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ORIGINAL PAPER

Refining the freeloading and no purchase behavior in pay as you wish pricing

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Abstract

Pay as you wish (PAYW) pricing offers a radical shift from posted pricing schemes. Modeling consumer behavior under PAYW pricing promises insights into conditions under which PAYW is profitable. Firstly, this paper extends an established model that builds on inequity-averse consumers and models their behavior in PAYW as well as the seller's profits. The paper uses a comprehensive approach to describe consumers with low fairness concerns and points to a new segment of consumers who were not considered in previous PAYW models. They are characterized by a decision not to buy a good under a PAYW pricing policy, even if they can get it for free, and are not strongly averse to advantageous inequity. Secondly, the paper discusses the profitability of PAYW with a suggested price when the seller's ability to suggest high prices is limited. Thirdly, the paper incorporates the effect of disadvantageous inequity aversion on PAYW with a minimum price. Finally, the paper offers guidelines on how a seller should choose the optimal pricing policy.

Keywords Pay what you want · Pay as you wish · Participative pricing · Inequity aversion · Pricing · Pricing strategy · Self-determined price

JEL Classification M31 · D42 · D63

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1 Introduction

Over the last decade, there has been increasing interest in participatory pricing schemes that give the consumer power over pricing decisions (Spann et al. 2018). Pay-as-you-wish (PAYW) pricing is probably the most disruptive and extreme form, giving the buyer (almost) no limit on how to set the price. Under PAYW, customers are offered a product or service and are free to choose any price they want, including zero (obtaining the good for free; Kim et al. 2009).

Previous examples from practice have shown that sellers can operate profitably using PAYW (Natter and Kaufmann 2015). As an example, the Viennese restaurant Der Wiener Deewan has run profitably on PAYW prices for over 15 years (Riener and Traxler 2012). However, many sellers try to implement PAYW but fail to do so on a permanent basis, going bankrupt or switching to fixed prices. For example, the US bakery chain Panera Bread experimented with PAYW several times, only to realize that its products could not be sold under PAYW conditions. Previous empirical research has established several factors that support the profitability of PAYW: as an example, consumers must be sufficiently generous and fair-minded to pay significant prices, and the seller has to operate with low variable costs (Gerpott 2017).

However, while empirical research offers an invaluable case-by-case perspective on conditions under which PAYW can be profitable, striving for generalizations calls for microeconomic modeling. In addition, sellers apply variants of pure PAYW, such as setting suggested or minimum prices. Modeling PAYW promises to support the seller in finding the optimal suggested and minimum price and give guidelines on which pricing scheme to choose.

Yet, previous models differ in their recommendations on how to set the suggested and minimum price. Isaac et al. (2015) show that the suggested price should be lower than a traditional price in asked (fixed) pricing and find that fair consumers pay more than the price suggested. However, Chen et al. (2017)—CKZ hereafter—maintain that the suggested price can be higher than the regular price. The effects of the suggested price are similarly unclear. According to Christopher and Machado (2019), the suggested price can increase sales, although they find that fair consumers will pay less in the presence of price suggestions. CKZ, on the other hand, claim that the suggested price increases the price a fair consumer pays. With respect to the minimum price, previous models present the minimum price as a tool to exclude freeloaders (CKZ) or to extract higher payments from fair-minded consumers (Isaac et al. 2015). Therefore, the structure and optimal level of the minimum price differs significantly.

Although previous research has established inequity aversion (Fehr and Schmidt 1999) as a consistent and important driver of PAYW prices (Schmidt et al. 2015; Jung et al. 2017), with the exception of CKZ, little theoretical analysis of inequity-averse consumer behavior in PAYW has been conducted.

CKZ's research stands out in offering a comprehensive model with a closed-form solution that simultaneously considers the consumer's and the seller's perspectives. Their results show that PAYW can be a profitable pricing scheme.

They identify the conditions under which it outperforms posted pricing, and how a suggested and a minimum price influence consumer behavior and profits.

