

Digital Marketplaces

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1 Introduction

Digital marketplaces represent a new and important organizational form in the economy. They have enabled new types of transactions such as online auctions, ride-sharing, and home-sharing, have grown to dominate verticals such as travel and books, and have continued spreading through other industries. The growth and increasing importance of these marketplaces has prompted a new and growing body of research. In this paper, I summarize this research, divided into three areas: effects on the economy, market design, and policy implications.

There is no universally accepted definition of an online marketplace. Delineating between online marketplaces and traditional firms is becoming harder as more firms are embracing technology. One way to do this delineation is to make a list of companies that could be considered digital marketplaces and consider what they have in common. A non-comprehensive list would include Airbnb, Alibaba, Amazon Marketplace, Craigslist, eBay, Expedia, Uber, and Upwork. Although these firms serve different verticals and use a variety of market designs, they share certain characteristics. I list these below both to highlight their salient features and to limit the scope of this article.

- **Digital Matching:** The process of search and matching between buyer and seller occurs digitally via a browser, app, or text interface. Digital interfaces allow for a precise tracking of the actions of users, which enables algorithmic matching. This is in contrast to older, relatively information poor shopping interfaces such as physical stores or mail-order catalogs.
- **Low Entry Costs:** A variety of sellers are allowed to participate in the platform and the entry costs are typically low. That means that non-professional sellers such as hobbyist collectors on eBay can compete with large firms such as Target.
- **Ex-post Screening:** A significant share of the screening is conducted ex-post, through explicit or implicit feedback given by users regarding transaction quality. Ex-post screening usually involves online reviews but can also include data on user engagement and customer service complaints.
- **Non-exclusive and Short-run Contracts:** Sellers are not obliged to exclusively use a particular platform, do not engage in long-term em-

ployment relationships, and retain at least some control rights over their product.

- **Direct Transactions:** The money paid by the buyer is transferred at least partially to the seller. This excludes other digital intermediaries such as streaming platforms (Netflix and Spotify), dating sites (Tinder and Okcupid), and advertising platforms (Google and Facebook) which have similarities to digital marketplaces.

These characteristics allow the concept of a digital marketplace to encompass and subsume a variety of terms commonly used in research and public discourse such as ‘peer-to-peer’, ‘the sharing economy’, and ‘the on-demand economy’. What distinguishes the marketplace from a re-seller such as Macy’s or Zappos.com is that at least some of the control rights regarding pricing, advertising, customer service, and order fulfillment remain with the seller (Hagi and Wright (2014)). This means that the marketplace serves as an aggregator and matchmaker of heterogeneous and autonomous buyers and sellers, even if in some cases the marketplace does participate as a buyer or seller in its own market.

Digital marketplaces pose new research questions and challenges for economists. First, the growth of these firms has affected consumers, workers, and firms and has prompted debates regarding the proper influence of these firms in society. Yet much of this debate has happened without rigorous analysis. The economics profession is just catching up to these debates.

Second, the design of these marketplaces poses new challenges. Technology has enabled market mechanisms including reputation systems, search engines, algorithmic recommendations, and signaling mechanisms. The choice of the proper design is important because of the scale of these companies. A single design change in a major marketplace can affect hundreds of millions of consumers and millions of sellers. Due to the complexity of these markets, design decisions often have unintended consequences such as altering the distribution of income on the platform or making it easier for users to discriminate.

Lastly, these marketplaces have also drawn attention from regulators. The diverse policy issues relating to these companies include anti-trust, licensing, labor practices, data sharing and privacy, and discrimination. These topics will become even more salient as more of the economy becomes intermediated by these firms.

The rest of the article discusses these three topics in detail.

2 The Causes and Consequences of Digital Marketplace Diffusion

The share of digital transactions varies greatly across industries, locations, and over time. In the retail sector, for example, books and magazines had a 44% digital market share in 2014. In contrast, digital purchases of clothing, accessories and footwear had a 15% market share and drugs, health, and beauty had

just 4.7% of market share (Hortaçsu and Syverson (2015)). Even within a given marketplace, growth varies over time and across cities as shown by Farronato and Fradkin (2017) for Airbnb, Hall and Krueger (2015) for Uber, and Cullen and Farronato (2016) for Taskrabbit, a marketplace for local services. A theory of digital marketplaces must explain why a transaction occurs digitally rather than at a physical location, why the transaction occurs on a marketplace rather than directly with a seller or pure reseller, and why the consumer chooses a particular marketplace (e.g. eBay vs. Amazon or Airbnb vs Booking.com).

