Fairness in Digital Platform Ecosystems:

A review and conceptualization

Thorhildur Jetzek (Copenhagen Business School),
Carmelo Cennamo (Copenhagen Business School, and
Platform Economy & Regulation monitor, SDA Bocconi

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***Thorhildur Jetzek**, Copenhagen Business School (tj.si@cbs.dk)*

***Carmelo Cennamo**, Copenhagen Business School (cce.si@cbs.dk)*

ABSTRACT

Digital platforms and ecosystems are new economic structures that enable organizations to create greater value compared to other structures and organizing modes. They also reveal new, inherent collaborative and competitive challenges that firms can face within the ecosystem. Some of the fundamental questions in business such as how value jointly produced is split among firms, what is a fair distribution of economic value among firms, and when do collaboration and competition turn into an unfair game take on new shape and relevance in the digital economy context. The network externalities and the dynamics of platforms and ecosystems imply that powerful orchestrators not only are rewarded for their superior products, but they can also abuse their orchestration power and impose excessive or unfair conditions for complementors' participation in the ecosystem and engagement with customers. Are platforms and ecosystems inherently leading to structural conditions of unfairness? Which governance practices cause fairness concerns, and which type? We address these questions by identifying the different cases of unfairness in platform ecosystems from a cross-disciplinary review, and the governance practices leading to these situations. We analyze the potential trade-offs between governance practices leading to fairness concerns and ecosystem wide value creation, and identify when such tradeoffs are most acute, creating situations of "conflictual governance", and what to do about.

Keywords: Fairness; Value Creation; Value Capture; Digital platforms; Platform Ecosystems

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INTRODUCTION

Platforms and ecosystems, whether conceptualized as digital platform marketplaces (Hagiu, 2009; Parker & Van Alstyne 2005; Rochet & Tirole, 2006; Rysman, 2009), innovation ecosystems (Adner & Kapoor, 2010; Nambisan & Sawhney, 2011; Parker et al. 2017), or data-based ecosystems (Iansiti and Lakhani 2020; Kramer et al. 2019; Li & Agarwal 2017), are new structures of economic relationships put in place to enable better coordination and collaboration among firms, whose activities are highly interdependent, for the production of joint value (see Adner, 2017; Jacobides et al., 2018). Several studies from different perspectives have highlighted the properties and distinctive elements of these structures, as well as the benefits including the presence of coopetitive relationships within and across ecosystems (e.g., Gawer & Henderson, 2007; Hannah & Eisenhardt 2019; Zhu & Liu, 2018); the ability to generate greater innovation than inside the firm from the recombination options afforded by modular designs and the ability to engage external innovators (Baldwin & Clark, 2000; Parker et al., 2017; Wareham et al. 2014); the enabling of exchanges and transactions among different groups of customers (Hagiu, 2009; Rochet & Tirole, 2006; Rysman, 2009); and reduction in costs of coordination and cooperation (Langlois 2003; Foss et al. 2021; Jacobides et al. 2018). Incentives' alignment across the participating actors is a common theme receiving emphasis in the different perspectives, which underscores the central role of platform governance for value creation in these structures.

However, these same governance practices, and some of the ecosystem models behind these successful firms are increasingly being challenged on the ground of (un)fairness by partners and new challengers. This is clearly reflected in the number of new regulatory initiatives around the globe, including the recent EU's Digital Market Act or the American Choice and Innovation Online Act. While the concept of fairness appears consistently throughout both EU competition law

framework and other legislations that concern digital platforms, fairness is not clearly defined in these regulations. This creates a lack of clarity about what a fairness standard requires (Crawford et al., 2021; Dunne, 2020). Scholars have thus called for more research on the topic.

There is emerging research highlighting possible "market failures" taking place in ecosystems in idiosyncratic forms, including "cooperation failures"- lowered incentives to invest in quality and cooperate due to value-capture problems (e.g., Miller & Toh, 2022; Panico & Cennamo, 2022; Zhang et al. 2022); "access failures" - exploitation of data aggregation and control to dictate excessive terms of participation (Kramer et al., 2019; Parker et al. 2021; Petropoulos, 2020; Prat and Valletti, 2020); "self-preferencing" - promotion of platform own services at the expense of those equally (or more) valuable of complementors (de Cremer et al, 2019; Furman et al 2019; Zhu & Liu, 2018; Sokol & Zhu, 2021), or more broadly the incentives of the orchestrator to selectively promote certain products and complementors to manipulate their fortunes and reduce their bargaining power (e.g., Brynjolfsson, Hu & Smith, 2010; Rietveld et al. 2019); privacy risks and value misappropriation related to the increased "datafication" of services, a concern that is particularly acute for services that are sensitive and fundamental such as healthcare (e.g., Bourreau et al., 2020; Caffarra & Valletti, 2020); "dark patterns" related to algorithmic opaqueness, whereby it is exceedingly difficult for both consumers and regulators to assess how the data are being used and how the options for customer choice and matching with complementors' product offerings are done (CMA 2022).

Some of the fundamental questions in business such as how value jointly produced is split among firms, what is a fair distribution of economic value among firms, when does competition turn into an unfair game, and whether and when fairness should be part of the strategic calculus, take therefore a new relevance and require to be revisited in the context of platform ecosystems (Davis,

2021; Jacobides & Lianos, 2021). *Are thus ecosystems inherently leading to structural conditions of unfairness (a problem with the economic structure itself)?*

We address this question by identifying the different cases of unfairness in platform ecosystems from a cross-disciplinary review, and the governance practices leading to these situations. The conversation we aim to stimulate in this paper concerns the trade-offs that firms involved in platform-based ecosystems face vis-à-vis the nature of their relationships and power forces. Platform providers employ a variety of governance mechanisms, which explain *how* platform providers utilize their institutional environment to address market failures and enable interactions (Boudreau & Hagiu, 2009; Chen et al., 2022; Eisenmann et al., 2011; Wareham, 2014; Zhang et al., 2022). The goal of platform governance is to sustain the platform ecosystem and facilitate and motivate value creation[1]. The literature has identified various governance tensions, such as the need to balance platform openness and control, how to manage both the quality and range of complements, balance collaboration and competition with and between complementors, and the need to sustain ecosystem value creation, while maximizing own value capture (e.g., Cennamo & Santálo, 2019; Chen et al. 2022; Rietveld & Schilling, 2021).

However, the vantage point of analysis in the literature is economic value, and thus how governance maximizes value potential of the platform ecosystem, and the firm's own value capture. Focus is thus on the externalities affecting users' choices in the business interaction. Standing the different fairness challenges described above, it becomes imperative to examine these other negative externalities in business relationships within ecosystems; we shall study the determinants

[1] This can be done through governance practices such as setting prices, regulating access to the platform, regulating the way in which business users can participate, controlling which data and APIs users can access, setting up review and rating systems, and imposing (technical) standards. Platform governance also includes the allocation of decision- and control-rights between the platform provider and the various participants (Chen et al., 2022). The platform provider defines what participants can do and how they are compensated while the participants themselves decide if and how they will contribute (Kretchmer et al., 2022).

and consequences of unfairness, and how to examine these conditions, conceptually and empirically. Our analysis represents a starting point in this direction.

We identified two key dimensions of unfairness from the extant literature, *distributional unfairness*, referring to the outcome of the allocation decision and *procedural unfairness*, referring to the process used to reach this decision. We map the different unfairness themes discussed in the literature to the governance practices that give rise to them. These practices can be classified into either *design rules* for the technical design of the platform or *market rules* that are used to facilitate cross-side interactions and business on the platform, and *data rules* (use and control over data) that cuts across the other two categories of platform governance (i.e., design and market rules). We identify the conditions and mechanisms for unfairness, as well as who is negatively affected by and who is benefiting from these unfair conditions. Finally, we analyze the potential trade-offs between governance practices leading to fairness concerns and ecosystem wide value creation, and identify when such tradeoffs are most acute, creating situations of "conflictual governance", and what to do about.

The paper is organized as follows. First, we review how fairness has been conceptualized in prior literature as it applies to platform ecosystems and identify the key discussion topics. Second, we categorized and map the governance practices that give rise to unfairness situations and identify the key underlying conditions and mechanisms. Finally, we discuss the potential tradeoffs between fairness and value creation in platform ecosystems, and the implications for theory and practice.

