Fair pricing on a platform with heterogeneous sellers: A cooperative game approach

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Abstract

A two-sided market platform that facilitates trade between sellers and buyers enters into the sellers' space with its own product or services offerings. This creates heterogeneity among the sellers in terms of their competitive position on the platform. The sellers face positive *cross-side externalities* from a higher participation level of buyers (and vice versa), and negative *same-side externalities* from a higher participation level of sellers. Under this modeling choice, we develop a cooperative game-based framework to study the fairness issues in the pricing decision of the platform. The framework proposes converting the pricing decision problem of the platform into a cooperative game-based payoff allocation problem, and then characterizing a fair pricing structure using a fairness-based solution concept from cooperative game theory. This paper also contributes to the methodological literature of analyzing market platforms as cooperative games, an alternative to the traditional method of equilibrium points.

Keywords: two-sided market platforms; pricing; fairness; cooperative game theory

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1 Introduction

Platform-based businesses have become increasingly popular today. Many sellers sell their products or services through platforms such as *Amazon*, *eBay*, *Uber*, *Airbnb*, etc. that give the sellers an access to a large number of buyers. Such platforms are called *two-sided platforms* where sellers constitute one side and buyers constitute the other side. A platform along with sellers and buyers constitutes a *two-sided market*. For example, a ride-hailing platform such as Uber along with cab drivers and riders constitutes a two-sided market. In unorganized and informal sectors where it is difficult for buyers and sellers to discover each other, platforms become vital for the existence of markets. Many existing companies are now converting their businesses into platforms (Hagiu et al., 2020).

A platform with cross-side and same-side externalities: The success of a platform depends on the participation level of players (both buyers and sellers) on the platform. An increased level of participation from one side increases the utility of players on the other side. This effect is called *cross-side externalities* (*see* Parker and Van Alstyne (2005)). Many platforms also exhibit *same-side externalities*, a property due to which an increased level of participation from one side decreases the utility of players on the same side (*see* Belleflamme and Toulemonde (2009)). For example, when a platform enters the sellers' space with its own product offerings, it introduces heterogeneity among the sellers. The sellers may differ in terms of any strategic or operational attributes that have effect on their competitive positions on the platform. In this paper, we categorise the sellers into two types – *independent sellers* and *platform-owned sellers*. The platform-owned sellers take cooperative decisions by pooling their resources and taking joint actions. The independent sellers do not cooperate with each other and their strategic decisions are based on their individual self-interests. The sellers' heterogeneity on the platform gives rise to the same-side externalities on the sellers' side of the platform due to their varied competitive positions. It is imperative for a platform to incorporate both cross-side and same-side externalities in its pricing decision. Figure 1 illustrates a two-sided platform with both cross-side and same-side externalities. Prior results on the pricing decision of a platform recommend endogenizing cross-side externalities and adopting a pricing strategy where the

less elastic side of the platform subsidizes the more elastic side (Caillaud and Jullien, 2003; Rochet and Tirole, 2003, 2006; Parker and Van Alstyne, 2005; Armstrong, 2006). Sometimes, platforms can generate maximum profit when the pricing structure is heavily skewed towards one side and against the other side based on the demand elasticities of the two sides (Bolt and Tieman, 2008). Such a strategy, although profit-maximizing, may lead to a pricing structure that is perceived "unfair". This paper studies the fairness aspect of pricing decision of a platform with heterogeneous sellers.