2.1 The Causes of Digital Marketplace Diffusion

The consumer’s choice between a digital and a physical transaction is governed by the benefits of examining a good in person, the relative hassle costs between search online and offline, the benefit of instant product availability offline, differences in assortment, and regulation. In a world where digital devices are ubiquitous, transactions with no in-person component, such as flight or hotel purchases, will naturally take place digitally. On the other hand, purchases like furniture, where examining a good in person is valuable, face a large hurdle to occurring online. Digital distribution also affects the cost side, most obviously due to firms no longer needing a physical retail presence.

Importantly, the attractiveness of digital transactions is endogenous and dynamic because firms can invest in services, market designs, and technologies such as same-day delivery, insurance, matching mechanisms, and customer service to enable new types of digital transactions. To the extent that there are returns to scale in these activities, firms which intermediate large volumes of transactions in equilibrium have the greatest incentive to make these investments and to conduct research. This also means that the growth in digital transactions can be driven by innovation spurred by competition between marketplaces. These innovations are discussed in the next section of this paper.

The growth of digital marketplaces directly affects consumers, firm owners, and workers. The magnitude and sign of these effects will vary depending on whether agents are associated with traditional firms (e.g. hotels), re-sellers (e.g. Barnes & Noble), new entrants (e.g. Airbnb hosts or eBay sellers), or the intermediaries themselves. Furthermore, there may be spillovers to seemingly unrelated markets (e.g. the housing market) or externalities (e.g. traffic congestion or noise) due to these new transactions.

2.2 The Effects of Digital Marketplace Diffusion

Contributions to the literature on the effects of marketplaces can typically be divided into theoretical papers, empirical work which tests predictions, and structural estimation. As an illustrative example, I discuss Farronato and Fradkin (2017), which combines all three of these approaches to theoretically and empirically study the direct effects of the growth of Airbnb on the accommodations industry in the United States. In their theoretical model, a market consists of a day and city. Consumers enter the market and can choose between

Airbnb hosts (peers), traditional hotels, and an outside option. The role of the marketplace in this model is to lower the entry and marginal costs of peers and to increase demand for these peers. Consequently, the marketplace increases the competitiveness of peer sellers and increases the assortment of options available to consumers.

A consumer's choice between options is determined both by the extent to which peer hosts offer a differentiated product and by the price of peer supply relative to traditional hotels. On the supply side, traditional hotels have relatively high fixed costs due to the fact that it takes time and money to build a new hotel. Traditional hotels also have low marginal costs because cleaning costs and other services tend to be cheap. In contrast, peer hosts have low entry costs, which consist of signing up on the Airbnb on website. On the other hand, their marginal costs can be high due to opportunity costs (hosts typically have a traditional job) and due to risk from the fact that strangers may damage the property or cause other problems.

The above framework predicts that peer transactions will be more likely to occur in places where hotel fixed costs are higher, when peer marginal costs are lower, and when demand is higher. [Farronato and Fradkin \(2017\)](#) show that these predictions are borne out across major US cities between 2011 and 2014, where hotel fixed costs are proxied by undevelopable land area and building regulations, peer marginal costs are proxied by share of unmarried adults, who have lower risks from hosting, and demand is proxied by incoming flights and Google searches for accommodations.

The implication of this framework is that the entry of the marketplace will have three primary effects, on consumer surplus, peer surplus, and traditional firm surplus. Most research studies each of these effects separately. For example, [Cohen et al. \(2016\)](#) use discontinuities in Uber's pricing algorithm to estimate its consumer surplus. They find that UberX, the most commonly used service option on Uber, generated \$2.9 billion in consumer surplus in four US cities in 2015. This large surplus is driven both by technology and by the fact that taxis, the traditional firms in this industry, were heavily constrained in their supply and pricing by regulations. Markets with a 'long-tail' of niche products generate benefits through a similar mechanism. [Quan and Williams \(2016\)](#) use transactional data to measure the size of this gain for apparel and footwear. A related mechanism is that, by allowing for increased entry and experimentation, digital markets help uncover unexpectedly high quality products and services. This mechanism is evident on the crowd-funding platform, Kickstarter, and its importance has been documented for music by [Aguiar and Waldfogel \(2016\)](#).

Turning to producer outcomes, e-commerce has generally been found to reduce equilibrium prices and price dispersion (see [Lieber and Syverson \(2012\)](#) for a summary of the literature and [Ellison and Ellison \(2014\)](#) for an exception in the case of niche books). [Goldmanis et al. \(2010\)](#) study the effect of e-commerce on physical retail sales. In their framework, the primary characteristic of digital transactions is lower search costs. Their empirical results corroborate the model predictions and show that employment falls the most at small firms with a physical presence. [Cramer \(2016\)](#) uses cross-city variation to study the effects

of Uber's growth on the labor supply and earnings of traditional drivers and finds no effect as of 2015. This is due to the fact that Uber increases the total demand for rides and taxi drivers can also earn money on Uber. Owners of taxi medallions have been hurt due to the falling prices of taxi medallions. In contrast early investors in successful digital marketplaces have benefited given the multi-billion dollar valuations of these companies.