DIFFERENT CONCEPTUALIZATIONS OF FAIRNESS

Cambridge Dictionary defines fairness as "the quality of treating people equally or in a way that is right or reasonable."[2] The concept of fairness thus refers mainly to treatment and requires some (accepted) reference point for establishing comparison and assessment of such treatment. Homans (1958) first noted that comparison is a critical element of fairness, or what is considered "just": "For, with men, the heart of these situations is a comparison…. Both Person and Other do in fact perceive and appraise their reward, costs and investments in relation to the rewards, costs and investments of other men." (Homans, 1961, p. 76). Such comparison has been conceptualized as *fairness concern* and refers to an individual's concern about the inequality between herself and other stakeholders. Fairness concern can be divided into horizontal fairness concern (comparison to peers) and vertical fairness concern (concern about fairness in a supply chain) (Cui et al., 2007). Kahneman and Tversky (1979) proposed that fairness minded individual's behavior will be affected by a reference point. For instance, consumers compare prices with internal or external reference prices from their previous purchases, such as the price other people paid, price by competitors or simply using how much they think a service should cost (Bolton et al., 2003; Nguyen et al., 2015). Fairness involves judgment (of the treatment in comparison to the reference point) (Bolton et al. 2003), and can thus vary across individuals, hence producing different perceptions of fairness, and be influenced by society's values and norms, and thus change over time (e.g., Kahneman et al., 1986).

Fairness is closely related to the concept of justice. Greenberg used the term organizational justice as referring to people's perceptions of fairness in organizations along with their associated behavioral, cognitive, and emotional reactions (Greenberg, 1987). In the context of algorithmic decision-making, fairness has been conceptualized as the absence of any prejudice or favoritism

[2] https://dictionary.cambridge.org/dictionary/english/fairness

toward an individual or group based on their inherent or acquired characteristics (Mehrabi et al., 2021). In the context of competition law, fairness is usually conceptualized in relation to the unbalanced (and unjust) contractual power between economic actors, with the law aims to re-establishing relational justice by protecting the weaker party in the relationship (Dehdashti, 2018).

Principles of fairness also vary in numerous dimensions. They vary in what is being allocated (income, wealth, opportunities, jobs, attention, etc.); what is the level of analysis (society, organizations, groups of persons, individuals); and on what basis the distribution should be made (equality, profit maximization, dynamic innovation, according to individual characteristics, etc.). Researchers generally distinguish between two macro categories of fairness: distributive fairness and procedural fairness (Poppo & Zhou, 2011).

The concept of *distributive fairness*, first introduced by Homans (1958; 1961) under the term of distributive justice, maintains that people, in an exchange relationship with others, are entitled to receive a reward that is proportional to what they have invested in the relationship. Distributive fairness refers to the evaluation of an outcome of an allocation decision, such as when deciding upon the compensation of a stakeholder of a business relationship (Folger & Konovsky, 1989; Gilliland, 1993). A party who receives compensation according to its contribution, duties and responsibilities will perceive distributive fairness (Luo, 2007; Poppo & Zhou, 2011). Perceptions of equity are intrinsic to the concept of distributive fairness (Poppo & Zhou, 2011). Distributive fairness is, for instance, commonly modelled as inequity aversion, such that an agent is willing to give up some monetary payoff to move in the direction of more equitable outcomes (Cui et al., 2007). An equitable allocation is symmetric in the sense that no agent wishes to hold other agent´s final bundle, including labor contribution (Varian, 1975). According to Varian (1975), an allocation that has both the properties of efficiency and equity is a fair allocation.

The concept of *procedural fairness* reflects instead the extent in which an individual perceives that the process leading to a decision of an outcome allocation is fair (Greenberg & Tyler, 1987; Konovsky, 2000). Procedural fairness is based on perceptions of the use of accurate and consistent procedures in decision making and granting voice to those that are subject to the procedures (Folger, 1977). Luo (2007) argues that in operational phases "when procedural information is available before outcome information, the information about the procedures will affect judgment about the fairness outcomes" (Luo, 2007, p. 649). Bies (1987) suggested that procedural fairness has an interactional component, which refers to the interpersonal behavior of the exchange partner, that is, whether the exchange partner provided accounts for his or her actions and whether the exchange partner treated others with dignity and respect (Bies & Moag, 1986; Bies & Shapiro, 1987). More recently, Colquitt (2001) empirically show that two dimensions are particularly critical in the determination of fairness perceptions: interpersonal justice and informational justice (Arino & Ring, 2010). Informational justice refers to the level and quality of information and explanations as well as the accountability of authorities. Interpersonal justice refers to how agents interact with each other and describes the dignity and respect agents receive from others (Colquitt, 2001). Colquitt (2001) argues that perceptions of interpersonal justice tend to alter perceptions of distributive fairness while perceptions of informational justice might alter perceptions of procedural fairness. However, in some cases, procedural and distributive fairness might be intertwined. Fair outcomes are generally the result of fair processes, and no judgment can proclaim an outcome to be fair or unfair without examining the process that produced the outcome (Holcombe, 1983). Against this background, we discuss the different fairness concerns with digital platforms ecosystems, categorizing them along the two dimensions of distributive and procedural fairness, and how they relate to each other.

LITERATURE REVIEW

Corpus

We followed guidelines from previous literature review studies to build our corpus (Chen et al., 2022; Rietveld & Schilling, 2021; Kumar & Srivastava, 2022). We performed three different searches in the Scopus database, iteratively expanding the corpus by adding search words, until we had a corpus of 646 articles in the business and economics category. To reduce the size of this search query we reviewed the keywords returned by the search results and limited them to keywords that fit our context of fairness in platform ecosystems. After collecting all the documents and removing duplications, we had a final corpus of 201 publications. Afterwards, we reviewed the abstract, title and source of these papers to qualitatively validate if they were compatible with our context and removed those that weren't. The final sample consists of 55 papers that were deemed relevant to our topic. We manually coded each paper with the goal of identifying the main themes in research on fairness in platform ecosystem as shown in Figure 1. Furthermore, we iteratively used two exploratory data analytics methods, Structural Topic Modelling and t-SNE clustering algorithm, to identify relevant topics and themes in the literature, described in figure 1.

Insert Figure 1 about here

Themes in platform fairness literature

Several studies in our corpus focus primarily on *distributive fairness*, i.e., how platform ecosystems can be designed to ensure that participants are fairly rewarded for their contribution.

Distributive fairness, market design and fairness concerns. In an automated contractual process without a trusted third party, algorithms must ensure beyond any doubt that none of the participating stakeholders holds an advantageous position or is able to cheat and thus gain too large

a share (Ferrer-Gomila et al., 2019). Though overcoming the "trust frontier" without a trusted third party is a major challenge, blockchain technology is portraited to replace trust to some degree (Ferrer-Gomila et al., 2019). However, when the platform provider holds a central position as a trusted third party, it becomes challenging to evaluate what is a fair contribution of users in platform ecosystem (Chang et al., 2014). Unlike traditional supply chains, the platform provider invests in the (costly) infrastructure and institutions of the platform, but also gains from external resources, network effects and economies of scale and scope. As opposed to traditional supply chains, business users must thus take the platform provider´s provision of services into account when considering what is a fair share of the overall gains of the platform (Wang et al., 2019).

The platform provider´s transaction fee or commission is a common source of disagreement regarding distribution of gains (Chang et al., 2014; Oh et al., 2015). Game theorists have endeavored to evaluate the fair distribution of value using methods such as the Shapley value (Chang et al., 2014; Parker et al., 2020).[3] However, Oh et al. (2015) argue that the Shapley value might not fully capture the impact of asymmetry in bargaining power between platform provider and individual business users, thus not reflecting the empirical reality of value distribution in platform ecosystems.[4] Lesser bargaining power is, however, not always an impediment for business users. Small business users with the capability to turn competition into collaboration (coopetition capability), can turn the challenge of a weaker bargaining power into a novel

[3] Shapley value is a method from game theory, calculated as the average expected marginal contribution of one player in a game after all possible combinations have been considered. Shapley value helps to determine a payoff for each player and is helpful when some players might contribute more or less than the others

[4] Oh et al. (2015) develop an alternative method to measure equilibrium distribution of value. Analyzing data from a network with over 100 business users in Korea, Oh et al.´s (2015) study shows that in a bargaining model´s stable equilibrium, the platform provider received 75% of the total value created by the ecosystem and app developers collectively received the remaining 25% (Oh et al., 2015). Their results indicated that in a stable equilibrium the platform provider is likely to receive an economic rent that exceeds its expected marginal contribution (Oh et al., 2015), and would indicate thus distributive unfairness compared to the prescription of the Shapley value.

opportunity for innovation (Yoo et al., 2022). However, Oh et al. (2015) conclude that disputes regarding value sharing can eventually cause the discontinuity of services as well as substantial economic losses.

