

Digital Platforms 2.0: Learnings, Opportunities, and Challenges

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Abstract

Platform-based digital ecosystems form the backbone of our interactions with the Internet. Over the past decade, digital ecosystems have witnessed significant growth, both in terms of industry footprint and academic research. Yet, the challenges associated with their operations, governance, and regulation continue to evolve. In this paper, we discuss some of these challenges and the resulting research opportunities they bring. We begin by highlighting how platforms have evolved over time, and how their definition has changed as a result. Contemporary online platforms simultaneously manage an attention and information economy as well as a goods and services economy. As information aggregators, they play a critical role in collecting and leveraging high-frequency data. As we discuss research on digital ecosystems, we classify existing work into four primary groups: mechanism design, information design, consumer protection, and competition. Finally, we describe the challenges inherent to conducting empirical research with and without the collaboration of the companies themselves. Our insights highlight the importance of multidisciplinary approaches to the study of digital ecosystems for a full grasp of the opportunities and challenges that they create for firms and consumers.

Keywords: online markets, platform design, platform regulation

Acknowledgements: The authors would like to thank the organizers of the 12th Triennial Choice Symposium at INSEAD, Fontainebleau for selecting the special session that enabled this paper to be conceptualized.

1 Introduction

Today, many of the most valuable companies are platform businesses (Cusumano et al., 2020; Parker and Van Alstyne, 2018). Five tech companies alone (Apple, Microsoft, Alphabet, Amazon, and Facebook) offer several platform-based solutions and represent \$8.42 trillion in market value as of September 2023, a more than 33% increase since January 2020. Platforms have also gained significant public interest and media coverage over the years. Based on data from Factiva, there has been over a sixfold increase in the number of mentions of the top 19 platform businesses¹ in major news and business sources between 2010 and 2017.

Platform businesses operate across many markets, but penetration in certain categories has grown faster than others, and profitability (or lack thereof) displays even greater heterogeneity. The A16Z's marketplace 100 list² tracks the top 100 emerging platforms and reveals striking differences across industries. Between 2020 and 2022, e-commerce, which is the dominant category, witnessed about 75% growth, followed by food and beverage, travel, and education. Table 1 displays the growth of the largest platforms (by revenue in 2022) in 12 categories. While most of the platforms report triple-digit growth rates in revenue as well as user base, many continue not to be profitable.

Such heterogeneity in growth and performance has led to two opposite challenges. On one hand, a wide range of questions has emerged on how to design platform businesses that create value for their users while allowing the companies to profitably survive in the long run. On the other hand, the extraordinary profits of a few dominant winners have attracted regulatory scrutiny and led to questions around consumer protection and privacy.

In light of these questions, and in tandem with the increasing importance of the platform economy, research on platforms has grown significantly across a broad range of disciplines. In 2022 alone, over 113 papers were published on the topic across management, economics, marketing and information systems, a ten-fold increase compared to ten years earlier.³

In this paper, we aim to discuss key features of modern platforms and the associated multi-disciplinary research conducted in this area (including open questions). In doing so, we provide some practical advice to navigate empirical challenges arising from the study of platforms. We begin by exploring how platform definitions have changed over time and the ensuing ramifications for academic studies. In Section 2, we argue that online platforms often manage both an attention/information economy and a goods/services economy. As information aggregators, they play a critical role in collecting and leveraging high-frequency

¹As defined by https://ec.europa.eu/commission/presscorner/detail/en/IP_23_2413.

²See <https://a16z.com/marketplace-100/>. Last retrieved in September 2023.

³See <https://platformpapers.com/data-visualizations/>. Last retrieved 1 September 2023.

Table 1: Growth in revenue and user base of top platform apps in various categories

| Category | Platform | Revenue (\$M) | | | Users (M) | | | Profitable? | |
|-----------|----------|---------------|--------|--------|-----------|-------|--------|-------------|------|
| | | 2017 | 2022 | Growth | 2017 | 2022 | Growth | 2017 | 2022 |
| Dating | Tinder | 0.40 | 1.79 | 345% | 2 | 11 | 445% | - | - |
| Delivery | UberEats | 0.60 | 10.90 | 1717% | 9 | 85 | 844% | - | - |
| Education | Chegg | 0.26 | 0.77 | 201% | 2 | 8 | 273% | No | Yes |
| Finance | Paypal | 13.00 | 27.50 | 112% | 227 | 435 | 92% | Yes | Yes |
| Health | Peloton | 1.00 | 3.58 | 258% | 1 | 7 | 379% | No | No |
| Messaging | Wechat | 8.37 | 17.49 | 109% | 938 | 1,270 | 35% | - | - |
| Music | Spotify | 4.62 | 11.72 | 154% | 138 | 433 | 214% | No | No |
| Shopping | Shein | 1.55 | 30.00 | 1835% | - | - | - | - | - |
| Social | Facebook | 40.65 | 116.60 | 187% | 2,000 | 2,933 | 47% | Yes | Yes |
| Travel | Uber | 7.90 | 31.80 | 303% | 58 | 122 | 110% | No | No |
| Vacation | AirBnB | 2.60 | 8.30 | 219% | 115 | 393 | 242% | No | Yes |
| Video | YouTube | 8.10 | 29.20 | 260% | - | - | - | - | - |

Data collected from <https://www.businessofapps.com/data/app-data/>.

data. Sections 3 and 4 provide an overview of platform research along two dimensions: an internal perspective related to platform design in Section 3, and an external perspective on platform regulation in Section 4. Each of these two perspectives can be further broken down into four broad groups: 1) mechanism design, 2) information design 3) consumer protection, and 4) competition. This framework is provided in Table 2, along with a summary of the key research areas we cover in these sections. Section 5 provides an overview of key practical challenges related to empirical research conducted with or without the collaboration of the relevant platforms. A summary of all sections and their focal areas is provided in Figure 1.

While several recent efforts have provided an overarching framework for studying online platforms (e.g., Rietveld and Schilling (2021); Cheng et al. (2023); Belleflamme and Peitz (2021)), our work is distinct in several ways. First, we link platform-specific concepts to well-established theories in mechanism design, information design, and competition. We believe this approach will help researchers build on valuable existing work to understand new business models. Second, our objective is to highlight how existing research across economics, management, marketing, operations, information systems, and law is deeply intertwined. Although somewhat generalized, management, operations, and marketing typically focus on firms' decisions to maximize their objectives, such as profits, revenues, or advertising efficiency. In a complementary fashion, economists focus on how platforms' decisions affect the incentives of their users and the surplus they capture, both in isolation and as a function of market competition. Together with legal scholars, they also discuss the practicality of regulation to limit market power and ensure consumer protection. Another distinguishing feature of our work is its focus on relatively new and evolving research, including working papers. Notably, more than 80% of the papers we cite were circulated after 2020. In

