considers the role of information intermediation in matching markets. It shows that strategic information disclosure can be an effective tool to balance the match quality and the match speed. When the sides of the market are not symmetric in their preference for match quality and match rate, the more patient and more selective side of the market (sellers in my model) tends to cream-skim. Strategically limiting information can be used to decrease cream-skimming and improve total welfare. Additionally, limiting information can alleviate the seller coordination failure by offsetting the cream-skimming externality.

The paper also contributes to the literature on information design. The paper extends the model of signaling game with heterogeneous audience to the case with endogenously available and dynamically optimizing receivers. In this case, the design of the optimal information disclosure is a non-trivial problem. With forward-looking receivers, information disclosure policy determines not only the receiver's stage payoff but also the distribution of his potential future payoffs. As a result, receiver's decision to accept depends not only on the posterior mean of the state but also on the entire signaling structure. This makes the concavification approach of **?**[KG11], as well as the linear programming approach of **?**[Kol15] unsuitable for the analysis of my model. I approach it by representing signaling structures as a particular class of convex functions and then using the calculus of variations to find the first-order necessary conditions. **??** sketches the main steps of the approach.

The rest of the paper is organized as follows. The next subsection relates this paper to the existing literature and highlights my contributions. **??** introduces the model of match-

ing market, and establishes the existence and uniqueness of equilibrium. **??** contains the discussion of the key assumptions of the model. **??** sets up the platform's information disclosure problem, solves and explains it in different settings. First, **??** explains the seller coordination failure. Then, **??** studies the setting with identical sellers, and **??** discusses the competing effects of information disclosure . **??** studies the setting with heterogeneous sellers and presents the main characterization result of the paper. **??** describes the technique for proving the main theoretical result.

[other related papers and strands]