Yet, CKZ's analysis appears to be somewhat restrictive when it comes to consumers' freeloading behavior. In particular, they postulate two segments (more fair-minded and less fair-minded consumers) and assume that one group always freeloads. Furthermore, they imply that non-fair-minded consumers cannot be influenced by a suggested price. Additionally, they assume that the minimum price does not affect consumers' perceptions of fairness. However, empirical evidence exists that minimum prices have negative effects on consumers and can create disadvantageous inequity (Johnson and Cui 2013). Moreover, in their model the seller is free to set any suggested price and some buyers will always accept this suggested price as a replacement for the fair price. In contrast, previous research found that there are boundaries for acceptable suggested prices (Johnson and Cui 2013). This paper relaxes these limitations in CKZ's model and also builds upon the refinement proposed by Akbari and Wagner (2022). Furthermore, it compares different pricing schemes with respect to induced profits. Previous models give promising guidelines under which PAYW should be profitable, yet they are silent on how sellers can assess their target market and measure the necessary parameters to make a pricing decision. In contrast, this paper proposes tools for measurement.

2 PWYW model for inequity-averse consumers

2.1 CKZ's model

As a starting point, CKZ seek to model buyers' reactions and seller's profits under PAYW pricing and traditional pricing. They assume inequity-averse buyers to explain why people pay under PAYW and also why people refrain from buying because they would otherwise experience inequity.

The customer's (i) utility (u_i) is introduced as[1]

$$u_i = r_i - p_i - \beta_i \max\left\{p_i - p_{f_i}, 0\right\} - \gamma_i \max\left\{p_{f_i} - p_i, 0\right\}, \beta_i, \gamma_i \geq 0. \qquad (1a)$$

The consumption utility (r_i) describes the customer's benefit from consuming the good, disregarding any transaction utility (Thaler 1983). The term $\beta_i \max\left\{p_i - p_{f_i}, 0\right\}$ captures disutility from disadvantageous inequity, namely if the actual price (p_i) is above the consumer's perceived fair price (p_{f_i}). This term becomes relevant only if the seller sets the price. Higher β_is indicate that customers have stronger opposition when the seller is over-privileged, that is, charges high prices. Correspondingly, the term $\gamma_i \max\left\{p_{f_i} - p_i, 0\right\}$ captures disutility from advantageous inequity: that is, if the price is below the consumer's perceived fair price. Higher values of γ_i correspond to a stronger aversion to advantageous inequity, that is, characterizing more fair-minded customers. Thus, the higher γ_i, the more the customer dislikes being over-privileged.

[1] We depart from CKZ's notation in exceptional cases only to increase comprehensibility.

The perceived fair price is defined as

$$p_{f_i} = \begin{cases} c & 0 \leq r_i \leq c \\ \lambda_i r_i + (1 - \lambda_i)c & c < r_i \leq 1 \end{cases}, \tag{2a}$$

where c describes the seller's costs and λ_i describers the seller's equitable share of the total surplus. By assumption, the consumer knows the seller's costs and compares them to her consumption utility r_i. When the costs are higher than the consumption utility, the consumer's fair price is equal to the seller's costs, as the consumer knows that lower prices will cause a loss for the seller. When the consumption utility is higher than the costs, taking the good creates a positive surplus ($r_i - c > 0$). The fair price implies that the consumer is willing to split this surplus proportionally (i.e. $\lambda_i : (1 - \lambda_i)$). Previous research has shown that the fair price is relevant to both PAYW (e.g. Kim et al. 2009) and traditional pricing schemes (e.g. Homburg et al. 2005; Koschate-Fischer et al. 2016). The parameter λ_i describes the generosity of the consumer. The higher λ_i, the stronger the consumer's conviction that she should pay the seller in order to be fair. By convention, the domain of r_i, c is restricted to $[0, 1]$ without loss of generality. Furthermore, generosity is constant for all consumers. Therefore, we set $\lambda_i = \lambda$. This results in $p_f^{max} = c + \lambda(1 - c)$ as the highest possible fair price (cf. Eq. (2a)). Figure 1a presents this fundamental relationship graphically.[2]