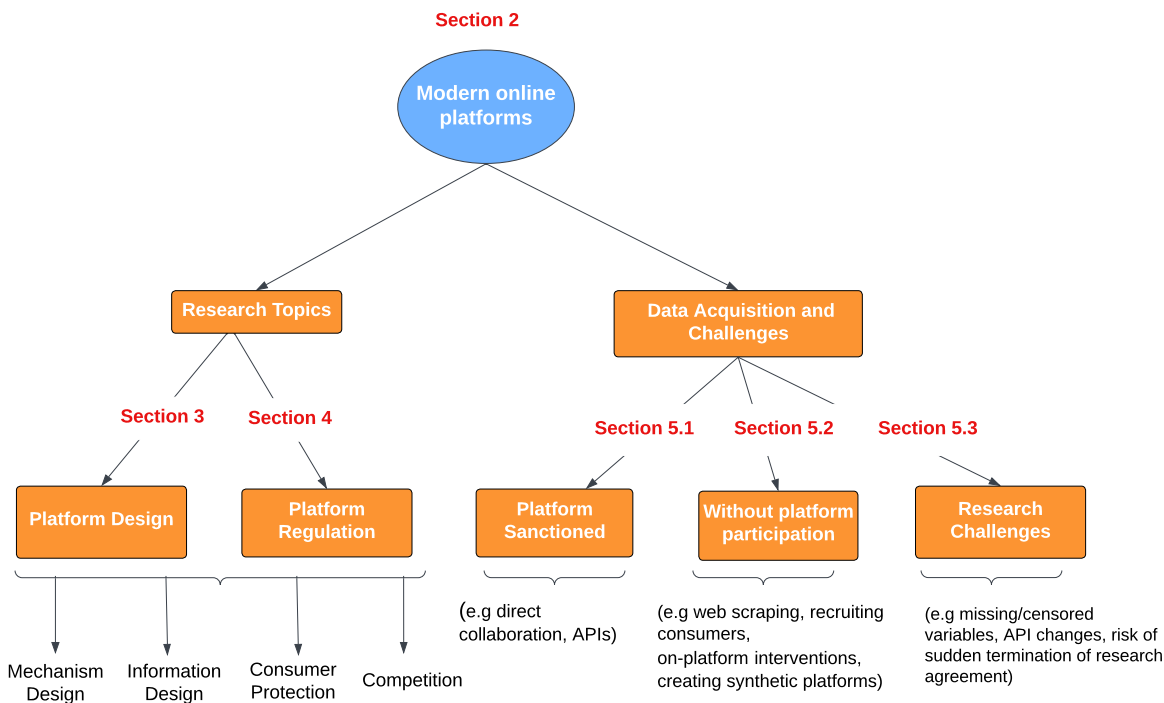


Figure 1: A Schema of the Paper

light of the rapidly changing landscape of platform research, we view this as an important contribution towards mapping the evolution of future work. Our final contribution is to highlight common practical challenges that arise when conducting empirical research on platform ecosystems. We hope that these discussions can help existing and future empirical researchers better understand and navigate the complexities in this area.

Our framework has limitations. Our aim is not to provide a comprehensive bibliometric analysis of every aspect of digital ecosystems, but to showcase a collection of key topics and themes at the frontier of platforms research. We also intend for the paper to be a complement, rather than a substitute, to existing reviews of the work on digital platforms, such as [Rietveld and Schilling \(2021\)](#) or [Chen et al. \(2023\)](#). Our discussion is purposefully forward looking, and we hope the interested reader will find inspiration to expand our knowledge of platform ecosystems.

2 Evolution in platform definitions

At their core, all markets involve buyers and sellers exchanging goods or services. Evidence suggests that markets in the form of bazaars existed as early as 3000 B.C. ([Mehdipour](#)

| | Platform Design | Platform Regulation |
|----------------------------|--|--|
| Mechanism Design | <ul style="list-style-type: none"> • Direct monetization • Advertising • Hybrid monetization strategies | <ul style="list-style-type: none"> • Self-preferencing |
| Information Design | <ul style="list-style-type: none"> • Online word-of-mouth • Content curation • Platform endorsements | <ul style="list-style-type: none"> • Advertising disclosure • Restricted products and DarkNet • Reviews as regulation substitute and fake reviews |
| Consumer Protection | <ul style="list-style-type: none"> • Discrimination • Misinformation • Value of data | <ul style="list-style-type: none"> • Licensing and provider quality • Privacy • GDPR • Content for children |
| Competition | <ul style="list-style-type: none"> • Competition between platforms | <ul style="list-style-type: none"> • Market entry • Labour laws in the gig economy • Mergers |

Table 2: Overview of Key Topics in Platform Design and Regulation

and Rashidi Nia, 2013). In their earliest versions, a platform or an intermediary would offer services to both buyers and sellers to facilitate interactions between them and increase net value creation for all market participants. The services offered by the intermediary can range from payment services (e.g., holding money in escrow until the transaction is complete) to screening providers to ensure their quality.

Platforms increasingly facilitate interactions beyond simple transactions of goods or services between a buyer and a seller. As Sriram et al. (2015) articulates: “Platforms are intermediaries that facilitate economic interactions between two sets of agents where one set’s decisions impact the other through direct and/or indirect externalities.” For instance, newspapers are platforms in the sense that they connect readers to content providers as well as advertisers, and offer value to all sides. If a newspaper publishes higher quality content that attracts more readers, the larger subscriber base can, in turn, make the platform more attractive to advertisers, which increases ad revenues and supports even better content (Beattie et al., 2021).

With the rise of the Internet and the expansion of platforms into an ever larger set of industries, the types of services platforms offer and interactions they facilitate continue to expand. Parker et al. (2024), for example, highlight the concepts of *open architecture*, *gover-*

nance, and *orchestrated interactions* as being fundamental to a platform. Open architecture allows third parties to participate and create value, while rules of governance and orchestration define the terms of their participation, i.e., how they can create and capture value, and how conflicts can be resolved, should they arise.

A key distinction between newer online platforms and ‘traditional’ platforms (e.g., newspapers) is that agents of new online platforms can exchange both goods and information, often simultaneously. This introduces a parallel attention and information economy alongside the conventional goods and services economy. As [Parker et al. \(2024\)](#) point out, platforms can use data from one interaction to generate or improve other interactions. This makes the platform even more valuable as more people use it, because of the opportunities to expand interactions along both intensive and extensive margins. Such a setup ensures the constant flow of high-frequency data within the platform.

When platforms are intermediating both exchanges of goods and information, it becomes harder to make distinctions among buyers and sellers, or users and advertisers. In fact, all participants can be merely thought of as ‘agents’. For example, on e-commerce platforms like Amazon, individuals can be both buyers of products and suppliers of information through consumer reviews. Similarly, sellers can both list their goods for sale and buy advertising slots to ensure a priority placement for their products. Social media platforms, which originally focused on exchanging information, now host both formal and informal advertising that can lead to exchanges of goods and services, in person or on a different website. Instead of merely arbitrating information, platforms capture all data generated ([Parker et al., 2024](#)). Consequently, they can refine market and information design, influencing agent behavior and the type and flow of future data. [Figure 2](#) shows this evolution of platforms and agent definitions over time. Such complexities introduce significant challenges for both researchers and regulators. We delve into these different issues in the sections below.

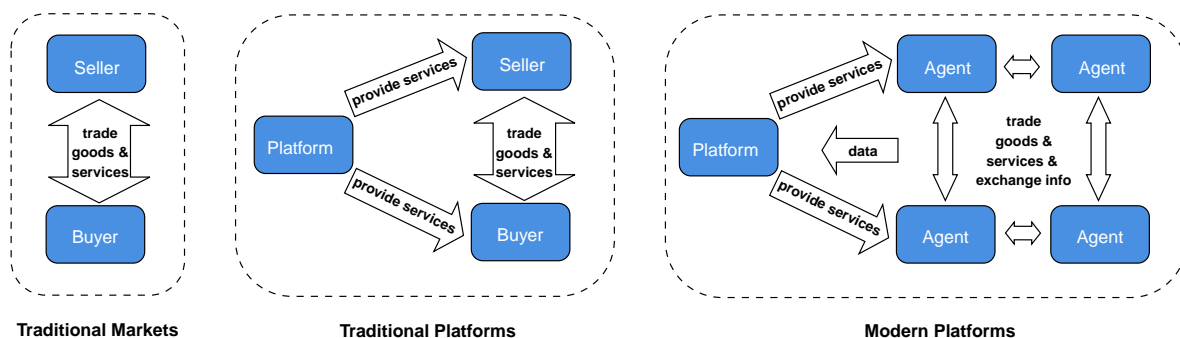


Figure 2: Evolution of online platforms

3 Platform Design

Platforms have a vast array of design tools at their disposal to guide their optimal functioning. As in classic mechanism design, the behavior of agents can be directly influenced by monetary incentives and services on the platform, but at the same time the information flow of platform participants can be managed via disclosure rules, rating and review options, or content curation. The platform, acting as an economic agent itself, can use these tools to maximize its own profit. At the same time, platform design choices can have implications for consumer outcomes (such as discrimination), as well as the competitive landscape on and off the platform. In this section, we first summarize work on how platforms can optimally monetize their services. We then move to the study of information flows, consumer protection and competition, and how they relate to platform design.

3.1 Mechanism Design

Classic mechanism design originated from economic theory that is concerned with the design of allocation and transfer rules to optimally match products to consumers. Auction design has been widely applied to online advertising services on platforms, and complex matching mechanisms are developed by ride-sharing platforms such as Uber. These design choices have a direct impact on platform monetization strategies. Below, we summarize three distinct classes of such strategies and highlight a few forces that are platform-specific. Specifically, we distinguish between subscription-based, ad-supported, or hybrid models of monetization.