[Farronato and Fradkin \(2017\)](#) estimate a structural model of equilibrium in the accommodations industry to jointly quantify the effects on consumers, peer producers (Airbnb hosts), and traditional firms. They find that consumer surplus increased due to both the fact that that Airbnb offers a differentiated product and the fact that hotels face more competitive pressure, especially in high demand periods where they would otherwise have market power. Second, traditional firms lose revenue, and this revenue loss will be driven by price adjustment in high demand periods in cities with high hotel entry costs. This prediction is also corroborated in the case of Airbnb by [Zervas et al. \(2015\)](#). In the long-run, the availability of peer-to-peer accommodations should reduce the equilibrium number of traditional firms, but we do not study this effect as it is out of sample. Lastly, we find substantial dispersion in the marginal costs of Airbnb hosts and that most hosts are close to the margin of hosting. Consequently, the typical host's listing is typically not booked and hosting generates much larger benefits for hosts in high demand periods. [Hall et al. \(2016\)](#) find similar results for Uber drivers, who typically drive part-time and are highly responsive to price and expected utilization changes on the margin.

The difference between peers and professionals has generated a vigorous debate in the media and among regulators. The worry on the part of critics and regulators is that purported peers are full-time sellers who avoid regulation by using a marketplace. More generally, the decision to own or rent an asset such as an apartment is endogenous. Digital marketplaces enable assets to be utilized a higher share of the time by making renting easier for buyers and owners.

[Horton and Zeckhauser \(2016\)](#) study the implications of the ability to rent out assets on equilibrium asset ownership and prices. In their models, a fall in the cost of bringing an asset to market causes owners with a relatively low expected utilization or valuation to switch to renting. On the other hand, non-owners may now rent due to the existence of a rental market. The long-run effects on total asset ownership and prices depend on the model parameters. [Fraiberger and Sundararajan \(2015\)](#) calibrate a model of car ownership with a peer-to-peer market and find that equilibrium asset ownership should fall.

The above discussion has treated digital marketplaces as technologies that statically affect the attractiveness of certain types of trades. In practice, marketplaces attempt to manage their growth, both in order to harness network effects and in order to preempt competition. This has been the stated justification for billion dollar financing rounds for companies like Uber ([Sorkin \(2016\)](#)). [White and Weyl \(2016\)](#) present a theory of this decision, where the firm's expansion strategy is a function of network effects and their heterogeneity across users.

3 Marketplace Design

The role of a digital marketplace is to maximize its profit by facilitating matches between buyers and sellers. The value of these matches, including the cost of using the marketplace, must exceed the value of the outside option. The marketplace fulfills its role through its market design, defined broadly to include both policies and technologies. Marketplace design varies across industries, over time within an industry, and within a given marketplace. Most research suggests that design is an important factor in marketplace growth and competition.

It is useful to divide marketplace design choices into three categories. First, the marketplace chooses the process by which buyers and sellers match with each other. Second, the marketplace chooses the manner in which prices, inclusive of fees, are set. Third, the marketplace chooses mechanisms which ensure that goods or services are delivered reliably and with minimal risk. Although these areas interact with each other, I follow the literature in describing them separately.

3.1 Search and Matching

Buyers and sellers find each other in a variety of ways in digital marketplaces, including directed search, auctions, and centralized matching. The choice of mechanism often involves tradeoffs between three factors: the quality of a match, the hassle costs of finding a match, and the overall balance of matches in the market.

These tradeoffs are well illustrated by the differences between Uber’s and Airbnb’s matching mechanisms, also discussed in [Einav et al. \(2016\)](#). In Uber’s app, consumers are algorithmically assigned a car and cannot choose specific makes and drivers. In contrast, Airbnb’s search engine allows consumers to choose between all options which are not explicitly marked as unavailable. The primary reason for this difference is the relative difficulty of expressing preferences across these two markets. Conditional on pickup and drop-off location, Uber riders mostly care about wait times, which are predicted by Uber, and prices, which are set by Uber. In contrast, Airbnb guests to a given city may have different preferences over location, room characteristics, and price. It is difficult to predict the option that a guest will find most appealing and search rankings, while helpful, do not eliminate the need for extensive consumer search ([Fradkin \(2017\)](#)).

The most common mechanism used for matching is the search engine, where searchers form a consideration set through textual search and filtering. The results shown on each page are determined according to an algorithm, which may be as simple as a reverse chronological ordering or as complex as a personalized ranking determined by a neural network. The market design for the search engine consists of the algorithm, the information presented about each option, the interface for search (including filters), and the manner in which that information is presented.