Fairness concerns can affect end users' choice, i.e., their decision to purchase or not (Baird et al., 2016). Many online platforms such as Amazon, Orbitz, Uber, and Didi Chuxing, have adopted differential pricing strategies as a tool for market clearing . While end users tend to be more tolerant of price differences when they perceive the quality of the services is high, platform providers are more likely to abandon differential pricing strategies on the side of the platform where fairness concerns are strong (Zhao et al., 2022).

Procedural fairness. Twelve studies discuss issues related to procedural fairness in platform ecosystems. Informational justice is one dimension of procedural fairness and refers to the level and quality of information and the transparency and explanations that are offered, as well as the accountability of the party in power. Chiu et al. (2022), conclude that increased information quality tends to improve perceived [procedural] fairness, as was suggested by Colquitt (2001). The level of procedural fairness through informational justice can be reflected in end user´s need for anonymity and privacy (Wiener et al., 2021), information transparency (e.g., Lee et al., 2019; Helberger et al., 2022), and transparency and explainability of algorithmic decision making (e.g., Fu et al., 2021; Mehrota et al., 2018; Shen et al., 2021).

A few studies investigate design methods for algorithms that have no inherent biases and thus exhibit procedural fairness (Noriega-Campero et al., 2021). Algorithms can indeed perform better in terms of procedural fairness than human decision making (e.g., Noriega-Campero et al., 2021; Fu et al, 2021). Procedural fairness is also an important factor in platform interface design. Two relatively recent terms have been used in this context: "Dark patterns" and "predatory

monetization".[5] They describe opportunistic behavior by the designer, either the platform provider or the business user. *Dark patterns* is used as a term when the user interface supports "tricks" that are designed to cause the end user to buy more, even if the purchase is not increasing the user´s utility (bounded rationality). *Predatory monetization* is defined as unfair, misleading and aggressive monetization techniques in digital games by Petrovskaya and Zendle (2021).

Impact of perceived procedural and distributive unfairness. Thirteen studies discuss how perceptions of fairness impact platform ecosystem outcomes. Perceived fairness is an important variable in platform ecosystems and is found to positively impact outcomes such as customer satisfaction (Huang & Ha, 20202), trusting beliefs (Lee & Kim, 2019; Wiener et al., 2021), sense of belonging (Wang, 2022) behavioral intentions (Chiu et al., 2022; Wang & Wang, 2019) and moral legitimacy (Newlands & Lutz, 2020). Newlands and Lutz (2020) find that for a home sharing platform, increased perceived procedural, informational and interpersonal fairness as experienced by end users increases moral legitimacy but reduces regulatory desirability, thus diminishing the need for stringent rules and external regulations.

Legal and institutional context. Twelve studies discuss the legal and institutional context of digital platforms. Many studies entertain the notion that network effects, (data-driven) economies of scale and scope, vertical integration, entry and exit barriers and lock-in effects are powerful forces that transfer platforms into monopolies that hold control over the platform ecosystem. This is found to result in a serious imbalance in bargaining power and the adoption of unfair practices (see e.g., Hirayama & Arai, 2021; Jarsulic, 2022). A few studies discuss how platform practices turn unfair from a legal perspective. This includes practices such as use of autonomous decision-

[5] The term Dark patterns was originally coined in 2010 by Harry Brignull, who defined dark patterns as 'tricks used in websites and apps that make you do things that you didn't mean to, like buying or signing up for something' (see www.darkpatterns.org). See for instance: https://queue.acm.org/detail.cfm?id=3400901

making algorithms (Lee, 2020; Lagioia, 2022), algorithmic surveillance (Jarsulic, 2022), targeted advertisements (Geradin & Katsifis, 2020) and self-preferencing (Hutchinson & Treščáková). Moreover, platforms can impose excessive entry and access conditions, and exclusive dealing rules that prevent business users from promoting their offers outside the gatekeeper's platform (Tombal, 2022, Hutchinson & Treščáková, 2022).

A few studies highlight both the positive and negative impact of recent regulatory initiatives (Davies et al., 2022, Dehdashti, 2018; Tombal, 2022; Dunne, 2020; Hirayama & Arai, 2021; Fuchikawa, 2020; Hutchinson & Treščáková, 2022; Anagnostopoulou, 2020). For instance, the European Commission´s Digital Markets Act (DMA) introduces the definition of a gatekeeper, a platform which is in a position of control over digital marketplaces and thus has the power to set unilateral terms and conditions of access and use for participants. Gatekeepers are required in the DMA to fulfill certain requirements, for example regarding data handling (see e.g., Hutchinson & Treščáková, 2022; Tombal 2022; Davies et al., 2022). The definition of a gatekeeper opens the possibility for an ex-ante assessment of a gatekeepers' unfair practices. However, while the proponents of the DMA argue that ex ante action is required to forestall irreversible harm to competition, others argue that same logic also implies that the risk of harm from excessive regulation should be assessed, and the DMA contains no mechanism to do that (Davies et al., 2022). Furthermore, DMA is criticized for setting too stringent ex ante rules of conduct that could potentially negatively impact innovation or have other unintended consequences (Davies et al., 2022; Fuchikawa, 2020; Tombal, 2022).

PLATFORM GOVERNANCE PRACTICES AND FAIRNESS TRADEOFFS

Although research on fairness in platform ecosystems is still in a nascent stage, the literature review

indicates that there are several fairness concerns that attain either to how the joint value being created in the ecosystem is distributed among its contributors or to how rules about participation, exchange interactions of data collection and sharing are set, and the extent to which end users and business users have voice in the rule setting or knowledge about it. In some cases, it is advanced that perceptions of unfair treatment will negatively influence end users' participation in the platform and business users' willingness to contribute to the ecosystem, and thus negatively impact value generation of the platform ecosystem in the long-term.

However, in other cases, we find that unfair treatment of a group of users might not affect the platform ecosystem's value-creation capacity; in fact, more value might be generated and some user groups may gain additional benefits as a result. In such cases, we propose that the unfair treatment gives rise to a clear tradeoff that emerges between the governance practice's value enhancing capacity and its unfair treatment effect for some user groups. These are highly relevant cases, both for theory – what should the management principles be in such cases? and for practice - how should regulators and policy makers discipline these cases? However, to be able to address these questions, we must first identify the cases where these tradeoffs are most acute, along with the conditions that give rise to them and the underlying mechanisms. We turn next to this exercise.

Governance rules and unfair practices

The focus in the extant platform literature has notably, and understandably, been on the creation of economic value, and how governance (and management) of platform ecosystems expand such value creation, with emphasis being on the coordination (internalization) of network effects. The discourse on fairness, and the related legislative initiatives, however, bring to the fore front a discussion of other aspects and externalities that, whether affecting the value creation-capture dynamics in ecosystems directly or not, must be governed by the platform provider. We find from

the preceding review that the nature of these externalities relates to the locus of the underlying governance rules, i.e., whether the rule concerns a) the market functioning and user interactions therein, b) how data are collected, used and shared or c) the user interfaces, algorithms and more generally the architectural design of the platform.

In identifying and categorizing the different governance rules that are creating fairness concerns, and their associated tradeoffs, we thus distinguish between market rules (governance rules disciplining user participation and exchange interactions in the platform marketplace), data rules (governance rules establishing how data are collected, used and shared among participants), and design rules (governance rules specifying how the technological architecture of the platform works, including the user interface, integration between the platform core components and complements, boundary resources such as APIs and SDKs, and the functioning of the underlying algorithms, i.e., searching, categorizing, pricing, matching…). These characteristics of these rules are shortly illustrated in Table 1. While these categories are not mutually exclusive, with rules at certain level possibly affecting and intertwining with rules at other levels, and with data rules cutting across the other two governance dimensions as data are used across the platform ecosystem, we discuss them here separately for presentation purposes. Table 2 furthermore summarizes the governance practices that give rise to fairness concerns along with the possible preconditions for unfairness, the groups of participants affected by, and the potential tradeoffs.