Direct monetization We start with the subscription-based “direct monetization” model. A platform can charge transaction fees through different direct pricing formats. We commonly observe simple transaction fees: for instance, Amazon.com levies a fee of 15% on the sale price on average, plus a \$0.99 per-item charge, which is waived for subscribers paying a monthly fee of \$39.99.⁴ In classic N -sided platforms (e.g., [Rochet and Tirole \(2006\)](#)), the markup paid by each side i is essentially determined by a classic adjusted markup rule

$$\underbrace{\frac{\text{price of } i - (\text{marginal cost of } i - \text{network value})}{\text{price of } i}}_{\text{markup of side } i} = -\frac{1}{\text{demand elasticity of } i},$$

where the network value is the value that one side of the platform adds to other market participants. As a result, the side of the market that is more inelastic is charged a higher

⁴<https://sell.amazon.com/pricing>

price which can lead to skewed pricing. In an extreme case, one side of the market could be rewarded for participation, such as credit card users who receive benefits for using a credit card while not having to pay any fees. A similar logic applies to heterogeneous parties on the same side of a platforms. [Zhang et al. \(2023\)](#) demonstrates that hospitals attracting more consumers to join an online healthcare platform also extract more economic value from the platform. The network effect on consumers increases the hospital's bargaining power, while the economic value provided to the hospital by the platform increases the platform's bargaining power. This unveils a novel source of bargaining power for both hospitals and the platform which determines prices. [Zhu et al. \(2023\)](#) establish that moving from no participation fee to a flat fee to promote books on Goodreads reduces book diversity in the marketplace. This reduces the value of the platform to consumers who benefited from books by small publishers. Hence, fine-tuning the pricing strategy by taking into account network effects through personalized access fees or fees on both sides of the market would likely improve welfare and profits. For instance, [Bhargava et al. \(2022\)](#) show that a small-business oriented differential revenue sharing design can increase total welfare and outputs on the Apple App Store.

Advertising Platforms also commonly use advertising as a monetization strategy. The ad-supported monetization strategy requires a careful matching of eyeballs to advertisers. The matching process has to account for advertiser willingness to pay, consumer willingness to attend to the ad, and consumer likelihood to take the advertiser's desired conversion action, all accounting for the context in which the ad appears. Such matching can be achieved by optimizing ad selection, format, creative, placement, quantity, and pricing, and the right balance between paid and organic listings ([Wilbur, 2008](#); [Wilbur et al., 2013](#); [Choi and Mela, 2019](#); [Chu et al., 2020](#); [Long et al., 2022](#); [McGranaghan et al., 2022](#)). The choice of search ranking algorithms also affects the ability to monetize via ads. Prominent ad placements may not align with consumer preferences, potentially hindering search efficiency and reducing transaction-based revenue. ([Ursu \(2018\)](#); [Ursu et al. \(2024\)](#); [Dinerstein et al. \(2018\)](#)).

The methodology and pricing of ad sales differ considerably. Ad sales can be priced per impression, click, or action, and sold at a fixed rate in advance with broad targeting criteria or through real-time bidding with more granular targeting options ([Sayedi, 2018](#)). They can also use first-price or second-price auctions with various reserve prices ([Despotakis et al., 2021](#); [Choi and Mela, 2023a,b](#)).⁵ Each of these choices can affect advertising revenue as well as the relevance and quality of the winning ads served to users.

⁵Please see [Choi et al. \(2020\)](#) for details of display advertising sales.

Hybrid monetization strategies Platforms can also employ more complex hybrid monetization strategies. [Wang et al. \(2024\)](#) find that a digital content platform can use a metered paywall to adjust the amount of free content under moderate ad rates. When ad rates increase, the platform may optimally offer less free content and lower the subscription price to attract new subscribers. [Amaldoss et al. \(2021\)](#) analyze media platforms' content provision and pricing strategies when they interact with three sides: content suppliers, consumers, and advertisers. They show that platforms' profits can increase with the cost of procuring content and reduced consumer desire for content. [Appel et al. \(2020\)](#) presents a framework for mobile app monetization through advertising and freemium models.

Platforms can also implement voluntary payments by counting on social norms. [Kim et al. \(2023\)](#) identify a positive impact of a norm message on tipping behavior on an online freelancing platform. [Huang et al. \(2022\)](#) compare two-sided platforms' quality self-regulation strategies, and find that both subsidization and first-party application strategies render the platform owner better off, but only subsidization always improves social welfare.

Ultimately, platform monetization needs to balance commission structures, ranking algorithms, and ad sales strategies. Deciding on a business model – subscription-based, ad-supported, or hybrid – also requires platforms to understand consumer preferences ([Cong et al., 2021](#)). Future research could focus on devising a unified framework to optimize these interrelated decisions to achieve the platform's overarching business goals.

3.2 Information Design

Traditional markets typically involve two types of asymmetric information: 1) consumers may have private information about their preferences over products; 2) firms may have private information about the quality of their products. Modern platforms may additionally have superior information about the value of a product to specific customers. For example, an expecting parent may be recommended products that have proven to be useful to other parents. Hence, platforms must carefully consider which types of information to collect from users, which information to disclose back to users, and how to utilize this information. This includes design elements like reputation systems, endorsements, and product rankings. For example, given the unlimited shelf-space in online platforms, designing an optimal search-ranking algorithm and recommendation system plays an important role in improving their profitability. Many relevant factors are incorporated in the design of such algorithms such as transaction volumes, profit margin, variety of offerings and privacy concerns ([Fradkin, 2018](#); [Ursu, 2018](#); [Zou and Zhou, 2023](#); [Donnelly et al., 2023](#); [Korganbekova and Zuber, 2023](#); [Lei et al., 2023](#); [Peukert et al., 2023](#)). In this section, we highlight some current research and

open questions pertaining to three important sub-categories of information design, namely online word of mouth, content curation and platform endorsements.

Online word of mouth The type of interactions that are permissible between agents on a platform influences the kind of content users generate and determines who remains active on the platform. For example, historically, review platforms only permitted one-way feedback from reviewers.⁶ Nowadays, many platforms have expanded to incorporate multi-sided dialogues, like Q&As (Banerjee et al., 2021), and allow businesses to reply to online critiques (Chevalier et al., 2018; Wang and Chaudhry, 2018). Such design changes affect subsequent customer feedback and determine which businesses stick around. An important consideration for the platform is to create incentives for agents to generate valuable content. For example, Chakraborty et al. (2022a) provide a theoretical framework for when consumers write positive versus negative reviews.

While some early research has started exploring the impact of these multi-sided conversations, there remain several open questions and conflicting findings. For instance, Chevalier et al. (2018) find that responding to reviews can make future reviews more negative whereas Proserpio and Zervas (2017) find that responding makes future reviews more favorable. These papers provide a foundation to delve deeper into several outstanding questions. For example, the nascent literature has not studied the wealth of information in the content of these replies using state-of-the-art text or image analysis algorithms, which could reconcile some of these initial conflicting findings. Karaman et al. (2024) study response styles (e.g., defensive vs accommodative) and its differential impact on future reviews and sales. Likewise, research on other types of interactions like retweets/shares (on social platforms) and endorsements (e.g., LinkedIn) is understudied. There is some early work in this area (e.g., Wang et al. (2023)) which could advance this literature further.

In terms of aggregating review statistics and presenting individual reviews, different platforms employ varying approaches, resulting in diverse user experiences. For instance, Tripadvisor takes a detailed approach, providing comprehensive distributions of reviews, including ratings related to specific attributes (such as location for hotels) and the count of reviews categorized by satisfaction level. In contrast, Airbnb opts for a more streamlined presentation, offering only aggregated measures such as review counts and average ratings. A significant challenge in the realm of review aggregation is that the aggregated information may fall short in capturing the subtleties of product quality. Dai et al. (2018) underscore the limitations of average ratings. They propose an alternative aggregation method that takes into account the variations in reviewers' accuracy, stringency, and social incentives,

⁶<https://reviewinc.com/2021/09/07/a-history-of-online-reviews/>

ultimately leading to more informative and nuanced assessments of quality. [Chakraborty et al. \(2022b\)](#) further suggest that enhancing review aggregation can be achieved by considering how reviewers self-select attributes to write about, introducing an additional layer of complexity to the process. [Vana and Lambrecht \(2021\)](#) demonstrate that individual reviews have a strong effect on consumer purchase decisions even after accounting for a product's average rating. [Aziz et al. \(2023\)](#) demonstrate how platforms' rating display rules can impact user behavior, benefiting platforms through rating inflation, while also affecting user trial and sales concentration among popular sellers.