Numerous papers in economics, marketing, and computer science have studied search ranking. A full summary of this literature is beyond the scope of this article but several lessons stand out. On the theoretical side, the structure of the search process affects equilibrium outcomes such as price dispersion (e.g. [Baye and Morgan \(2001\)](#)), and intermediaries may have an incentive to divert search away from the social optimum (e.g. [Hagiu and Jullien \(2011\)](#)). On the empirical side, much of the literature has found that ranking matters (e.g. [Ursu \(2016\)](#) and references), that changes in algorithms can improve match rates in these settings (e.g. [Fradkin \(2017\)](#)), and that there is substantial heterogeneity in the effects of ranking ([Goldman and Rao \(2014\)](#)). There is also an entire field of computer science focused on designing recommender systems (see [Jannach et al. \(2016\)](#) for a recent overview).

From the perspective of the marketplace, the key choices regarding algorithms are which objective function to maximize and which information to use. One may naively think that rankings should be determined according to a prediction of the consumer's expected utility. However, this ignores several complicating factors. First, in two-sided markets, the other side of the market may also have preferences. For example, [Fradkin \(2017\)](#) and [Horton \(2016\)](#) show that rejections of searchers occur on both Airbnb and Upwork, a business services marketplace created through the merger of Odesk and Elance, and that these rejections cause searchers to leave the marketplace. Therefore, the ability of the search engine to filter out bad matches is critical for the marketplace to compete with the outside option. Second, rankings may have equilibrium effects on congestion, available options, and other outcomes, which the marketplace should try to account for. Third, alternative objective functions may be desired if there is uncertainty about user preferences, if rankings serve as incentive mechanisms for sellers, or if rankings help the marketplace learn. Lastly, much effort by ranking algorithm engineers goes into generating 'signals' to input into the algorithm, but incorporating certain signals may be costly from an engineering perspective and may raise privacy concerns.

Information regarding users provides a complementary role to the ranking algorithm. [Lewis \(2011\)](#) studies information and disclosure costs for car auctions on eBay. He shows that the information displayed in photos and text affects equilibrium prices and that reductions to disclosure costs increase the information provided in the market and equilibrium prices. [Tadelis and Zettelmeyer \(2015\)](#) use a field experiment to show how the provision of information in the market can increase prices even for low quality goods, which see an increase in demand due to the reduction in quality uncertainty. Data on historical transaction volume and online reviews is also ubiquitous in digital marketplaces and will be covered later in the article.

The design of the filtering and sorting interface in a marketplace also affects market outcomes. The managers of digital marketplaces consider design important and employ well compensated user experience designers to create these interfaces. Much of their work involves devising visual cues to users that make the interface easy to understand and convenient to use. Other design decisions involve the dimensions on which users are allowed to search. [Fradkin \(2017\)](#)

notes that Craigslist’s search engine in 2005 did not let users filter for short-term rentals based on trip dates, that there were no standardized prices, and that the geography filter was inaccurate. In contrast, Airbnb searchers in 2014 used trip date filters, price filters, and map filters over 50% of the time. I estimate a model of choice amongst a set of search results and shows that with a random ranking rather than the actually seen consideration set, searchers would be 68% less likely to find a suitable option. Relatedly, [Chen and Yao \(2016\)](#) estimate a model of search on an travel site and use it to show that filters (called ‘refinements’ by the authors) increase the utility of products by 17%.

Both Uber and Airbnb are two-sided markets, where both buyers and sellers have heterogeneous preferences over potential transactions. A simple form of preference heterogeneity in many markets occurs due to the limited capacity of firms. Uber drivers and Airbnb hosts can only service one trip at a time. Consequently, there needs to be a mechanism that allows the seller to signal preferences, which include availability. Otherwise, searching users will be rejected from seemingly good matches.

Both Uber and Airbnb solve at least part of the availability problem by operating a payments platform, which gives them data on bookings as they happen. In contrast, Homeaway, traditionally a marketplace for vacation rentals, has historically operated based on a pay to list model and was consequently unable to track bookings in real time. Furthermore, even on Airbnb, peers do not always signal to the platform when they are unavailable. There are other reasons why sellers may reject. For example, an Uber driver may not like the destination of a trip or an Airbnb host may not want guests with no reviews. Users may also discriminate against certain ethnicities or nationalities ([Doleac and Stein \(2013\)](#), [Edelman et al. \(2016\)](#)).