Insert Table 1 and 2 about here

Market rules

A set of governance practices that affect the functioning of the platform market have been identified as problematic in terms of fairness concerns, because they might produce distributive unfairness,

especially in the case in which the platform provider is also a provider of services and complements that compete directly with those of business users, such as in the case of "self-preferencing".

Self-preferencing. Self-preferencing refers to the conduct of a large provider of core platform services, which consists in favoring one's own products and services over those offered by competitors on the same platform (Hutchinson & Treščáková, 2022). Concerns have been raised that a platform provider that competes with business users on its own platform will have a clear incentive to promote its own product offerings against those of third-party business users that might be equally or more valuable to users (de Corniére & Taylor, 2019). These concerns have given rise to high-profile investigations in many markets by regulators and competition authorities, who worry about potentially harmful effects of bias (de Corniére & Taylor, 2019). de Corniére & Taylor (2019) find that self-preferencing can benefit end users that prefer quality over price. However, in markets where business users are competing on prices mostly, this practice leads to worse matching, higher prices, and less utility for end users.[6]

Self-preferencing practices can have negative or positive effects on innovation depending on whether they replace, sustain, or trigger new interactions (Cennamo et al., 2022). If the platform provider's just replaces complementary products by business users with own products, no new value is created. However, in other cases, self-preferencing practices might lead to platform providers investing in new market domains, which open entirely new market categories. Cennamo et al. (2022) refer to this case as a *trigger effect*, which results in generativity and innovation and/or

[6] de Corniére & Taylor (2019) developed a model with biased intermediation where sellers' and consumers' payoffs are either congruent or conflicting. Under conflict, end user's utility depends mostly on prices, indicating that lower prices bring more utility. In this case, their model showed more mismatches because of biased recommendations, where the favored firm was able to raise prices and thus offered lower utility to consumers. However, under congruence where both end users and business users benefit from higher quality, the firm's payoff and the consumer's utility both increase under bias. In that case the bias creates a space for the seller to improve quality of the product, which also benefits end users. Under congruence, policy interventions such as divestiture, neutrality and transparency obligations may fail to improve consumer outcomes and even cause investment in quality to decline.

attention spillovers that shape the innovation trajectory in the whole platform ecosystem towards new tech domains, and better coordinate the innovation efforts of business users.

Self-preferencing can thus be harmful if the promotion of the product offerings is done only on the ground of the identity of its provider rather than on objective characteristics of the product that constitute attributes that the consumers value, matching becomes worse. This description fits markets for generic products with low product differentiation, where competition is primarily price driven. When self-preferencing is harmful, business users in competition with platform provider and/or allied business users will lose market share and their producer surplus will decrease. End users will experience worse matching, higher prices and less consumer surplus. However, in other markets where innovation is important and end users are primarily looking for novelty and quality, self-preferencing practices might lead to more innovation (Cennamo et al., 2022).

Selective promotions. Selective promotion as a governance mechanism can take many forms: endorsements, awards, special marketing campaigns or being featured in higher-visibility locations (Rietveld et al., 2019). Selective promotion in platform governance may introduce market distortions by directing users' attention to few, selected offerings, leading to greater market concentration (Cennamo et al., 2021). Superstar economics refers to the practice of promoting famous and well-known artists (or complementors) above those that are less well known and have less reach. To keep end users happy, platforms optimize for relevance, promoting the more famous artists (or complementors) above the rest. Blindly optimizing for consumer relevance may have a detrimental impact on distributive fairness towards (some) business users (Mehrota et al., 2018). This practice in general harms those that occupy the long tail of the attention curve as lesser-known artists struggle to get attention but is at the same time beneficial to (some) end users who like the familiar artists more (Mehrotra et al., 2018).

If a platform provider behaves opportunistically, selective promotion might cause procedural and distributive unfairness.[7] However, wen promotion of product offerings is not biased towards the platform provider's own products, it can stimulate competition, innovation and be value-enhancing overall (Hagiu et al. 2020). Selective promotions can be used to orchestrate and shape interactions of market participants towards desired value-creating domains (Cennamo et al., 2021). Many platforms utilize selective promotion not simply to promote "best in class" complements, but also strategically invest in complements. Platform providers might thus choose to promote business users through their contribution to the ecosystem's overall depth and range (Rietveld et al., 2019). In this case, this practice mainly functions as an incentive mechanism designed to increase overall value creation in the platform ecosystem.

Personalized pricing. Despite the recent attention to the topic of personalized pricing, the extent to which such practices are happening in real markets remains largely unknown, as there are few documented cases reported (OECD, 2018). The current lack of evidence might either be explained by the fact that firms are not entirely transparent about their pricing strategies, or that they are abstaining from setting personalized prices as they fear a negative response from end users with fairness concerns (Fehr & Schmidt, 1999). Varian (2009) suggested that end users are generally better off when sellers know their preferences but not their willingness to pay for products. Alternatively, Taylor (2004) finds that when sellers can infer end users' preferences from tracking technologies and use these preferences to engage in price discrimination, end users become worse off. The end user suffers direct economic losses from personalized pricing enabled

[7] The online radio company Pandora revealed that it manipulates its recommendation algorithm to increase or decrease the frequency at which a music title is played based on the ownership of the sound recordings and level of royalty payments (Bourreau & Gaudin, 2022; Mehrotra et al., 2018). Similar cases have been uncovered on other music streaming platforms. Manipulation of data inputs in promotion algorithms with the aim of increasing off-market revenue results in worse matching for end users and a loss of producer surplus by long-tail business users.

by the detailed data and inferences on personal willingness to pay (Choi et al., 2019).

Dubé and Mirsa (2023), however, show in an empirical study that even if consumer surplus decreases under personalized pricing, over 60% of end users are actually better off, albeit at the expense of the highest-willingness-to-pay consumers. Moreover, their result shows that there is still considerable consumer surplus left, rendering the result far from the theoretical prediction of perfect price discrimination (Dubé & Mirsa, 2023). By creating a mechanism for firms to raise revenues without sacrificing sales, personalized pricing might also encourage firms to innovate and to differentiate themselves (OECD, 2018). Personalized pricing might therefore increase dynamic efficiency in the long run while in the short run cause distributive unfairness for end users.

Al*gorithmic price collusion.* Dynamic pricing through algorithmic price setting can also lead to higher prices overall across competing platforms, de facto reducing price competition, and possibly resulting in distributive unfairness for platform end users. Using a repeated game theoretic approach to investigate the results from two competing pricing algorithms, Calvano et al. (2019) found that algorithmic price competition led to a stable tacit collusive price equilibrium, similar to what happens in situations where companies illegally cooperate. Algorithms can indeed learn to collude tacitly, i.e., without communicating with one another and without having been specifically instructed to cooperate instead of competing (Calvano et al., 2019). Ezrachi & Stucke (2016), Parker et al. (2020) and Calvano et al. (2019) point out that tacit collusion is generally not illegal, as it concerns rational reaction to market characteristics, raising the issue of whether current policy on tacit collusion is still adequate in the age of AI and pricing algorithms that feed on large amounts of customer data. As the practice of using algorithmic pricing is now prevalent in e-commerce platforms, the result might very well be overall higher prices for end users and a corresponding reduction in consumer surplus, indicating distributive unfairness towards end users.

Arbitrary changes in terms and conditions. Most digital platform providers act as private regulators of their ecosystems. They establish the rules through which their users interact, decide what behavior to encourage or discourage on the platform, and choose how to enforce these rules. Platform providers tend to be open to and supportive of complementors during the growth period of their platform ecosystem but change their policies and become significantly more exploitative over time (Rietveld et al., 2020). Nadler and Cicilline (2021) reported that (during antitrust hearings) numerous businesses described how "dominant platforms exploit their gatekeeper power to dictate terms and extract concessions that no one would reasonably consent to in a competitive market." Similar concerns could be identified from the Ecorys Survey (Duch-Brown, 2017).[8] Business users may receive inferior quality services by some platforms, such as unilateral changes in the access terms and conditions, favoring own services, content removal and delisting and suspension of accounts (Lagioia et al., 2022; Parker et al., 2020; Rietveld et al., 2020). In the absence of alternatives, business users have no other choice but to accept the terms laid out (Tombal, 2022). Such changes are furthermore costly for business users and may lead to distributive unfairness where the platform provider appropriates an increasingly larger share of the joint value being created in the ecosystem under the guise of gatekeeper status.