We start by distinguishing between two scenarios for setting prices. (i) The customer sets the price, that is, PAYW. She will never pay more than the fair price because she strives to avoid disadvantageous inequity (β-term in Eq. (1a): $p \leq p_f$) (Sect. 3 provides further details). (ii) The seller sets the price denoted as "pay as asked" pricing (PAAP). CKZ show that a profit-maximizing firm will always charge prices above the perceived fair price. Thereby they assume uniformly distributed consumption utilities across the population, and we follow this assumption. A seller faced with inequity-averse consumers will maximize his profits by setting the optimal price under PAAP as

$$p^*_{PAAP} = c + \frac{1 + \beta\lambda}{2(1 + \beta)}(1 - c), \tag{3}$$

and the optimal profits of a seller charging this price are

$$\pi^*_{PAAP} = \frac{(1 - c)^2(1 + \beta\lambda)}{4(1 + \beta)}. \tag{4}$$

When comparing the highest possible fair price, p_f^{max}, to the price under PAAP, p^*_{PAAP}, we find that for

$$\lambda > 1/(2 + \beta), \tag{5}$$

[2] For ease of notation the individual consumer index i will be dropped in the sequel. However, it should be borne in mind, that the model assumes individual level variables for u, r, and p_f and parameter γ to vary across the population.

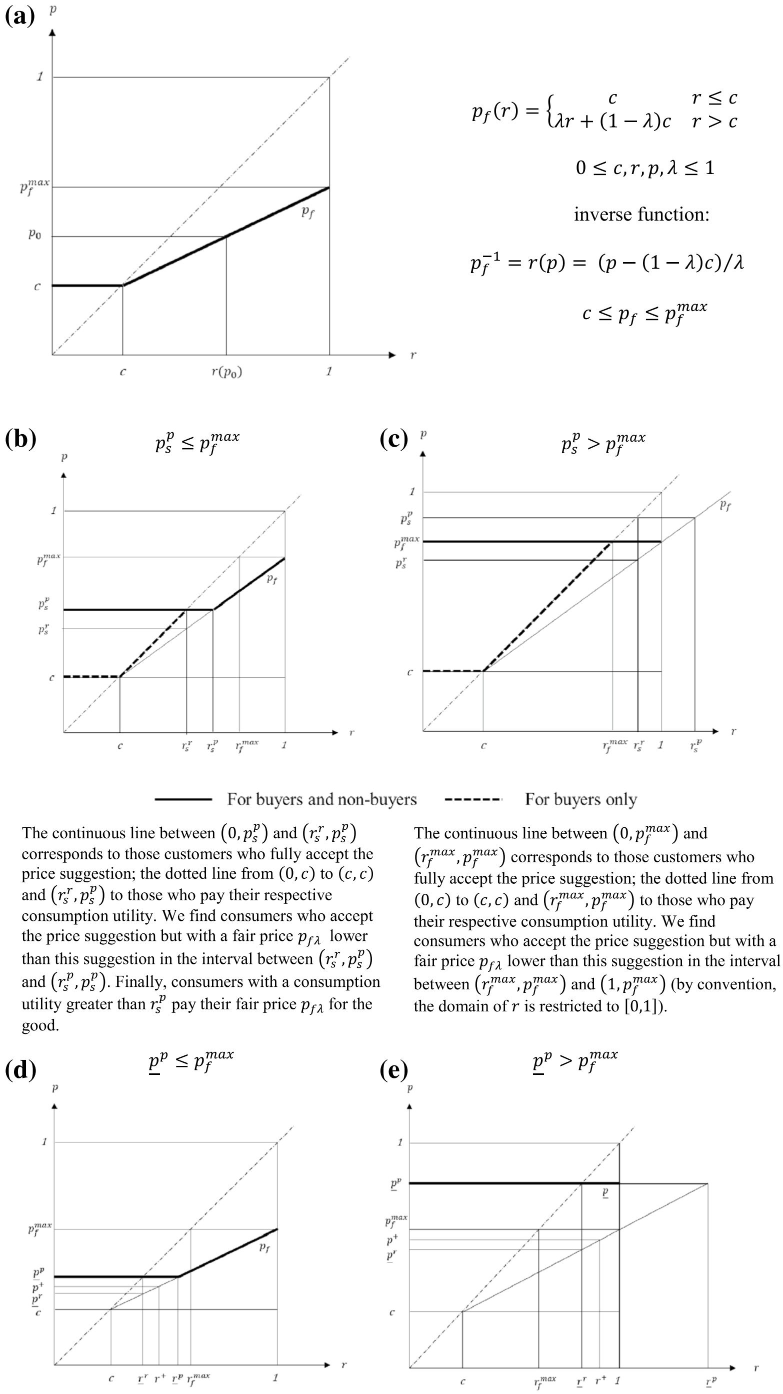

Fig. 1 **a** The fair price in PAYW **b, c** The fair price in PAYW-SP, **d, e** The fair price in PAYW-MP