Sellers who reject buyers create an externality for the platform because buyers do not like being rejected. [Romanyuk \(2017\)](#) theoretically shows how the platform can coarsen the information set of sellers in order to increase matching probabilities and welfare. This justifies the movement towards ‘instant booking’ and away from communication in successful digital marketplaces. Under ‘instant book’ systems, sellers pre-commit to a coarse set of conditions under which they will accept a buyer. This allows the marketplace to display only options which are guaranteed to accept a buyer’s proposal. Other mechanisms that can alleviate these problems include capacity signaling ([Horton \(2016\)](#)) and platform rules which punish users who reject frequently.

Lastly, marketplaces such as Amazon, eBay, and Taobao, the major Chinese retail marketplace, have developed search advertising platforms that allow sellers to bid for paid placement next to ‘organic’ results determined by an algorithm. Paid advertising has potentially interesting effects on market outcomes. First, and most directly, it offers another way for the marketplace to earn revenue. Second, it allows sellers with private information about the returns to high placement to signal that information in a credible manner. Third, it potentially reduces the overall quality of a user’s experience. Lastly, it gives sellers and products a way to be discovered ([Zhang \(2017\)](#)).

3.2 Pricing

From eBay’s auction mechanism to Uber’s surge pricing, digital technology has enabled a variety of innovative pricing mechanisms. The market design decisions regarding pricing mechanisms can be divided into three components. First, who has the right to set prices and what mechanism should be used? Second, what price should be set or recommended to the seller, conditional on a mechanism? Third, how should the marketplace generate revenue?

Moving first to the question of control rights and mechanism, the literature has identified several factors that affect who sets the price and how. The first is the relative importance of price discovery versus the hassle costs of price discovery (Einav et al. (Forthcoming)). A second factor determining the price mechanism is the relative informational advantage of the marketplace and the seller. If individual sellers receive more informative private signals regarding demand conditions or costs than the marketplace, then they should set prices. Third, the presence of moral hazard or spillovers can shift the optimal price setting decision (Hagi and Wright (2016)).

The auction mechanism is best in situations when demand, and consequently a good price, is uncertain. Einav et al. (Forthcoming) use eBay data to show that sellers use auctions for used goods, idiosyncratic products, and when they have less experience. They also show that demand for auctions relative to fixed price has fallen over time. This is likely to be driven by the availability of an outside option (Amazon) for consumers where prices are fixed and have the reputation for being low. Given that auctions take cognitive effort and time, consumers prefer fixed price mechanisms, all else equal. There is also a recent literature (Backus and Lewis (2016), Bodoh-Creed et al. (2016), Coey et al. (2016)) examining the efficiency of various auction formats on eBay.

Auctions have proven to be a successful mechanism in other marketplaces such as Upwork, for business services, and Thumbtack, for local services. In both settings, buyers demand the fulfillment of an idiosyncratic task (e.g. interior painting or programming), and face search costs. An auction mechanism where sellers bid, reduces the search costs for the buyer and allows for price and quality discovery. Furthermore, because each task is idiosyncratic, there is typically no low friction outside option for the buyer. While this format is advantageous for the buyer, it may be unattractive to the seller. Consequently, online marketplaces have experimented with features such as reserve prices and limits on the number of bids in order to make seller participation more attractive.

Another common arrangement in marketplaces, seen on Airbnb and Etsy, leaves the pricing up to the seller. In both of these marketplaces, sellers offer idiosyncratic products and services and have significant cost heterogeneity, which may vary over time. Consequently, both marketplaces make it easy for sellers to change prices and set prices based on specific conditions (e.g. weekend vs weekday). On the other hand, neither marketplace forces the sellers to accept pre-determined prices. One drawback of seller pricing is that sellers may choose to obfuscate relevant product prices and characteristics from consumers (Ellison

and Ellison (2009)).

A note of caution about prediction is warranted here. Advances in data collection and machine learning may make it more attractive for marketplaces to set prices instead of sellers. For example, Airbnb has implemented ‘Pricing Tips’, which suggest prices to hosts, and ‘Smart Pricing’, which automatically sets prices for listings. Although the effects of these features have not yet been studied, there is an interesting incentive problem in this market design. Given the same information set, marketplaces and sellers generally have different objective functions and would like to set different prices.

In other cases, as on Uber and in many lending marketplaces, the marketplace determines the price. Centralized price setting is efficient when marketplaces are better able to observe aggregate demand conditions than individual sellers, can group sellers into well-defined categories, and benefit from internalizing externalities arising from pricing decisions. For example, because Uber observes both real-time and historical user behavior and can experiment, it can predict the demand and supply responses to changes in price at a detailed geographic and temporal level (Hall et al. (2016)). Furthermore, because consumers are relatively indifferent between drivers and car makes conditional on a minimal quality threshold, Uber can set the same price for all cars in each category and location. This allows Uber to set prices in order to maximize a marketplace-wide objective function.