Data rules

Because of economies of scale and scope in data aggregation, the social value of aggregated data often exceeds the private value of segmented data. Use of data can and does in many cases benefit end users as well as business users, allowing the platform to improve their services, both in terms

[8] The business user's concerns included a lack of possibility to negotiate or amend the terms and conditions set by the digital platform; limitation of payment possibilities; limited access to dispute resolution; language difficulties; unfair pricing; limitation of access and or use of customer data; limitations on portability of data; biased or non-transparent search practices and termination policies.

of quality and novelty (Crawford et al., 2021). However, there are also downsides to the increasing use of data, especially when it comes to the collection and use of personal data. Some researchers hypothesize that the market will tend toward the collection of excessive personal data and insufficient protection of privacy as long as privacy concerns are not fully internalized in the economic decisions of data collectors and processors (Carrière-Swallow & Haksar, 2019; Choi et al., 2016). Moreover, platform providers have asymmetric access to business users data. The tension between market failures and efficiency gains pervades the debate on data in the context of digital platforms (Cennamo et al. 2022). These fairness concerns relate to the application of data rules, including *default* access and use of user data (without informed consent), *targeted advertising*, or *data control* (and sharing).

Default use of personal data. Extant research shows that end users do indeed value their privacy (Acquisiti, 2013; 2016). However, lack of transparency on the collection and use of personal data can create information asymmetries and make it more difficult for end users to understand the full value created and captured by the platform provider, causing privacy concerns (Acquisiti, 2016). Privacy related costs incurred by end users may be immediate and tangible, such as time and efforts spent deleting junk mail, annoyances from telemarketing, or higher prices paid due to (adverse) price discrimination (Acquisiti, 2013; Choi et al., 2019). Other costs are more indirect. For instance, adverse segmentation and profiling can create nuisance costs for end users (Jacobides & Lianos, 2021). End users fearing excessive surveillance experience various types of psychological discomfort, such as feeling observed or violated; or fearing the possible embarrassment or social stigma following a potential disclosure of personal data as a result of information leakage (Jarsulic, 2022; Acquisiti, 2013). Increased costs and reduced utility will lead

to distributive unfairness for those same users. Moreover, if privacy consent terms are designed to be too obscure for the general user, users experience procedural unfairness (Coyle, 2019).[9]

Targeted advertising. Matching in search engines and targeted advertising requires use of data on the characteristics of users and products to select the most optimal matches. Marotta et al. (2021) analyze the welfare implications of targeted advertising, where data is used to match advertising companies to potential buyers over a digital platform. To this end, Marotta et al. (2021) use a theoretical model where the display ad market is modelled as a two-sided market[10]. They find that platform provider may adopt information sharing practices designed to increase its expected payoff to the detriment of other platform users involved in the process, thus promoting distributive unfairness. The This result supports other research that has found that the information sharing interests of a profit maximizing advertising platform intermediary do not in all cases coincide with the interest of advertising firms or end users (se e.g., Bergemann & Bonatti, 2015; Corniére & Nijs, 2016; Hagiu & Jullien, 2011). In Marotta et al.'s (2021) model, end users are less willing to share information if their preferences are more generic. Thus, in case of generic products and services with little novelty it might make sense to regulate the platform provider's ability to share users' personal information with advertisers. However, in markets with highly differentiated preferences the opposite applies.

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[9] In a 2019 Pew Research Center survey, over 72 percent of individuals said that they believed that all or almost all of what they do online or using smart phones is tracked by technology firms, advertisers, and other companies. But 59 percent of those surveyed said they had little, or no understanding of what companies do with the data collected (Jarsulic, 2022).

[10] On one side are advertisers that buy ads on publishers' websites to target specific segments of consumers. On the other side are publishers that sell ad spaces on their web pages. In between, a platform facilitates the match between publishers and advertisers by managing data and running auctions for the advertisement allocation. The platform collects all the data and then decides what to share with the advertisers using a profit maximization method. A key premise of the model is that the advertiser prefers to have access to all information about the end user to target the right consumer. End users (consumers) have different preferences: Some prefer no information to be shared, others are indifferent, some prefer to share payment ability related information only (willingness to pay) and others product preference related information only.

Data control and lack of data sharing. Platform providers have been accused of not sharing data or insights with the rest of the ecosystem and rather using these data for their own benefit only, competing with their business users (Jacobides, 2021). Platforms' exclusive access to business user´s data generates a comparative advantage against business users. During recent antitrust hearings, multiple business users described platform provider's power over data as unaccountable and arbitrary (Nadler & Cicilline, 2020). Data access and portability have been at the center of some proposals for promoting competition, such as the DMA[11] (Jacobides, 2021). If a platform provider obtains information on business users´ products via its platform, and then uses those data opportunistically to decide whether to copy and compete on the more successful offerings, the focal business user is likely to experience unfair treatment and thus procedural unfairness (Hagiu et al., 2020). [12] Furthermore, if such practices only create substitutes that push business user´s products out of market, they will cause distributive unfairness.

However, if the use of data leads to a development of novel goods that create new value for end users, it might be in the best interest of the ecosystem (Cennamo et al., 2022). Demanding data silos and prohibiting use of the data thus risks reducing data-driven innovation (Davies et al., 2022). The question remains, whether this data could have been used by business users to create more value for the ecosystem. Parker et al. (2020) claim that regulatory intervention that facilitates data

[11] The DMA prohibits platforms classified as gatekeepers from using any data generated or provided by their business users or their customers for the purpose of competing with these same business users, unless that data is publicly available (Hutchinson & Treščáková, 2021). Article 6 of the DMA stipulates that gatekeepers shall silo any non-public data that is generated by business users when the platform is actively competing against those users. Article 6 also requires continuous and real-time data access and data portability for business users, though possibly provided as anonymized and/or aggregated data.

[12] Regulatory interventions regarding data protection must also be carefully monitored as they can have unintended consequences for competition. Sokol and Zhu (2020) suggest that Apple uses its market power for their mobile iOS to enforce privacy rules that apply asymmetrically to business users as compared to Apple´s own use of data. Apple's own advertising service, Apple Search Ads, does not have to comply with the same rules as other ad providers. Such practices indicate procedural unfairness as the process favors one party above others.

sharing might be crucial for creating more competitive and innovative digital markets. Such mechanisms will ensure that data will not only confer value to platform providers but also to their third-party businesses, eventually to the benefit of consumers.

Design rules

Nadler & Cicilline (2021) claim that platforms are harming consumers through practices such as behavioral nudges and dark patterns that manipulate users into making decisions that are not in their own best interest. The use of digital technology to render consumers vulnerable is viewed as the epitome of an unfair digital commercial practice (Helberger et al., 2022). This can occur through design rules that affect the way user interfaces, algorithms and core and complementary technological modules work to create the "choice architecture" (Helberger et al., 2022).

Dark patterns. Dark patterns are features of online interface design, crafted to intentionally confuse end users, make it difficult for users to express their actual preferences, or manipulate them into taking certain actions (Luguri et al., 2021). Dark patterns can harm end users by convincing them to surrender cash or personal data in deals that do not reflect their actual preferences and may not serve their own interests (Luguri et al., 2021). Examples include a) drip pricing, which are additional surcharges that become clear only once a consumer is about to pay for the selected product; b) misdirection, the use of visuals or language to steer users towards a particular choice and; c) disguised advertisements, for example, a social media advertisement disguised as a regular social media post. These practices can lead to behavioral discrimination where platforms providers convince end users to buy products or services they don´t want at the highest price they are willing to pay (Stucke, 2017). Using an experimental method, Luguri et al. (2021) conclude that dark patterns are strikingly effective in getting consumers to do what they would not do when confronted with more neutral user interfaces.