Another challenge is that user-generated ratings are subject to self selection—the decision of potential future reviewers to purchase a good is driven by the information available at the time of purchase ([Acemoglu et al. \(2022\)](#)). This can lead to a cold start effect where new entrants to the platform may struggle if they are unlucky to receive a negative review. This can affect the long-run composition of platform participants ([Vellodi \(2018\)](#)).

The future of platforms' choice on how to display ratings holds immense potential, particularly with advancements in machine learning algorithms capable of extracting real-time customer sentiments in various attributes. These algorithms have the capacity to capture and present more accurate quality metrics for products. However, as platforms navigate this evolving landscape, they must carefully consider several critical factors. These include understanding reviewers' motivations to ensure continued participation, aligning their aggregation methods with consumer intent to utilize the information presented in reviews, maintaining transparency in algorithmic processes, and addressing challenges like promotional reviews ([Mayzlin et al., 2014](#)), fake reviews ([He et al., 2022b](#)), rating inflation or discrimination ([Filippas et al., 2018](#); [Bairathi et al., 2023](#)).

Content Curation Another key platform-design decision that can impact participation as well as the value generated for participating agents is the selection and presentation of displayed information. An example of how platform-curated cues can affect behavior comes from vacation rental platforms. These platforms have access to historical pricing information for listings, which they can leverage to decide what kinds of price estimates to display when incomplete search information is provided. [Banerjee et al. \(2024\)](#) show in a field experiment that the decision to display lower floor prices has a positive effect on engagement, even though higher floor prices are closer to the 'true' price consumers would have to pay. Another class of design issues emerge with regard to ranking algorithms. As an example, [Donnelly et al. \(2023\)](#) find that personalized rankings increase consumer searches and purchases, and despite the ranking algorithm putting positive weight on profitability, these rankings still significantly enhance consumer welfare. Similarly, [Pachali and Datta \(2022\)](#) show that users

have strong preferences for playlists curated by Spotify. [Ichihashi \(2020\)](#) demonstrates the interplay between information disclosure by consumers and its impact on the quality of subsequent recommendations on the platform. Although the consumer benefits from accurate recommendations, the seller may use the information to price discriminate. Their model also suggests that while the seller prefers to commit to not using information for pricing in order to encourage information disclosure, this commitment harms the consumer, who could be better off by precommitting to withhold some information. There is also recent work looking into appropriate analysis approaches of complex ranking algorithms. For instance, [Goli et al. \(2021\)](#) find that naive estimates of the total average treatment effect (TATE) of a ranking algorithm in an A/B test can be significantly biased (click and booking rates can be biased by as much as 15% and 29%, respectively) and thus need bias correction measures.

Platform endorsements Recently, platforms have increasingly introduced aggregate quality signals by incorporating not only review information but also a broad spectrum of product information. One prominent example is platform endorsements like Amazon's Choice and Etsy's Picks. [Bairathi et al. \(2022\)](#) demonstrate that exposure to platform endorsement increases user search and purchases not only for endorsed services, but also for unendorsed services due to an increase in the overall perceived platform quality. Furthermore, focusing on an online healthcare platform, [Zhan et al. \(2024\)](#) finds that platform endorsements could motivate doctors to provide more services. [Paridar et al. \(2023\)](#) explore the often nuanced and different effects between endorsements from platforms and those from other users, as well as the distinction between monetary and non-monetary incentives. Relatedly, [Zhou and Zou \(2023\)](#) show that sellers strategically adjust prices to compete for an online marketplace's personalized product recommendations. As the marketplace more accurately predicts consumers' preferences, the equilibrium price first decreases and then increases, and both the marketplace's and the sellers' profits may decrease. These results are driven by three distinct incentives of competing sellers: competing for recommendations, exploiting targeted consumers, and undercutting rivals' prices.

Many open questions remain relating to platform information design and its interaction with mechanism design. Specifically, the active role of a platforms in holding information is understudied and future research may require novel market definitions for different platform participants and the platform itself. For example, [Bergemann and Bonatti \(2015\)](#) and [Bergemann et al. \(2018\)](#) study aspects of a market for data which may interact with a platform's information and mechanism design. Information design may also interact with issues such as disintermediation, i.e, preventing off-platform interactions between agents so that the platform continues to remain profitable (e.g., [Hagiwara and Wright \(2023\)](#)). Conceptualizing

platform power in relation to the control of private information, and devising measures to ensure a more equitable distribution of gains, are important open questions. It is also worth exploring the long term effects of platform outcomes that result from optimizing short-term metrics such as clicks when deciding curation policies. Information design also has important implications on consumer protection, which we discuss next.

3.3 Consumer Protection

While consumer protection is primarily a regulatory question (discussed in [Section 4](#)), platform design and information flows can also affect consumers' willingness to join a platform, and resultant outcomes. For example, [Hui et al. \(2016\)](#) show using data from eBay, that buyer protection increases efficiency by reducing moral hazard by sellers. This increases the value of a platform to buyers. Below, we discuss other aspects that can affect the value of a platform to a user group such as discrimination, misinformation and data transparency.

Discrimination Platforms oftentimes reduce information asymmetry between participants by allowing them to access personal information about each other before deciding to provide service. However, this may trigger discriminatory behavior. For example, [Edelman et al. \(2017\)](#) find that requests for accommodations by guests with distinctively African-American names were significantly less likely to be accepted on Airbnb than requests by guests with distinctively white names. [Chan \(2023\)](#) detects similar discriminatory behavior by customers towards service providers, specifically African-American and Asian doctors. However, [Cui et al. \(2020\)](#) find in the context of Airbnb that a positive review on the guest page can reduce discrimination if the review is credible. On the other hand, [Bairathi et al. \(2023\)](#) and [Teng et al. \(2023\)](#) find that online reviews provided on digital platforms could be biased themselves due to gender or ethnicity discrimination. Recent research highlights how digital platforms have a unique opportunity to reduce discrimination, by virtue of the information they gather about consumer preferences and providers' quality. For example, [Chan \(2023\)](#) finds that providing information about doctor quality can reduce discrimination by 90%.

Misinformation An important strand in the consumer protection literature is related to misinformation/disinformation on social media platforms. Past work has analytically modeled the conditions for misinformation to spread (e.g., [Acemoglu et al. \(2010\)](#)). There has also been work investigating this question on specific social media platforms. While [Allcott et al. \(2019\)](#) find, in the context of Facebook, that the relative magnitude of the misinformation problem declined between 2016 and 2018, [Vosoughi et al. \(2018\)](#) show that misinformation tends to travel faster and further than true news on Twitter between 2006 and

2017. Recent papers have highlighted interventions and design choices that can potentially mitigate the spread of misinformation, such as self-certification (Nichols et al., 2024), subtle nudges and minimal digital literacy tips (Arechar et al., 2023). A recent study Casillas et al. (2024) introduces a novel model to identify accounts that are created to spread disinformation on Twitter using deep network connections between accounts.

Value of data Consumer protection is also influenced by how consumers and platforms value data. When it comes to consumer privacy preferences, individuals often claim to value privacy (Acquisti et al., 2013), though few end up making choices consistent with these preferences (Johnson et al., 2020). Some research has suggested these patterns may relate to the way in which digital platforms structure choices available to consumers (Lin and Strulov-Shlain, 2023; Farronato et al., 2023b). Bergemann et al. (2022) highlight how consumers' incentives to disclose their personal data can depend on its statistical correlation structure, impacting market outcomes like consumer participation and welfare. Galperti et al. (2023) characterize the value platforms derive from each participant's data record using information design and duality theory. They identify a novel externality between records, which arises when the intermediary pools certain records to withhold information they contain.