A final consideration is the fee structure in a marketplace. Marketplaces use a variety of fees including platform entry fees, listing fees, bidding fees, and transaction fees, which may be fixed or a percentage of the sale price. Furthermore, marketplaces also choose how a fee is spread across buyers and sellers and whether there are additional surcharges for value added services (e.g. international site visibility on eBay). There has been little theoretical or empirical work on this topic, although there are clear parallels between optimal marketplace fees and the literatures on pass-through (Weyl and Fabinger (2013)), platform design (Weyl (2010)), and platform competition (Rochet and Tirole (2003)). Hagiwara and Wright (2016) provide an analysis of optimal revenue sharing between a principal and agent where there is two-sided moral hazard. They find that the side that gets control rights over the non-contractible and transferable action, such as pricing or equipment maintenance, is typically the one that receives a larger percentage of the sale revenue. Platform fees are often obfuscated and may differ in their salience relative to the prices set by sellers. These factors can shift the optimal fee structure for behavioral reasons.

Some settings, notably local services marketplaces, face the threat of disintermediation, where buyers and sellers meet on the platform but transact off of the platform. Generating revenue while avoiding disintermediation is challenging for marketplaces and is a hypothesized reason for the failure of Homejoy, an ‘Uber for cleaning’ startup. Other local services marketplaces such as Houzz, Porch, and Thumbtack have avoided disintermediation by relying on bidding or ad placement fees rather than the transaction fees.

Although the economics of optimal fees is complex, an interesting stylized fact is that many marketplaces avoid experimenting with fee structures. For

example, Upwork, both in its current iteration and previous one as Odesk, has consistently kept a 20% transaction fee on contracts. This may be the result of a brand commitment to a ‘fair price’ or due to the difficulty of measuring the equilibrium effects of platform fees.

3.3 Reputation Systems and Other Mechanisms for Trust and Safety

A final component of marketplace design concerns ensuring that transactions are safe and reliable and convincing users that this is the case. Both buyers and sellers face risks in anonymous transactions. Sellers risk not being paid, having their assets damaged, or having to deal with an overly demanding or unpleasant buyer. Buyers face the risk of not getting the good or service that they expected to get. The typical solution to the problem of trust has been a combination of firms developing reputable brands and governments requiring that sellers comply with regulations.

Digital technology offers new mechanisms to make transactions safe and lowers the costs of existing mechanisms. A non-comprehensive list of these mechanisms includes digital reputation systems, escrow services, insurance, fraud detection algorithms, identity and credential verification, dispute resolution procedures, and customer service. I begin by describing reputation systems, which have been the most salient of the above to both users and researchers.

Reputation systems work by tracking the transactions of an agent and allowing the counterparty to rate or review the transaction after it has been completed. Much of the work regarding reputation systems has focused on determining whether reviews affect consumer demand and seller behavior. The overwhelming consensus is that reviews do affect demand and that they reduce moral hazard on behalf of sellers (e.g. [Dellarocas \(2003\)](#), [Cabral and Hortaçsu \(2010\)](#), [Luca \(2013\)](#), [Pallais \(2014\)](#)). Furthermore, the existence of marketplaces such as eBay or Airbnb seems impossible without reputation systems, suggesting that reputation systems ‘work’.

That said, just because reputation systems have effects, does not mean that they are appropriately designed. One fundamental problem for any marketplace is that informative reviews are a public good because writing reviews takes effort and has the potential to trigger retaliation. A second problem concerns the best manner in which to use review information throughout the platform. Importantly, these two choices are related because the incentives of reviewers depend on how the marketplace uses those reviews.

The empirical literature on reputation system design has studied review informativeness as a sufficient statistics for its design quality. [Fradkin et al. \(2017\)](#) use the setting of Airbnb to study the extent to which submitted reviews accurately represent the experiences of guests and hosts. We find that approximately 70% of users submit reviews after a transaction and that public reviews typically conform with more objective metrics of transaction quality including private and anonymous ratings only seen by the platform, customer

service complaints, and return rates to the platform. This suggests that even without financial incentives, reviews are informative.

That said, the reviews are not fully informative. The authors use two large-scale field experiments in Airbnb’s reputation system to study sources of information loss in the review system. The first experiment studies a simultaneous reveal system proposed initially in [Bolton et al. \(2012\)](#). The idea behind this policy is that, in a two-sided review system, there is the potential that a negative review results in retaliatory negative review by the counterparty. A simultaneous reveal system removes this possibility by ensuring that reviews are not revealed until both parties have submitted or the submission period has expired. [Fradkin et al. \(2017\)](#) evaluate such a system and show that while it does work as predicted, the overall effects are relatively small.