Proprietary standards, complementor lock-in. Many platform ecosystems rely on non-generic complementarities, where participation in the platform ecosystem requires that business users integrate and co-specialize with the platform´s core modules, interfaces, and protocols (Jacobides et al., 2018). Hence, business users are tied into the ecosystem and accordingly, their investment in interfaces and technology only has value within that platform ecosystem (Jacobides et al. 2018). The more customized these interfaces and protocols are, and the more differentiated across platform ecosystems, the higher the design tradeoffs that complementors face when designing their complements for multiple platforms, which can lead to quality differences across platforms of the same complementor's product offering (Cennamo et al., 2018). While these situations can be pro-competitive at the cross-platform level, with platforms competing on the ground of differential levels of platform-complement integration and user experience, it also creates "competitive bottlenecks" (Armstrong, 2007) in which end- and business users face stronger locked-in and hold-up problems.[13] These lock-in situations where an actor with a central position in an ecosystem uses its dominant position to impose use of core platform modules, interfaces, or standards as a condition for business users, raises the cost of participation for business users, causing distributive unfairness (Biggar & Heimler, 2021; Lianos & Ivanov, 2019).

DISCUSSION

Our review of the cross disciplinary literature on fairness in platform ecosystems serves to enrich

[13] For example, Google conditioned access to the Google Play Store on exclusively pre-installing Google Search, a requirement that gave Google a significant advantage over competing search engines (Nadler & Cicilline, 2020). Through revenue-sharing agreements, Google has established default positions on Apple's Safari browser and on Mozilla's Firefox. Furthermore, the Play Store's dominance over app distribution on Android devices has enabled Google to require the use of its in-app payment system (IAP) (Nadler & Cicilline, 2020). Apple does not allow competing digital voice assistants to replace Siri as the default on Apple devices and does not have a program where third-party device manufacturers can install a speaker that receives Siri commands. Instead, Apple uses its voice-enabled devices to strengthen consumer engagement with its own services and apps. By default, all requests to Siri to play music will open the Apple Music app; voice requests for directions open the Apple Maps app; and voice requests for web searches open the Safari app (Nadler & Cicilline, 2020).

the emerging research on digital platforms with insights on how governance practices impact platform ecosystems, both in terms of value creation and in terms of their relationship with fairness. The review shows that fairness is a complex concept that influences value creation and value capture in platform ecosystems, both through an evaluation of the distribution of value and through the fairness of processes and procedures. Furthermore, we have outlined various examples from extant literature that illustrate how different governance practices can under certain circumstances impact fairness in a negative way, aiming to understand the contingencies of unfair practices. Based on this, we suggest that it is not the structure of the platform ecosystem itself that automatically generates these conditions for unfairness. Rather, as in all market economies, unfair outcomes come about due to a combination of power differences, opportunistic behavior, bounded rationality However, platform specific structures such as the superior data- and algorithmic capabilities of platform providers can result in asymmetries and biases, causing fairness concerns.

In Figure 3 we propose a framework to attest to different impact of governance practices and ways to balance off the possible tradeoffs between value creation and fairness concerns. The figure depicts a "value creation frontier" which shows how a fixed amount of generated value (all points on the frontier) can be distributed differently to (for visual clarity) two stakeholders: users on the y-axis and platform provider on the x-axis. The red lines indicate the set of possible configurations, as it is unlikely to be acceptable to either stakeholder to get zero percent of the value. If governance contributes to innovation (dynamic efficiency gains), the value creation frontier moves outwards. If platform governance is statically inefficient, the overall value created could be increased for both stakeholders by appropriate governance (Pareto improvement), which would be indicated by a dot inside the frontier (not shown in figure). If value capture is characterized by distributive unfairness, one stakeholder increases value capture while another stakeholder (group) captures less value than

before. We identify three potential scenarios based on the examples in table 2.

Insert Figure 2 about here

In scenario one, there is no new value creation. The unfair governance practice reflects opportunistic behavior and only serves to transfer value from one or more user groups to the platform provider. In this case, regulatory interventions could improve the situation without the ecosystem suffering a loss of value or becoming unsustainable. These cases include self-preferencing practices (in generic market with no new interactions being created), algorithmic price collusion, or use of dark patterns.

In scenario two, the governance practice is contributing to increased value creation in the platform ecosystem, as is shown by the outwards movement of the "value creation frontier", benefiting both the platform provider and affiliated business users. However, the value captured by the harmed user group decreases, indicating a Pareto deterioration for that group. In this scenario, the practice is good for the ecosystem "health" but leaves one or more user groups worse off. Hence, these cases constitute what we call cases of "conflictual governance", with governance trade-off options for the platform provider. Examples from table 2 include self-preferencing practices (in innovative markets), data control and sharing (with asymmetry in access to data between the platform provider and business users)[14], or default options.[15]

In scenario three, distributive unfairness is not an issue, at least in the short term. While there might be smaller subgroups that are worse off, their loss is more than made up for by the increase in value

[14] The platform provider uses business user´s data to improve own products and services or expand into new markets while also competing with them. While this practice creates more value for the ecosystem, business users are harmed as their competitive position worsens as a result of these information asymmetries.

[15]Proprietary standards and design rules as well as default use of platform provider´s own core services are used by platform providers to simplify the governance of the platform infrastructure design, facilitate coordination, and reduce transaction costs. However, these standards may cause lock-in (or out) situation for business users.

captured by other users in the same group. Hence, both platform provider and platform users are capturing more value, albeit not necessarily in the same proportion. The potential issues related to fairness is that some users might have strong fairness concerns that will influence the platform ecosystem´s ability to create value and hence will move the "value creation frontier" inwards. In theory, such an outcome might lead to users becoming worse off, at least if the platform providers won´t give up a part of their own share of value as a response to the situation. Examples from table 2 include selected promotions[16], or use of personal data.[17]

Our analysis finds that there are cases where a chosen governance practice, within a context of certain behavioral and market conditions, may contribute to distributive unfairness where value is simply transferred from user groups to the platform provider. In such cases, external intervention can be warranted, as it is not in the platform providers' best interest to diverge unless incentives change. In other cases, the issue can be remedied by slight changes in governance. These cases indicate a potential of a trade-off between fairness (balanced distribution of value) and platform providers own value capture that can be alleviated without negatively impacting overall value creation (a move along the "value creation frontier"). In yet other cases, only limited subgroups experience unfairness, while most of the platform ecosystem is better off. However, left un-treated, these groups' fairness concerns can lead to lack of user engagement and willingness to participate, thus reducing value in the long run. Such cases require a careful evaluation of how fairness

[16] The platform provider strategically uses promotions as an incentive mechanism and thus manages to increase the overall value created in the ecosystem. However, as this practice might cause some (less capable) business users to become worse off, increasing fairness concerns (comparison with peers) might disturb the effectiveness of the governance practice with time and reduce the value creation potential.

[17] This can create many efficiencies and improved services that increase the value created in the ecosystem and leave all user groups better off in terms of value capture. However, as some users value privacy above the increased value offered through better products and services, these users become worse off due to both direct and indirect nuisance costs and psychological harms inflicted.

concerns can be reduced without putting the sustainability of the whole ecosystem at risk.

While we can confidently conclude that the platform ecosystem as an organizational structure is not inherently unfair, we cannot identify a simple cause - effect relationship between the type of governance practice and unfairness. Rather, our aim has been to identify the most relevant scenarios where governance practices can lead to unfair outcomes, with the aim to help academics and practitioners identify relevant trade-offs and potential counteractions. We only look at the fairness of the outcome as a matter of distribution between stakeholders as a collective and a single platform provider. Of course, there are many other constellations possible. There could be multiple platform providers or none (fully distributed platform). We do not discuss this specifically. There could also be perceived unfairness in the distribution of gains between individuals in a group. Despite such unfairness being a focus in some of the papers, we do not consider that unless there are two easily separated subgroups within a group. Finally, according to our definition, fairness does not imply efficiency, unlike Varian´s (1975) definition of fair outcomes that he views as both equitable and efficient. In many cases outcomes are efficient in terms of productivity, resource allocation and innovative capabilities but stakeholders still perceive the practice as unfair - or the other way around. These are the most interesting configurations where regulators should pay attention to all the underlying assumptions and conditions that fair outcomes rely upon.