A wealth of empirical work also highlights the value of data, especially first-party data. Sun et al. (2023), for example, conduct a large-scale field experiment to quantify the losses incurred when a platform cannot use personal consumer data for product recommendations. Their results emphasize that these losses are unequally distributed, disproportionately affecting niche sellers and consumers who would otherwise benefit most from e-commerce. Similar positive values of personal data have been found in news consumption (Peukert et al., 2023) and advertising (Goldfarb and Tucker, 2011).

It remains an open question what approach platforms should take to balance tensions between personalization and transparency. While transparency builds user trust, it may conflict with personalization and also have unintended consequences for fairness. Overall, fairness is important for platforms but has multiple definitions (e.g. marginal contribution, exogenous rights, egalitarianism). More research is needed to determine how to operationalize fairness and balance it with other objectives. For instance, users could potentially gain more control and value from their data through decentralized, cooperative platforms or granting "in situ" data access rights.⁷

⁷<https://cacm.acm.org/opinion/in-situ-data-rights/#R7>

3.4 Competition

Similar to consumer protection, competition is a major area of discussion in regulation. Market structure can significantly impact platform design choices.

Competition between platforms The first theoretical papers that study platform competition including [Rochet and Tirole \(2003\)](#) and [Armstrong \(2006\)](#) explain market segmentation, with platforms offering differentiated matching services. [Armstrong \(2006\)](#) presents models for three types of two-sided platform market structures: a monopoly platform; a model of competing platforms where agents join a single platform; and a model of “competitive bottlenecks” where one group joins all platforms. The determinants of equilibrium prices are (i) the magnitude of the cross-group externalities, (ii) whether fees are levied on a lump-sum or per-transaction basis, and (iii) whether agents join one platform or several platforms. [Karle et al. \(2020\)](#) show that competitive conditions among sellers shape the market structure in platform industries. If product market competition is tough, sellers avoid competitors by joining different platforms. This allows platforms to sustain high fees and explains why, for example, in some online markets, several homogeneous platforms segment the market. Instead, if product market competition is soft, agglomeration on a single platform emerges, and platforms fight for the dominant position. Thus, market concentration and fees are negatively correlated in platform industries, which inverts the standard logic of competition.

Overall, competition is an understudied area in the literature. There are three types of competition: first, competition between similar platforms, such as Netflix and Disney Plus; second, competition between a platform and sellers outside the platform, such as Amazon versus individual stores; and third, competition between agents on a platform, such as sellers on Amazon. In all three cases, the monetization and information design strategy is affected by the market structure. Furthermore, classic marketing strategies such as bundling different services into one platform can be an effective response to improve the competitiveness of a platform. On a platform this can include products in entirely different domains such as streaming services and physical products.

4 Platform Regulation

Given the growth of digital platforms, the question of their regulation has received increased attention.⁸ A platform’s ability to scale and do so quickly, primarily due to own-

⁸A detailed description of the extent and evolution of platform regulation in the United States can be found in [Bietti \(2023\)](#).

and cross-network effects (Chu and Manchanda, 2016), can have adverse consequences for welfare. Once a platform scales, it can tip the market in its favor, potentially leading to a quasi or true monopoly. Recent regulatory discussions have focused on where a platform can use its power, including pricing, controlling access and participation, selectively curating and/or targeting content, violating privacy, “kill zone” expropriation (where the platform copies the benefits provided by a participant over time, rendering it obsolete) and product preferencing.⁹

However, any call for platform regulation needs to answer three basic questions. First, does the platform’s power arise due to economies of scale or anti-competitive behavior? Making this distinction is often challenging to policymakers, but critical to design appropriate interventions (Hylton, 2019). Second, does regulation benefit all sides of a platform (e.g., “buyers” and “sellers”) or is it likely to benefit one side at the expense of the other? As noted by Rogerson and Shelanski (2020), the challenge for antitrust law in platform settings is to assess the net benefit by quantifying both the positive and negative effects for all sides of the platform, which are often asymmetric. Finally, in the context of regulations focused on user data, what balance should regulators strike to prevent data misuse while considering data benefits, specifically taking into account consumer preferences about privacy in relation to the services they get from the platform (as discussed in Section 3.3)? While calibrating the collection and use of consumer data by platforms is important (for instance to avoid incidents such as the Cambridge Analytica scandal¹⁰), restricting data access may worsen user experience on the platform, e.g., by providing less relevant recommendations.

Similar to Section 3, we structure our discussion into mechanism design and information design, and then discuss consumer privacy regulation and platform competition.

4.1 Mechanism Design

While the bulk of mechanism design questions link directly to monetization and platform design as discussed in Section 3, one important component that has drawn significant regulatory attention is self-preferencing, which we discuss below.

Self-preferencing There is a substantial body of literature looking at platforms operating on a dual mode (i.e., running marketplaces for third-party products while also selling their own products, such as Amazon). Such platforms may have incentives to engage in self-

⁹Many of these themes emerge in the most recent lawsuit against Google Search: <https://borneobulletin.com.bn/final-arguments-concluded-in-google-lawsuit/>

¹⁰<https://www.nytimes.com/2018/04/04/us/politics/cambridge-analytica-scandal-fallout.html>

preferencing behavior. Put simply, self-preferencing refers to dual mode platforms giving an unfair advantage to their own products or services. From an empirical perspective, recent work is emerging on the effects of self-preferencing (Farronato et al., 2023c; Jürgensmeier and Skiera, 2023; Raval, 2022; Lam, 2023; Lee and Musolff, 2021) and how to detect it (Reimers and Waldfogel, 2023). Long and Amaldoss (2022) find that self-preferencing in sponsored ads hurts consumers even though the platform offers the private label at a price lower than the price of third-party sellers.

However, the consequences of regulating or banning self-preferencing are nuanced. Zou and Zhou (2023) analytically examine the possible impact of a ban on self-preferencing (e.g., by Digital Markets Act (EU) or American Information Online Act (AICOA, US)) on third-party sellers and consumers, and show that search neutrality may harm consumers and third-party sellers by weakening the price competition between the platform and third-party sellers. Dubé (2022) also finds that self-preferencing regulations on Amazon could reduce consumer welfare. Hagiú et al. (2022) highlight that banning dual mode can harm consumer surplus and welfare even when the platform would otherwise engage in product imitation and self-preferencing. However, they stress that policy interventions which target specific behaviors by the platform are preferable to an outright ban on the dual mode. Finally, Krämer and Schnurr (2018) argue that there is no sufficient basis for a general ex-ante neutrality regulation for online platforms. Instead, the obligation of transparency on various platform practices should be explored.

The success of policies regulating self preferencing also depends on consumer preferences. For instance, Anderson and Bedre-Defolie (2022) show that homogeneous tastes lead to reduced prices while heterogeneous tastes result in higher prices and fewer choices. Therefore, a systematic ban on dual mode might have unintended consequences, for example, the platform may shut down its marketplace and switch itself into a reseller. In this line of work, Kittaka et al. (2023) offer a broader literature review on self-preferencing.

Several open questions remain about designing optimal self-preferencing regulation in various settings. In particular, it remains to be seen whether certain universal regulatory frameworks may more effectively balance the promotion of innovation and competition among online platforms while protecting consumer interests and ensuring fair market access for third-party sellers. In markets dominated by a few large platforms, the long-term effects of current interventions, such as bans on self-preferencing and dual mode operations, on market structure, competition, and consumer welfare need to be explored further. Finally, the impact of these regulations on new entrants and the evolution of platform business models remains an active area of research.

4.2 Information Design

The interconnected role of online advertising, consumer privacy, and regulatory impacts on various stakeholders has been demonstrated by a collection of recent studies.

Advertising disclosure Disclosure of advertising or sponsorships on platforms is an important information design question that regulators are faced with. Native advertising is one domain in this context that may require regulatory attention if it misguides consumers.¹¹ However, [Sahni and Nair \(2020\)](#) find in a field experiments that while native advertising benefits advertisers, there is no evidence of deception under formats of disclosure typically used in the paid-search marketplace. This suggests that we do not require more stringent regulation on the disclosure policy of native ads on media platforms. In terms of social media disclosure, [Ershov et al. \(2023\)](#) find that almost 96% of influencer posts on Twitter are not disclosed as such. However, mandatory disclosure policy regulation has certain unintended consequences: [Ershov \(2024\)](#) find that while stricter country-level disclosure regulations in Germany lead to an increase in both disclosed and non-disclosed sponsored content, overall consumer engagement declines and is concentrated more among undisclosed-sponsored posts relative to non-sponsored post, suggesting that followers are made worse off by this policy.