The other Airbnb experimental policy that we study incentivizes reviews through coupons. We show that the coupon induced reviews have lower ratings and that the explanation for this is that those with worse experiences are less likely to review. This corroborates findings by [Dellarocas and Wood \(2007\)](#) and [Nosko and Tadelis \(2015\)](#) for eBay. [Cabral and Li \(2014\)](#) study a similar experiment in which the seller provides a rebate for a review and show that this policy induces reviews but that these reviews are biased upward by reciprocity on behalf of buyers. [Fradkin et al. \(2017\)](#) also document that social reciprocity generated by communication between buyers and sellers results in upwardly biased ratings.

One potential solution to the problem of partially informative reviews is to augment or aggregate these reviews in an appropriate manner. [Nosko and Tadelis \(2015\)](#) show that if non-reviewers have worse experiences, then the review rate is also informative about seller quality. They demonstrate how a search algorithm can use this additional data to steer buyers towards better sellers. Other papers have studied alternative methods for eliciting, displaying, and aggregating reviews ([Horton \(2014\)](#), [Aperjis and Johari \(2010\)](#), [Dai et al. \(2012\)](#)). Design choices also include the review prompt, whether reviews should be associated with reviewer identifies, and the types of reviews that are included in an aggregate score. Lastly, reputation systems face the threat of manipulation by interested parties. For example, [Mayzlin et al. \(2014\)](#) use differences in reputation system design across Expedia and Tripadvisor to document that hotels leave promotional reviews for themselves and fake negative reviews for competitors. One way to reduce the threat of fake reviews is to require that reviewers have a valid transaction prior to a review.

Lastly, there are a variety of other less studied trust and safety mechanisms used by marketplaces. For example, some marketplaces such as Airbnb and Uber conduct identity verification through both government issued documents and social media (e.g. ensuring a legitimate Facebook account). Other platforms such as Lyft and Thumbtack conduct formal background checks and verify professional certifications and licenses. New companies have arisen with the goal of reducing the costs of these activities. For example, Checkr offers an API for conducting verification, and Sift Science offers a service for identifying fake accounts, malicious content, and credit card fraud.

Customer service and dispute resolution are also roles undertaken by marketplaces. In the case of a bad transaction, the marketplace may compensate the buyer or seller or find them a better match for free. A reputation for having a reliable customer service operation can be an important competitive advantage. Sometimes marketplaces also offer explicit insurance contracts. For example, both Airbnb and Uber provide insurance for sellers for any property damage occurring during a transaction. Determining the importance of these mechanisms is a topic for future research.

4 Policy Relating to Digital Marketplaces

Do laws regarding offline transactions apply to related digital transactions and who bears the responsibility for enforcement? These dual questions unite a seemingly disparate set of policy questions about marketplaces including taxation, licensing, zoning, and discrimination. Intermediaries generally argue that they are not responsible for enforcing government regulations regarding the transactions of independent buyers and sellers. Marketplaces view enforcement as costly because assuming regulatory responsibility creates legal risk and complexity, especially when laws vary across jurisdictions. In contrast, governments often argue that intermediaries are best situated to enforce regulations because they have a comparative advantage in enforcement and because they generate value from these transactions. The observed balance between these positions depends on the economics of each regulation, the importance of each marketplace, and on idiosyncrasies in political environments.

One of the first policy issues with this flavor concerned the collection of taxes by Amazon and eBay. Sales taxes in the United States are collected at the local level. However, jurisdictions often do not have the power to collect taxes from externally located sellers. Consumers are often legally required to pay the corresponding tax, but typically do not. Research by [Goolsbee \(2000\)](#) and [Einav et al. \(2014\)](#) shows that the lack of effective sales tax on online purchases provides a competitive advantage for online marketplaces relative to traditional retailers. States have, with varying degrees of success, tried to pass laws to compel major online marketplaces to collect appropriate taxes. One, as of yet unresolved question, is whether this regulatory burden constitutes a significant entry barrier for new companies.

Taxation issues are also relevant for vertical specific taxes. For example, Airbnb has traditionally not collected hotel taxes on its transactions. The argument for not collecting taxes has an additional layer of complexity in the case of Airbnb, who has argued that individual hosts who occasionally rent out a room do not necessarily engage in transactions covered by hotel taxes. Airbnb's strategy has been to offer the possibility of collecting taxes as a carrot to cities in exchange for legitimizing the Airbnb-style transaction with explicit regulation.