FIGURE 1: LITERATURE EVALUATIONPROCESS

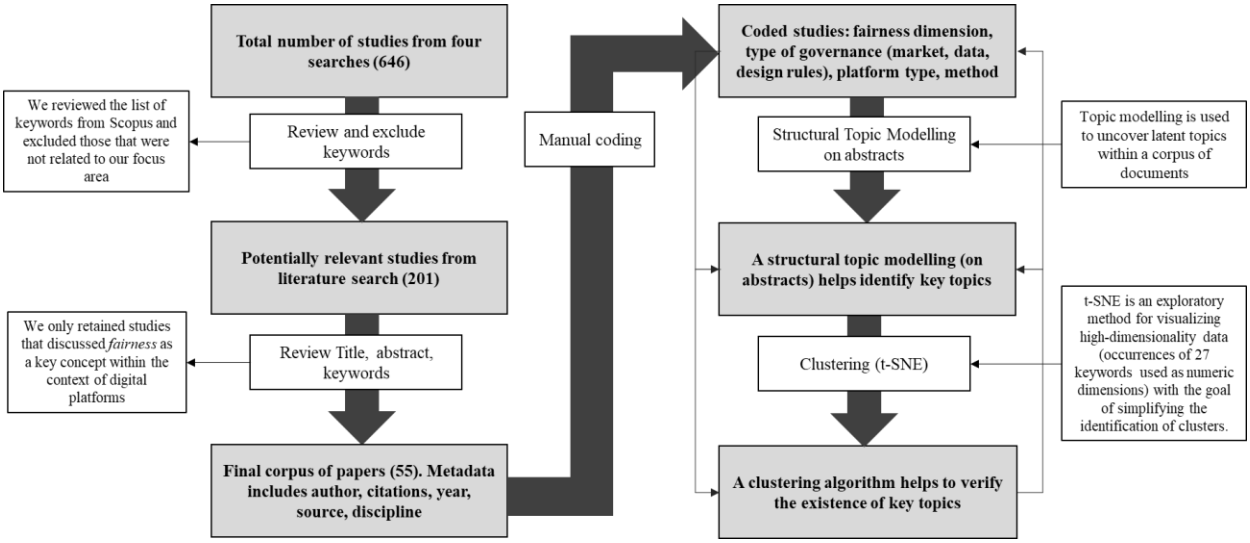

FIGURE 2: THREE DIFFERENT SCENARIOS OF UNFAIRNESS

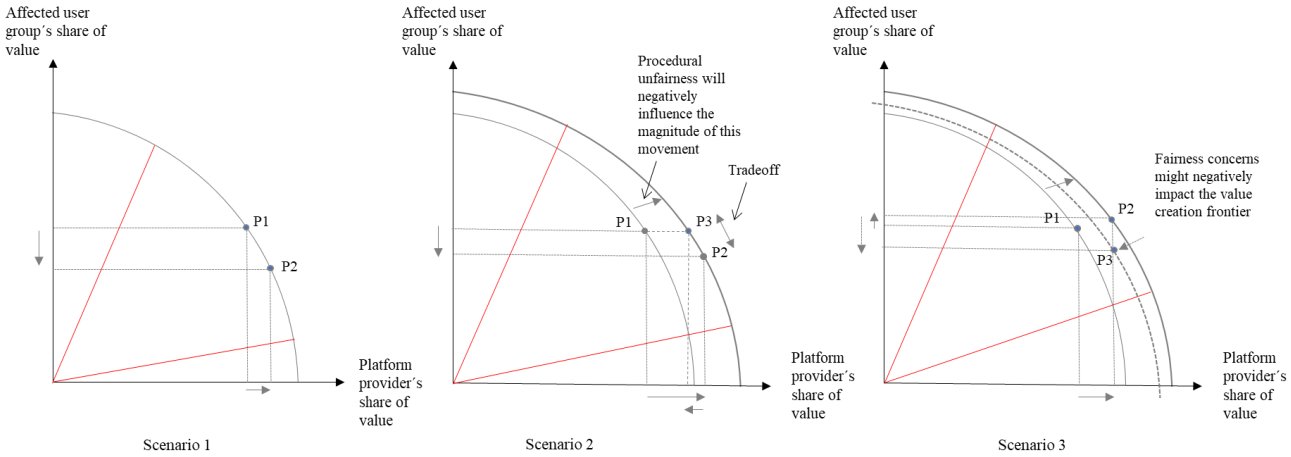

TABLE 1: MARKET, DATA, AND DESIGN RULES

Rules	Description	Mechanisms	Examples of benefits	Examples of impediments
Market rules	Governance rules disciplining user participation and exchange interactions in the platform marketplace	Coopetition: The platform can use coopetition to balance between common benefits and private benefits (Hannah & Eisenhardt, 2018)	Coopetition can lead to more innovation (Cennamo et al., 2022; Yoo et al., 2022)	Platform provider might be tempted to give preferential treatment to own goods (Hutchinson & Treščáková, 2022)
		Coordination: The platform can use coordination to enable the matching and interaction between distant and previously unconnected parties (Kretchmer et al., 2022).	More coordination increases co-creation of value (Cennamo & Santaló 2019; Huber et al., 2017)	More coordination increases governance costs (Huber et al., 2017)

Rules	Description	Mechanisms	Examples of benefits	Examples of impediments
		Incentive: The platform can use incentives to encourage business- and end users to contribute in their most valuable way (Chen et al., 2022; Kretchmer et al., 2022)	Incentives stimulate the desired variance of creativity and contribute to the development of products that enhance user satisfaction (Wareham et al., 2014; Cennamo & Santaló, 2019).	Incentives such as resource sharing may further result in platform-specific investments which will create switching costs for business users (Chen et al., 2022)
		Control: The platform is uniquely positioned to exert control over who participates, the rules of participation, and how rents are allocated (Chen et al., Kretchmer et al., 2022).	Strict access control can reduce competition on the business user side and facilitate complementors' interactions with one another (Zhang, et al., 2022).	Controls might be used by platform providers to capture a higher share of the overall value created in the platform ecosystem (Ghu &Zhu, 2021; Jacobides & Lianos, 2021)
		Pricing: Pricing rights, can be fully controlled by the platform owner, fully delegated to complementors, or partially determined by a centralized pricing guide (Chen et al., 2022)	Platform pricing can be used for market clearing and for substitution across platform sides in order to capitalize on network effects (Rochet & Tirole, 2006; Tan & Wright, 2018)	Platform provider with access to data can use the information to charge excessively using dynamic pricing algorithms or personalized pricing (Marotta et al., 2021; De Corniére & Taylor, 2019)
Data rules	Governance rules establishing how data are collected, used and shared among participants	Sharing of data with platform users, for example sharing end user´s product preferences with business users or by giving end users access to product reviews (Cennamo, 2021)	Sharing of data leads to less information asymmetry & power difference. More autonomy leads to generativity & innovation (Boudreau, 2010; Cennamo, 2018; Cennamo et al. 2022)	To free sharing of data can cause misaligned interests, too much complexity and creates room for opportunistic behavior by users (Chen et al., 2020; Karhu et al., 2018)
		Controlling data, making sure that only curated data is used and centralizing access to data, potentially only to preferred users (Foerderer et al., 2019)	More coordination capabilities, potentially higher quality and less risk of opportunistic behavior, such as shirking and free-riding (Chen et al., 2022; Cennamo & Santaló, 2019)	Less generativity and autonomy, perceived procedural unfairness, power imbalance and potentially biased decision making (Cutolo & Kenney, 2019; Fieseler et al., 2017)
Design rules	Governance rules specifying how the technological architecture of the platform works, including the user interface, integration between the platform core components	Platform infrastructure and interface architecture and design can be viewed as a tool for managing the delicate balance between coordination and autonomy of platform stakeholders (Hein et al., 2020)	Modular design affords the ability to generate greater innovation from the recombination options and the ability to engage external innovators (Baldwin & Clark, 2000; Parker et al., 2017; Wareham et al. 2014);	While curation standards can ensure increased quality of platform complements, they are also perceived as being too slow, opaque, and restrictive (McAfee & Brynjolfsson, 2017).
		A digital platform incorporates various modules that extend the functionality of the software product (Baldwin & Clark, 2000). Platform design involves a spectrum of design choices including applications designed and developed by third-party developers (de Reuver et al., 2018).	Access to rich data and algorithmic capabilities can lead to competitive advantage, complementary innovations McAfee et al., 2012) and support distributed governance (Mačiulienė, & Skaržauskienė, 2021).	Platform governance can be distorted toward insufficient or excessive business user competition when platform provider controls information provision recommendations, and search-design choices (Teh, 2022)