Restricted products and DarkNet While regulation is crucial for overseeing and controlling platforms dealing in illegal or restricted products and services, evidence on the efficacy of regulations has been mixed. For instance, [Zeng et al. \(2022\)](#) examine the impact of shutting down two major commercial sex advertising sites on prostitution arrests and violence against women. They find that targeting a small number of prominent sex advertising portals is unlikely to be effective in combating sex trafficking, given the fluidity of online markets for illegal activity. [Vana and Pachigolla \(2021\)](#) look at Darknet markets, where sales of illegal goods such as drugs, weapons and counterfeit occur online. Their key finding is that after an FBI bust, prices dropped and the number of transactions per month per vendor increased in adjacent Dark Web markets without a bust. Consequently, the bust did not deter criminal activity in these markets and it was in fact cheaper to buy illegal products.

Reviews as regulation substitute and fake reviews Given that reviews can screen for high quality on platforms, research has explored the extent to which reviews can substitute for existing regulation. While there are dimensions of quality for which that may be the case – for example, quality dimensions that are directly observable to the consumer – [Farronato and](#)

¹¹Native advertising has been extensively discussed by the FTC. See here for more details: <https://www.ftc.gov/business-guidance/resources/native-advertising-guide-businesses>

Zervas (2022) find that monitoring by regulators may still be needed for many dimensions of quality relevant for consumer safety. In a similar vein, the issue of fake reviews is an important information design question relevant for regulators. Injecting promotional reviews undermines platform credibility, generates noise and deception, and results in sub-optimal purchase decisions (Pocchiari et al., 2023). As a result, more stringent policies against review fraud have recently been proposed by the FTC ¹². Fake reviews can primarily arise in two ways. In the first case, factors governing the business environment itself (such as reputation shocks or nearby competition) can spur businesses to leave fake reviews (Luca and Zervas, 2016; Mayzlin et al., 2014). This type of fraud primarily affects the service industry (hotels and restaurants). In the second case, which is more common for e-commerce platforms, an active online market for fraudulent reviews exists, where businesses compensate customers to purchase selected products and leave positive (fake) reviews (He et al., 2022b). In both cases, smaller independent businesses tend to engage more in fraud, implying that fake reviews can be perceived as a substitute for brand reputation (Hollenbeck, 2018).

Some notable open questions related to the regulation of information design concern the efficacy and consequences of various types of disclosure regulation, specifically given the rise of influencer marketing. Next, in the context of markets that operate outside of traditional governance (such as DarkNet markets) which are challenging for law enforcement to combat, it is important to explore how different governments and markets can collaborate to develop reasonable global policy solutions. Finally, while some early work has demonstrated ways in which fake review filters can be improved (for instance by using the product-reviewer network structure, see He et al. (2022a)), other approaches to detect review fraud at scale remain scarce. Platforms like Yelp and Amazon already have automated filters in place to detect and remove fake reviews, but these can be inaccurate in the face of more sophisticated fraud (e.g., by using AI generated text).

4.3 Consumer protection

Consumer protection and privacy are arguably the most sizeable part of the regulation discussion. One aspect of consumer welfare oriented regulation is to ensure that products and services exchanged on platforms comply with local regulations and certifications. For example, a regulatory failure in the context of products could mean toys sold on Amazon violate certain safety standards¹³. In the context of services, regulation might require providers to obtain appropriate certifications (e.g occupational licenses) to reduce information asym-

¹²<https://www.ftc.gov/news-events/news/press-releases/2024/01/ftc-hold-informal-hearing-proposed-rule>

¹³These failures are often fixed quickly, for example: <https://sellercentral-europe.amazon.com/seller-forums/discussions/t/2f6d4df58540d20a202c3e3522020c3b>

metries between consumers and service providers. Other aspects of consumer protection focus on data privacy (in particular GDPR), and content for children.

Licensing and provider quality Many digital platforms intermediate services traditionally provided by professionals who are subject to regulatory screening and monitoring, such as occupational licensing or ongoing health and safety inspections. Because these types of policies may increase entry barriers, which in turn can lead to fewer options and higher consumer prices (Farronato et al., 2020), they are often justified only when the benefits outweigh the costs. For many professions, such as doctors or lawyers, there is no question that occupational licensing regulation should extend to the digital world. For others however, such as taxi drivers, it is not obvious whether the benefits outweigh the costs. The challenge to answer this question lies in having access to objective measures of service quality. Athey et al. (2019) overcome this challenge by focusing on the ride-sharing market, where telemetry measures allow for the recording of speed, acceleration, braking, and phone handling. The authors find that Uber drivers provide better quality than taxi drivers matched through the Uber app. This quality seems to be driven, at least in part, by drivers' responsiveness to consumer preferences, platform incentives, and access to information about their own performance. However, better understanding spillover effects between traditional and platform-driven businesses in the same sector is important. For instance, Yu et al. (2020) examine the impact of policies regulating the number of registered Uber/DiDi drivers on various stakeholders, and find that without government intervention, on-demand ride service platforms can potentially drive traditional taxis out of the market under certain conditions.

Privacy The next set of questions concern protection of consumer and data privacy on online platforms. Results on the value of data to identify consumers and their preferences are mixed. While there is evidence of first-party data being valuable (as discussed in Section 3.3), third-party data from data brokers seem to perform poorly at the task they are designed to complete (Neumann et al., 2019). Even worse, they may exacerbate existing societal inequalities by offering different degrees of prediction performance across different demographic groups (Neumann and Tucker, 2021), leading to what Tucker (2023) calls *algorithmic exclusion*. Bergemann and Bonatti (2023) argue that privacy-enhancing data governance, such as federated learning, can increase consumer welfare by mitigating the informational advantages platforms hold, thus addressing concerns over excessive data collection and its use in bargaining power dynamics. On the other hand, Fainmesser et al. (2023) theoretically examine the influence of platforms' revenue models on their data practices, discovering that data-driven businesses tend to both collect and protect more consumer data compared to

their usage-driven counterparts. Their findings also hint at the potential pitfalls of regulations focusing solely on data protection, which may inadvertently harm consumer surplus and overall welfare.

GDPR Given the value data provides to companies, it is not surprising that studies looking at the effect of the European Union’s General Data Protection Regulation (GDPR) have found that privacy regulation tends to hurt firms’ performance and innovation, limit competition and increase market concentration ([Johnson, 2022](#); [Peukert et al., 2022](#); [Johnson et al., 2023b](#)). Yet, regulators in the European Union, China, and California have all passed legislation to limit the collection of consumer data, and to ask for explicit consent from consumers. While consumers may often undervalue privacy, it seems apparent that GDPR has improved consumer awareness about firms’ data practices and their perceived control over their own data (see [Johnson \(2022\)](#) for an overview of the literature on GDPR).

Content for children Recent papers have also specifically examined targeting and data protection for children. [Kircher and Foerderer \(2023\)](#) investigate Google’s ban on targeted advertising in the Android market for children’s games. They find that the ban led to substantial app abandonment and reduced the release of feature updates, especially for games of young, undiversified, and ad-dependent companies. Similarly, [Johnson et al. \(2023a\)](#) explore the tradeoff between privacy and personalization for online content by evaluating the impact of YouTube’s settlement with the FTC over violations of the Children’s Online Privacy Protection Act (COPPA), which removed all forms of personalization (ads, search and recommendations) for child-directed content. They find that this leads to a decline in both the quantity and quality of content created for children. Despite these drawbacks, the need for regulation for vulnerable user groups, such as children, is evident. For instance, [Ananthakrishnan and Tucker \(2022\)](#) have found document widespread hate speech on children’s videos on Youtube. This points to the need of calibrating policies that ensure protection while not hampering the content ecosystem.