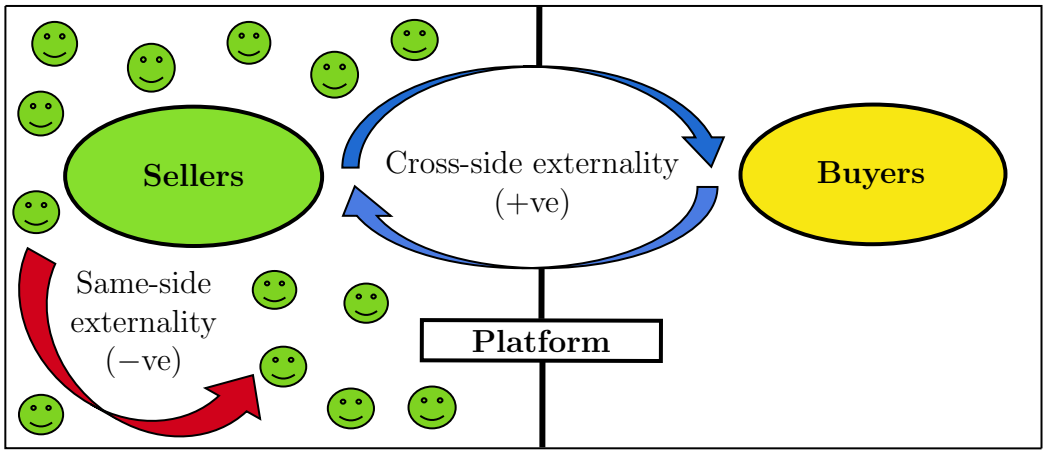

Figure 1: A platform with cross-side and same-side externalities

Pricing based on demand elasticity may be perceived unfair: Numerous studies in economics indicate that people are concerned about the issue of "fairness" in pricing (Kahneman et al., 1986; Kachelmeier et al., 1991). According to the pioneering work by Kahneman et al. (1986), consumers perceive a price pattern unfair when it is a function of demand elasticity. By contrast, they regard it as fair when a firm sets the price in response to its marginal cost of production. Kachelmeier et al. (1991) shows that the prices that are not justified by the increase in production cost but instead contribute to the firm's profit are perceived unfair. The perception of unfair pricing can either arise between the sellers and the buyers (we call it "cross-side unfairness") or it can arise among the players on the same side (we call it "same-side unfairness"). Credit card payment platforms like *MasterCard* and *Visa* are often found to be facing backlash from retailers for being biased against them and favouring cardholders. Many economists, policy-makers and public authorities have argued that the fee structure in credit cards is such that retailers pay too much and

cardholders pay too little. Wright (2012) provides an excellent discussion on the distorted pricing structure in card payment markets. This is an example of cross-side unfairness. Our focus in this paper is on the perception of same-side unfairness among the sellers which is observed in many real life scenarios such as the following:

Example (Food delivery platforms) – These platforms match restaurants with food consumers. Recently, a group of 500 restaurants in India submitted a petition to the Competition Commission of India and the Prime Minister's Office urging to take action against food delivery platforms such as *Swiggy* and *Zomato* for allegedly using "unsustainable pricing" and misusing their dominant position with an aim to wipe out small and mid-sized restaurants[1]. The restaurants accused the food delivery companies of providing deep discounts to the consumers, and adopting practices like cloud kitchens and internal sourcing to take away their business. The sellers on these food delivery platform face same-side externalities due to the sellers' heterogeneity. The perceptions of unfairness among the sellers arise not just with respect to the buyers on the other side of the platform but also with respect to the other sellers on the same side of the platform.

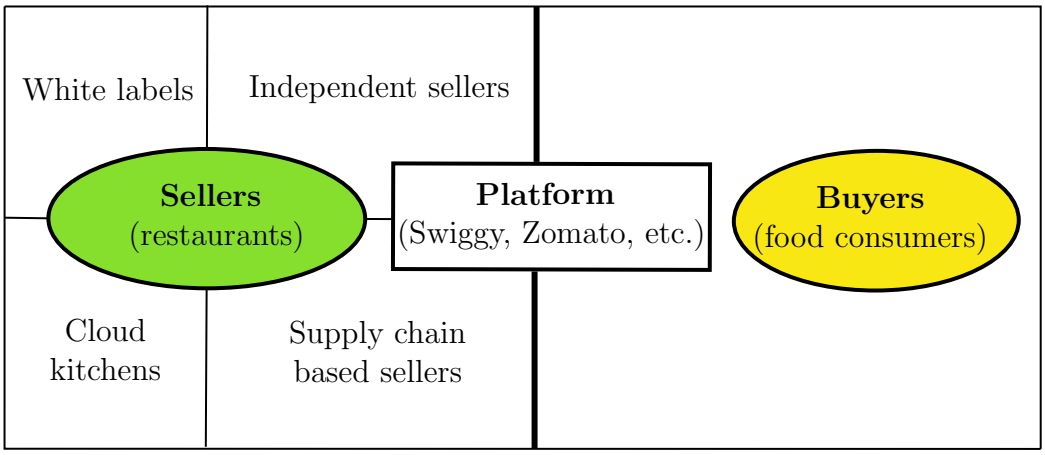

Figure 2: Sellers' heterogeneity on a food delivery platform

The sellers' heterogeneity on Swiggy and Zomato is due to the following types of sellers (refer Figure 2): (*a*) *Independent sellers* – These are restaurants who completely own the operation of food preparation, and sell the prepared food to consumers under their own