TABLE 2: UNFAIR PRACTICE CATEGORIES

Practice	Rule type	Underlying cause and conditions	Harm and/or tradeoffs	Impact on fairness	Studies
Self-preferencing Platform provider favors own products and services over those offered by competitors on the platform	Market rules Matching mechanism	Information asymmetry & algorithmic/data capabilities: Platform provider has control over data and ability to use to data coordinate and control the platform ecosystem - Platform provider competes with business user(s) - Product market is generic	*Cause of harm*: Distributive unfairness Worse matching reduces market efficiency. *Fairness tradeoffs*: In a market for novelty products, banning self-preferencing to protect a subgroup of business users can reduce dynamic efficiency	PP & allied business users increase surplus and business users that are substituted out lose surplus Some end users lose surplus due to worse matching and increased transaction costs	Hagiu et al.,2020 (model), Rietveld et al, 2019 conceptual), de Corniére & Taylor (model), 2019, Cennamo et al., 2022 (conceptual Hutchinson & Treščáková, 2022 (Law)
Selective promotions Platform provider directs end users' attention to few, selected offerings	Market rules Matching mechanism	Information asymmetry & algorithmic/data capabilities: Platform provider has control over data and ability to use to coordinate and control the platform ecosystem - Platform provider maximizing own profit, for example through blindly optimizing for consumer relevance	*Cause of harm*: Fairness concerns – inequity aversion Distributive unfairness Worse matching reduces market efficiency. *Fairness tradeoffs*: If platform provider might use promotions to increase overall value creation on the platform the overall value gain	Platform provider & selected business users increase surplus Business users not chosen for promotion experience procedural unfairness End users might lose surplus if matching is not in their best interest	Bourreau & Gaudin, 2022 (model), Mehrotra et al., 2018 (algorithmic design), Cennamo et al., 2021, Jarsulic, 2022 (Law)
Personalized pricing Use of algorithms to set prices, differentiating between individuals based on WTP (willingness to pay)	Market rules Pricing mechanism	Information asymmetry & algorithmic/data capabilities: PP has control over data and ability to use data to find the end user's willingness to pay - PP uses data on end user's WTP - Users have bounded rationality	*Cause of harm*: Fairness concerns – inequity aversion Distributive unfairness *Fairness tradeoffs*: Personalized pricing benefits those with lower WTP	PP & business users increase surplus while end users pay closer to their WTP, which reduces consumer surplus for those with higher WTP End user's experience procedural unfairness	Dubé & Mirsa, 2023 (case study – experiment), Taylor, 2004 (model), Varian, 2009 (model), OECD, 2018 (report)

Practice	**Rule type**	**Underlying cause and conditions**	**Harm and/or tradeoffs**	**Impact on fairness**	**Studies**
Algorithmic price collusion Use of pricing algorithms with (potentially public) data.	Market rules Pricing mechanism	Algorithmic/data capabilities: Business user/PP use algorithms that compete against each other, learning to raise prices to collusive levels - Prices are adjusted to maximize profit of business user/PP - Pricing agents have some market power	*Cause of harm* Fairness concerns – inequity aversion Distributive unfairness Higher prices reduce static efficiency *Fairness tradeoffs*: Dynamic efficiency could increase as dynamic pricing might incentivize differentiation and innovation	Business users/PP increase surplus at the cost of end users surplus because of generally higher prices.	Parker et al., 2020 (antitrust law), Calvano et al. 2019 (algorithmic experimental approach), Ezrachi and Stucke, 2016 (comp. policy), OECD, 2018 (report)
Arbitrary terms in terms and conditions Platform provider enforces unreasonable rules and conditions on business users.	Market rules? Institutional environment	Power differences & control over platform's institutions: Platform provider sets the terms and conditions for participation - Platform provider behaves opportunistically - Business users are dependent on platform and cannot easily switch	*Cause of harm* Procedural unfairness Distributive unfairness Increase in transaction costs reduce static efficiency *Fairness tradeoffs*: In some cases, opportunistic behavior by business users might decrease as a result of such changes	Higher costs for business users reduce their profits while PP gains market share and strengthens own position	Nadler and Cicilline, 2021 (report), Rietveld et al., 2020 (case study), Duch-Brown, 2017 (report), Tombal, 2022 (law), Jacobides & Lianos, 2021 (comp. policy), Biggar & Heimler, 2021 (comp. policy)
Use of personal data that causes loss of privacy Personal data are collected and used for improving services but also cause loss of privacy	Data rules Information sharing mechanism	Information asymmetry & algorithmic/data capabilities: Platform provider has the ability to collect data from many places and analyze data to infer on probable behavior and tastes of end users - Some end users have bounded rationality - Some end users value privacy	*Cause of harm* Procedural unfairness due to cumbersome privacy terms and conditions Distributive unfairness *Fairness tradeoffs*: Dynamic efficiency might increase as services are improved.	PP/Business users increases surplus through improved insights and/or engagement End users that value privacy and experience loss of privacy and lose surplus	Choi et al, 2019 (model), Acquisti et al., 2013 (experiments), Acquisti et al., 2016 (literature review), Crawford et al., 2021 (discussion paper), Coyle, 2019 (law), Jarsulic, 2022 (law)
Targeted advertisement Platform provider acts as an intermediary between advertisers and end users	Data rules Information sharing mechanism	Information asymmetry & algorithmic/data capabilities: Platform provider has control over data and ability to get highest bidder for ad spaces - Some end users value privacy and prefer that	*Cause of harm*: Distributive unfairness Worse matching reduces market efficiency. End users that value privacy are worse off.	Platform provider increases surplus Advertisers are worse off due to worse matching and less sales Some end users are worse off because too much	Marotta et al., 2021 (model); Bergeman & Bonatti, 2015 (model); Corniére & Nijs, 2016 (model); Hagiu & Jullien, 2011 (model) Chawla et al., 2020

Practice	**Rule type**	**Underlying cause and conditions**	**Harm and/or tradeoffs**	**Impact on fairness**	**Studies**
and maximizes own profits		their information is not shared - Information is shared only for platform provider´s gain	*Fairness tradeoffs*: The information sharing scheme does not create synergies between stakeholders.	or wrong information is shared	(algorithmic design),
Data control and sharing Business user´s data are collected and analyzed to increase understanding of the platform´s interactions	Data rules Information sharing mechanism	Information asymmetry & algorithmic data capabilities: Platform provider can extract and analyze data across all complementors There is unclear data ownership and platform provider has asymmetric access to data - Opportunistic behavior - Platform provider competes against business users	*Cause of harm*: Procedural unfairness Distributive unfairness *Fairness tradeoffs*: Dynamic efficiency and innovation might increase when aggregated and analyzed data is used to improve matching or to innovate new services and goods.	Platform provider increases surplus Business users are less able to compete with platform provider due to arbitrary data rules or lack of insights that cause decrease in sales or direct cost increases	Hagiu et al, 2020, (model), (Parker et al., 2020 (antitrust law), Cennamo et al., 2022 (conceptual), Hutchinson & Treščáková, 2021 (comp. policy), Davies et al., 2022 (comp. policy), Sokol & Zhu, 2020 (discussion paper)
Dark patterns Use of manipulative user interface designs and underlying algorithms	Design rules	Control over infrastructure design: PP and business users use design of interfaces and algorithms that is intended to manipulate users - Some end users have bounded rationality - Opportunistic behavior	*Cause of harm*: Procedural unfairness Behavioral discrimination confuses and manipulates users	Platform provider and/or business users use manipulative techniques to benefit at the cost of users End users are manipulated and experience unfairness	Helberger et al, 2022 (conceptual), Nadler & Cicilline, 2021 (report), Luguri et al., 2021 (behavioral experiments), Stucke, 2017 (antitrust law), Petrovskaya & Zendle, 2021 (empirical)
Proprietary standards, complementor lock-in Platform provider enforces unreasonable rules and conditions on business users.	Design rules	Power differences & control over platform's institutions: Platform provider sets the terms and conditions for participation - Opportunistic behavior - Business users are dependent on platform - Standards and design rules are designed to raise switching costs and barriers to exit	*Cause of harm*: Distributive unfairness due to competitive bottlenecks and lock-ins *Fairness tradeoffs*: Dynamic efficiency might increase because of the efficiency gains of standards and the user related benefits they bring	Platform provider increases surplus if the efficiency gains are not distributed fairly Business users lose surplus if they have sunk cost that lock them in End users might increase surplus as transaction costs decrease due to efficiency gains	Jacobides et al., 2018 (conceptual); Biggar & Heimler, 2021 (comp. policy), Oh et al, 2015 (model and empirical data), Cennamo et al.,

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