There are several open questions in the space of consumer protection. As highlighted above, several studies focus on the drawbacks of data and privacy regulations on firm outcomes. This suggests that the benefits of consumer privacy must be substantial for such regulations to provide a social net benefit. Measuring consumer benefits from privacy is significantly more challenging compared to firm-side metrics, which are clearly defined. Hence, additional studies focusing on potential privacy benefits in different data contexts, as in [Lin and Strulov-Shlain \(2023\)](#) and [Collis et al. \(2021\)](#), could be useful from a policy perspective. Additionally, questions remain about how regulatory bodies or platforms can design more

effective consumer opt-out mechanisms or privacy settings that are accessible and understandable to a broader range of users, thereby ensuring meaningful privacy protection. Such varying degrees of consumer data privacy regulations could also influence the strategic behavior of online platforms and third-party sellers, particularly with personalized advertising and product recommendations. More fundamentally, these issues underscore the need to understand how online platforms can best balance the collection of data to improve their services while respecting user privacy.

4.4 Competition

Digital platforms raise a host of important issues around antitrust. Many platforms have achieved large scales in the main market where they operate, in part because of a confluence of strong economics of scale, scope, and network effects. Recent regulation in the European Union¹⁴ and lawsuits in the US¹⁵ have deviated dramatically from the hands-off approach that characterized the last couple of decades.

Market entry Platform regulation may have direct repercussions on market entry. [Faronato and Fradkin \(2022\)](#) find that the entry of Airbnb into the lodging industry to compete with hotels expands supply when it's most needed, during demand peaks, which results in large welfare benefits. However, to inform policy, researchers have also been interested in understanding the effects of home-sharing platforms on the housing market. [Barron et al. \(2021\)](#) study the effect of home-sharing on the housing market, and find increases in rental and sale prices due to the entry of Airbnb. The effect, [Calder-Wang \(2021\)](#) finds, seems to be concentrated in high-income neighborhoods. Together with studies on the effects on the main market, quantifying the potential spillovers on adjacent markets allows regulators to weigh the benefits and costs of complete or partial bans on digital platforms. For example, [Bekkerman et al. \(2023\)](#) show that regulation on short term rentals (STR) such as Airbnb reduce residential permits by 11.0%, thus pointing to the role of platforms like Airbnb in incentivizing residential real estate investment on the one hand while raising rental prices on the other.

In the e-commerce domain, [Etro \(2021\)](#) studies whether the profit-maximizing choices on entry by the marketplace are aligned with the interest of consumers, when the marketplace has an advantage in logistics and the sellers have an advantage in marketing. The key finding is that entry of the first-party product maximizes aggregate consumer welfare, so the

¹⁴https://digital-markets-act.ec.europa.eu/index_en

¹⁵<https://www.ftc.gov/news-events/news/press-releases/2023/09/ftc-sues-amazon-illegally-maintaining-m>

regulation that calls for the banning of sales of the first-party products (e.g., the Ending Platform Monopolies Act in the U.S.) by platforms may be welfare reducing.

Labor laws in the gig economy Digital platforms often match consumers to small-scale and occasional service providers, with more than 500 platforms in the European Union alone that provide such services. Collectively, 28 million people in the European Union were employed in such a way in 2021, with an expected increase to 43 million by 2025.¹⁶ This has raised questions related to labor protection of gig workers. Although virtually all digital platforms attract providers who work as independent contractors or freelancers, some platforms (e.g. in ride-sharing domains) have received scrutiny over their level of control of providers—especially when it comes to setting prices—relative to the lack of benefits, such as health insurance or paid leave. In such cases, while providers have full discretion over their work schedule, they entirely bear responsibility for providing the services. The discretion has clear upsides, allowing for gig work to adjust in response to losses of other sources of earnings or sudden increases in consumption (Kousta, 2018, 2019; Garin et al., 2020). The benefits are particularly concentrated among those who want flexibility in their working schedule (Hall and Krueger, 2018; Chen et al., 2019).

The fact that providers are compensated only when they provide services has raised criticism and calls for strengthening protection of gig workers. It is unclear whether the earnings of gig workers make up for the lack of benefits. However, both Hall and Krueger (2018) and Hall et al. (2023) find empirical support for earnings on Uber to be anchored by an outside option. Because the prevalence of these alternative work arrangements is growing over time (Mas and Pallais, 2020), understanding how to effectively regulate them will become increasingly more important.

Mergers Recently, the FTC and DOJ issued new draft merger guidelines for the general setting of multi-sided platforms. However, McCarthy and Wilbur (2023) document that the majority of existing mergers are defensive – five of the six mergers they studied resulted in greater competition indicators. Parker et al. (2022) argue that antitrust intervention should satisfy three criteria: it should not decrease platform value creation, it should ensure efficiency by fairly distributing created value among participants, and it should promote dynamic efficiency and competition to eliminate incentives for anticompetitive strategies like artificial entry barriers. Overall, it is important to weigh the compliance costs of regulation (e.g., decreased innovation) with the benefits (Sokol and Zhou, 2024).

Several open questions remain in the broad area of regulation. The first set of questions

¹⁶<https://www.consilium.europa.eu/en/policies/platform-work-eu/>

are around how to create legislation that is tailored to specific contexts. For example, the assumption by the courts that online platforms compete only with other online platforms has led to a determination that a merger between an online travel platform and more traditional travel service provider is not a merger of competitors (see [Hovencamp \(2021\)](#)), which may not be accurate. Besides providing clear definitions, the impact of novel regulations, targeted at specific (types of) platforms that encourage competition but are not too onerous are also worth exploring.

The next set of questions revolve around content moderation policies on platforms. Given the complexity and nature of content, it is hard to draft regulation that applies to all settings. Some researchers have argued that allowing platforms to be responsible for their own content can distort incentives. One option that has been discussed to address this is involving a third party that could be charged by regulators to evaluate specific cases, balancing the perspectives of the content creator, the platform and the content viewers.¹⁷ Others have argued that these decisions be made in the judicial system, with courts ruling on individual cases ([Keller, 2017](#)). The relative of merits and consequences of these options remain to be studied.

5 Empirical Research: Data Acquisition & Common Challenges

In the final section, we focus exclusively on empirical research challenges that may arise when working with platform data. In particular, we discuss platform-researcher collaborations, platform research without platform collaboration, and common issues that affect empirical research about online platforms.

5.1 Platform-sanctioned research approaches

Platforms have often been the first parties to enable empirical platform research. They do this through a variety of approaches. Some large platforms have created internal teams of scientists (e.g., AirBnB, Amazon, Google, Lyft, Meta, Microsoft, Uber, Yahoo). These efforts are often well-resourced and staffed. Some teams have developed robust internal scientific cultures, but the degree to which internal teams can collaborate and/or publish externally varies across organizations and over time.

¹⁷For more on third party audits, see for example: https://www.brennancenter.org/sites/default/files/2021-08/Double_Standards_Content_Moderation.pdf

Apart from these larger platforms, many small and medium-sized platforms have also directly collaborated with academics on research projects, sharing data and enabling field experiments. Though initially rare, this approach has recently become more common. One such indicator is that, out of 70 working papers submitted to the 2023 Workshop on Platform Analytics, more than half were direct collaborations between academics and platforms.¹⁸ One advantage of such an approach is that researchers may be able to study fine-grained user data that are otherwise not easily available. For example, Xie et al. (2022) used geolocation data from a transportation app to study users propensity to take transactions off the platform (disintermediation). Other advantages include access to proprietary internal information such as algorithms used, and the possibility to implement improvements to platform design based on the findings of the research.

Some platforms have created public datasets that can be used for research, teaching or other public purposes. Popular examples include the Yelp Open Dataset and the Expedia Hotel Recommendations dataset, both of which have been analyzed in numerous academic papers. These may be available directly from the platform or through a data aggregator like Kaggle. Open datasets enable the platform to protect user privacy and may enable external innovations that the platform can then adopt and expand upon (Ursu, 2018; Compiani et al., 2021). Some platforms enable external researchers to access platform data through Application Programming Interfaces (APIs). APIs can enable powerful, flexible, regular access to various platform data. Some of the best-known platform APIs include Facebook, Reddit, Twitter, and YouTube. There are also numerous less famous APIs, such as those that enabled Lu (2023) to explore the video game industry.