Another issue, especially important in services marketplaces, is whether sellers must comply with existing licensing regulations. For example, taxi drivers in many major cities must obtain a medallion and a license to drive. In con-

trast, Uber and Lyft have their own vetting mechanisms which involve fewer up front costs but more ex-post monitoring through reputation systems. If there is no conceptual difference between an Uber ride and a taxi ride, then this creates a disparate regulatory burden on traditional taxi drivers. Proponents of ride-sharing make two related arguments. The first is that the ride-sharing transaction is different from a traditional taxi transaction and therefore does not fall under the same regulatory framework. The second argument is that traditional taxi regulation is a form of regulatory capture to exclude competition. The success of ride-sharing suggests that consumers do not value traditional taxi licenses enough to continue using taxis. Similarly, consumers are willing to book on Airbnb even though most hosts do not go out of their way to follow hotel safety regulations. Other marketplaces, such as Thumbtack, verify licenses on behalf of sellers but do not require that sellers be licensed to bid for a job. They leave it up to the consumer to determine whether the service provider has the ability to do the job.

Employment regulation poses another legal gray area for marketplaces. Peer-to-peer marketplaces typically treat their sellers as independent contractors and do not provide them with benefits such as health insurance, retirement plans, or vacation. However, some share of sellers on these platforms work full-time hours ([Hall and Krueger \(2015\)](#)). This has raised a vigorous regulatory debate regarding whether these workers are misclassified and, if not, whether new employment regulations are needed to account for gig-work ([Harris and Krueger \(2015\)](#)). A longer run and more speculative concern is that new technology may shift the economy wide mix of jobs to alternate models, with fewer protections and benefits. Equity issues also arise in other contexts. For example, ride-sharing companies might decrease public support for public transport, which would hurt those who rely on public transport the most.

Other areas of debate include the scope of zoning laws and externalities from transactions. For example, critics of Airbnb claim that the presence of tourists hurts a neighborhood, especially if tourists are loud or disruptive. These critics also allege that properties are being converted from long-term rentals to short-term rentals, even though zoning excludes hotels from particular city areas. However, there is still no academic research regarding the validity of these claims and whether Airbnb increases housing prices and results in evictions. In response to this debate, some cities and Airbnb have agreed on regulatory frameworks which often cap the number of nights a listing can be rented. This type of regulation ostensibly reserves property for long-term rentals but allows individuals to make extra money by renting the place to tourists on occasion.

Another regulatory issue is digital discrimination and equity. Companies cannot compel two parties to transact with each other. At the same time, the Civil Rights Act makes it illegal for hotels and motels to discriminate based on race, color, religion or national origin. This raises the question of whether marketplaces are responsible for reporting and banning discriminatory sellers. Relatedly, marketplaces can try to reduce discrimination by removing race related information, but there is a potential for such measures to backfire. For example, removing real names and user pictures may reduce overall trust in the

platform.

Marketplaces also possess a variety of data that is useful in city planning and enforcing regulations. For example, if cities had data on Airbnb transactions, then they could find and leverage fines for any violations by hosts. Data on outcomes could also be used to evaluate the effectiveness of existing regulations in ensuring service quality. However, data sharing also raises privacy concerns because both governments and third-parties could potentially abuse this data. There are already active secondary markets for data and there may be reasons to regulate the manner in which marketplace data can be sold. These issues are just beginning to gain policy relevance.

5 Conclusion

The digital marketplace represents a novel and increasingly important form of economic activity. I have discussed three aspects of the economics of these marketplaces. First, what is the effect of marketplaces on economic outcomes? Second, how should these markets be designed? Lastly, what is the appropriate regulation? By necessity, this article only skims this complicated topic.

Digital marketplaces also have a role to play in economics research as laboratories to study economic behavior. Detailed data on behavior allows researchers to observe behavior such as search, communication, pricing, and labor supply decisions with unprecedented granularity. It is also much easier to conduct experiments online ([Horton et al. \(2010\)](#)). This creates several advantages for researchers. First, they can use prior experiments conducted by the platform in clever ways to isolate casual mechanisms. Second, researchers can help companies design experiments with both an academic and business relevance. Lastly, because digital marketplaces have low entry costs, it is relatively easy to conduct experiments on the platform even without the platform's cooperation.

In conclusion, I'll briefly mention several speculative topics that may have relevance in the future. First, new technologies such as voice interfaces and the Blockchain may further affect the structure of digital businesses. New interfaces may result in shifts in market leadership and the Blockchain may reduce the costs of entry and the structure of reputation systems. Second, as digital transactions become ubiquitous, companies such as Uber may be able to implement Pigouvian taxation in order to reduce congestion externalities. This could result in a more efficient traffic system. Lastly, many digital marketplaces are already large players in their respective industries. If there are substantial network effects and returns to scale, then these companies may be subject to antitrust enforcement. These topics are sure to generate exciting research for many years to come.

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