[1] https://inc42.com/buzz/restaurant-association-files-cci-complaint-against-major-foodtech-players/, accessed 18 April 2022

brand name. (b) *White labels* – These are platform-owned restaurants who source prepared food from individual cooks and tiny eateries, and repackage and sell it to consumers under their own brand name. (c) *Cloud kitchens* – These are platform-owned and platform-operated mega kitchens that house the cooking facilities of multiple restaurant brands under the same roof. A cloud kitchen acts as a central warehouse for a group of independent restaurants. The prepared food is sold under the respective brand names of the restaurants who belong to the cloud kitchen. (d) *Supply-chain based sellers* – These are similar to independent restaurants with a difference that they source the raw material and ingredients for food preparation from a platform-owned raw material supplier. In return, they get some preferential treatments such as price discount from the platforms.

Research questions and contribution: We study the issue of fairness in pricing decision of a two-sided platform that faces both cross-side and same-side externalities. In particular, this paper deals with the following research questions:

(i) What is the optimal number of sellers on a two-sided platform that balances the trade-off between the utility due to positive cross-side externalities and the dis-utility due to negative same-side externalities?

(ii) How to model the pricing decision problem of a two-sided platform with heterogeneous sellers as a payoff allocation problem using cooperative game theory? How to allocate the total payoff generated on the platform among the players in a fair manner?

The utility structure of the platform, that captures the overall value generated due to trade, indicates that there is an optimal number of sellers on the platform beyond which the utility of the platform declines if more sellers are added. To develop the pricing model, we convert the pricing decision problem of a platform into a cooperative game-based payoff allocation problem. We characterize a fair pricing structure using a solution concept from cooperative games that allocates the payoff in an equitable manner. From the methodological point of view, our paper also contributes to the literature that analyzes markets as cooperative games, an idea initiated by Shapley (1955) as an alternative to the traditional method of equilibrium points.

References

Mark Armstrong. Competition in two-sided markets. *The RAND Journal of Economics*, 37(3):668–691, 2006.

Paul Belleflamme and Eric Toulemonde. Negative intra-group externalities in two-sided markets. *International Economic Review*, 50(1):245–272, 2009.

Wilko Bolt and Alexander F Tieman. Heavily skewed pricing in two-sided markets. *International Journal of Industrial Organization*, 26(5):1250–1255, 2008.

Bernard Caillaud and Bruno Jullien. Chicken & egg: Competition among intermediation service providers. *RAND journal of Economics*, pages 309–328, 2003.

Andrei Hagiu, Bruno Jullien, and Julian Wright. Creating platforms by hosting rivals. *Management Science*, 66(7):3234–3248, 2020.

Steven J Kachelmeier, Stephen T Limberg, and Michael S Schadewald. Fairness in markets: A laboratory investigation. *Journal of Economic Psychology*, 12(3):447–464, 1991.

Daniel Kahneman, Jack L Knetsch, and Richard Thaler. Fairness as a constraint on profit seeking: Entitlements in the market. *The American economic review*, pages 728–741, 1986.

Geoffrey G Parker and Marshall W Van Alstyne. Two-sided network effects: A theory of information product design. *Management science*, 51(10):1494–1504, 2005.

Jean-Charles Rochet and Jean Tirole. Platform competition in two-sided markets. *Journal of the european economic association*, 1(4):990–1029, 2003.

Jean-Charles Rochet and Jean Tirole. Two-sided markets: a progress report. *The RAND journal of economics*, 37(3):645–667, 2006.

Lloyd S Shapley. Markets as cooperative games. Technical report, RAND CORP SANTA MONICA CA, 1955.

Julian Wright. Why payment card fees are biased against retailers. *The RAND Journal of Economics*, 43(4):761–780, 2012.