Finally, some non-profit platforms have shared data and practices with independent researchers upon request, continuing a long tradition of openness among non-profit organizations. For example, Vana and Lambrecht (2022) analyzed extensive data and the exact algorithm used by the nonprofit crowdfunding platform DonorsChoose to rank projects in search results. This allowed the authors to use a model to evaluate the algorithm used in practice versus two competing algorithms. Agarwal and Sen (2022) also use data from DonorsChoose to address the role of digital platforms in bridging the political divide and providing resources for teachers, enabling them to have conversations about diversity and inclusion with young students.

¹⁸<https://platformanalytics.org/>

5.2 Research approaches without platform participation

Academic researchers have developed diverse techniques to collect platform data without requiring platform permission. This allows them to explore questions that may be of great academic interest but at odds with the platform's own objectives. We group the sources of these data into six categories: (1) third-party partners, (2) scripted platform monitoring (scraping), (3) recruiting consumers, (4) on-platform interventions, (5) creating synthetic platforms, and (6) market research studies.

First, platform behaviors can often be observed by other platform companies such as internet service providers, credit card companies, or other partners. [Simonov et al. \(2023\)](#) studied consumer clickstream data from a market research firm to understand how display advertising affected subsequent consumer search. [Kim and McCarthy \(2023\)](#) used a large credit card expenditure dataset to understand how the entry of scooter-sharing platforms changed local restaurant demand. [Batikas et al. \(2023\)](#) studied how the GDPR regulation changed apps' testing policies, using data collected by an experimentation-focused shared Software Development Kit (SDK) provider.

Second, nonprofits, researchers, and other organizations have created panel datasets of platform behaviors by systematically crawling and monitoring digital platforms. For example, InsideAirBnB.com monitors AirBnB listings and provides archived data. Until recently, PushShift.io offered a similar service related to Reddit content ([Baumgartner et al., 2020](#)). Similarly, individual researchers create scrapers to collect data from platforms such as Amazon ([Lam, 2023](#)) and Google reviews ([Troncoso et al., 2023](#)) and often make them available to other researchers ([Ni et al., 2019](#)). Furthermore, the recent development of blockchain technology has also encouraged data transparency, offering unique opportunities for researchers to explore new avenues in platform studies ([Liu et al., 2024](#)).

Third, platform data can be collected directly from consumers through various means. [Allcott et al. \(2022\)](#) created a smartphone app to monitor social media usage, recruited users through online display advertising on Facebook, and paid respondents to install the app. [Zeller \(2023\)](#) analyzed data from trakt.tv, a service consumers self-select into to self-monitor media consumption behavior and generate personalized recommendations. Browser extensions have been used to track browsing behavior, manipulate browsing experience, and prompt user completion of additional tasks ([Beknazar-Yuzbashev et al., 2022](#); [Farronato et al., 2023c,b](#)). One such browser extension has recently been open sourced to make this approach more easily available to other researchers.¹⁹

Fourth, researchers have studied platform topics by intervening directly in platform envi-

¹⁹See <https://www.webmunk.org/>.

ronments. [Toubia and Stephen \(2013\)](#) created 100 inauthentic Twitter profiles and randomly added them as followers of noncommercial Twitter accounts, finding that increasing audiences decreased posting frequency for most users. [Jiménez Durán \(2021\)](#) reported hateful posts using Twitter’s on-platform tools, leading to increased post removals, no activity change by post authors, and increased subsequent activity by attacked profiles. [Mosleh et al. \(2022\)](#) offer a valuable and nuanced discussion of conducting ecologically valid field experiments in social media settings.

Fifth, some researchers have created new entities to perform platform interventions. Researchers at the University of Minnesota used National Science Foundation funding to create the non-profit movie recommendation platform MovieLens.org, leading to a long series of publications, including several field experiments. Other researchers have used online tools to create realistic virtual shopping environments, studying how advertising content affects subsequent consumer search and purchase decisions ([Morozov and Tuchman, 2022](#)), and collecting consumer reasons for revisiting previously seen products during the shopping process ([Dang et al., 2022](#)).

Finally, researchers have studied platform topics using realistic controlled settings. One approach is to use conjoint analysis with incentive-aligned designs, as has been done to study consumers’ willingness to accept payment for personal data ([Collis et al., 2021](#)), data choice architecture effects ([Lin and Strulov-Shlain, 2023](#)), and efforts to debunk product misinformation ([Fong et al., 2023](#)).

5.3 Frequent Challenges in Empirical Platform Research

Even with unfettered access, platform data have limitations. Platforms often do not store full information about every choice environment, as the cost of storing unclicked search results, untaken recommendations, unclicked ads, or unaccepted bids may exceed its perceived business value. Researchers who partner with platforms often have to deal with missing or censored variables that limit causal and mechanism analyses.

Platforms also may decline to disclose full information, such as revenue, sales and algorithms, or require that they be masked in a scientific paper. Even willing partners may lack unified internal data, as different data types may be handled by different internal teams (e.g., distinct teams for buyers and sellers, or for advertising and logistics). Many platforms are relatively young firms with internal data structures that are more complicated than traditional firms. Data architecture such as APIs may change without warning. We recommend researchers to ask partner firms for data retrieval scripts alongside data for research, to reduce the chance of an undetected data retrieval error. Also, it is important not to assume

that platform openness to research will necessarily persist, as issues like bad press, executive turnover, data breaches, and lawsuits may change collaboration opportunities.

Internal platform data often omit unobserved but relevant competitor variables such as multihoming, competing prices or competitor algorithms. When interested in market-level outcomes, researchers often have to collect data from multiple competitors (Farronato and Fradkin, 2022; Farronato et al., 2023a). Competitor changes may drive platform outcomes and therefore threaten to confound regression discontinuities in time (RDiT), or increase statistical noise and thereby make causal estimates from randomized controlled trials (RCTs) less precise.

RCTs are treated as gold standards of evidence within most platforms, but they carry some predictable limitations in platform contexts. Interference or violation of the Stable Unit Value Treatment Assumption (SUTVA) is a common concern. Potential SUTVA violations may accrue from improper RCT infrastructure, the type of experiment being run, or (perhaps most commonly) on-platform competition among treated units (Goli et al., 2022; Holtz et al., 2020). Most large digital platforms have parallel experimentation infrastructure in place that allows them to run several A/B/n tests simultaneously, ensuring no contamination; but given the limitations of a smaller platform's infrastructure, individual consumers might end up being allocated into multiple simultaneous experiments. Often, a proportion of the traffic is never assigned to any experimental condition to serve as a (perpetual) control group. Even with state-of-the-art infrastructure, there can be interference when the outcome of the treated users depends on the treatment assignment of other users, for example when search results are ranked by aggregate statistics such as click-through rates.

Research collaborations with platforms typically require agreeing on a legal framework including non-disclosure agreements (NDAs) or data usage agreements (DUAs), which are agreed upon between the researchers or university counsel and the partner company. Ensuring unambiguous terminology is important to reduce the risk of different interpretation between the parties, which might otherwise delay or scuttle working partnerships prior to completion. Since data and privacy regulations continue to evolve, it may be useful to monitor the viability of verbal agreements until they are formally codified into an NDA. Further, within any such legal framework, a researcher or university should ensure upfront that they are guaranteed the unconditional right to publish results in academic journals.

Research without platform participation can be risky and subject to unexpected termination. For example, Edelman et al. (2017) studied racial discrimination on AirBnB by setting up automated guest accounts and manipulating guest race. They found that hosts discriminate against guests that seem to be from African-American backgrounds. In their power calculations, the authors aimed for 10,000 responses from hosts, but had to work with

6,400 responses. AirBnB shut down their experiment by taking down the guest profiles the authors had created on the platform. Other researchers who collected platform data without platform participation have experienced API termination, restrictions, pricing changes, and even lawsuits from the platforms.²⁰

Overall, researchers play a key role in quantifying the tradeoffs between the logistical hassles of gaining platform cooperation and alternate channels to access similar data. More innovative approaches (such as browser extensions and synthetic platforms) can be reasonable workarounds, but direct third party access through APIs can enable better external validity.

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²⁰Research without platform participation also may need to comply with the platform’s terms of service. Some journals require any scraped data to comply with published terms of service. Yet site terms change frequently and are often unclear.

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