$p^*_{PAAP} < p_f^{max}$. As will be shown later, this relation is relevant under several scenarios. This implies that generosity λ and disadvantageous inequity aversion β are not completely independent of each other. Rather, when allowing for $\beta > 0$, the feasible domain for λ increases with increasing β, that is, consumers might also be less generous when minding disadvantageous inequity.

2.2 First extension of CKZ's model

In PAYW, the seller cannot set prices or influence profits. Instead, the consumer can decide on the price and, therefore, we focus on the consumer perspective. By paying no more than the fair price, a buyer can always avoid disadvantageous inequity. Thus, Eq. (1a) simplifies to

$$u = r - p - \gamma(p_f - p) = r - \gamma p_f - (1 - \gamma)p. \tag{1b}$$

This utility function is linear in p, under PAYW $0 \le p \le p_f$ holds and therefore, optimal prices will be corner solutions, that is, either 0 or p_f depending on the sign of $(1 - \gamma)$. Accordingly, maximal utilities are

$$u^* = \begin{cases} r - \gamma p_f & \gamma \le 1, p^* = 0 \\ r - p_f & \gamma > 1, p^* = p_f \end{cases}. \tag{1c}$$

Online Resource A explicates in detail the conceptual consequences of (1c) and (2a). We streamline these derivations and point to Panel 1 of Table 1. This panel illustrates that the model splits consumers into four different segments by distinguishing (i) between less ($\gamma \le 1$) and more ($\gamma > 1$) fair-minded consumers; and (ii) whether the good generates a positive utility ($u^* > 0$) or not ($u^* = 0$).

Only members of Segment III_{PAYW} generate revenue (by paying their fair price p_f). Members of Segments II_{PAYW} and IV_{PAYW} do not take the product. Whereas consumers belonging to the latter are fair-minded but do not like the good, consumers of the former perceive such a low consumption utility that they are better off abstaining from taking the good even for free; please note that CKZ did not consider this segment. Members of Segment I^{a+d}_{PAYW} freeride and cause a loss to the seller.

Determination the firm's profits under PAYW requires calibrating the size of these segments. In line with CKZ, we introduce heterogeneity by assuming that r and γ are distributed independently across the population according to density functions $\phi(r)$ and $h(\gamma)$, respectively (and $\phi(r) = 1$ as above).

Little empirical evidence is available supporting the choice of an appropriate distribution of γ and, therefore, we consider some conceptual issues. If there are no customers with $\gamma > 1$ (Segments III_{PAYW} and IV_{PAYW}), then nobody would pay for the good and, therefore, PAYW could not be profitable. As a result, there only exist some customers with small $\gamma \le 1$. These consumers (Segments I^{a+d}_{PAYW}, and II_{PAYW}) will make up a proportion of ω of the market and correspond to the less fair-minded consumers who will never pay. To determine the actual segment sizes, we postulate γ to be distributed according to some distribution $h_{[0,1]}(\gamma)$ in

Table 1 Customer segments for different pricing policies

	Less fair-minded consumers $\gamma \leq 1$			More fair-minded consumers $\gamma > 1$		
	Panel 1: PAYW, PAYW-SP (ignoring the suggested price)					
	Consumption utility			Consumption utility		
High	$c < r \leq 1$	I^a_{PAYW}	$u^* > 0$ consumer freeloads	$c < r \leq 1$	III_{PAYW}	$u^* > 0$ consumer buys for p_f
Low	$\gamma c < r \leq c$ (1)	I^d_{PAYW}	$u^* > 0$ consumer freeloads	$0 < r \leq c$	IV_{PAYW}	$u^* = 0$ consumer abstains
Very low	$0 \leq r \leq \gamma c \leq c$ (1)	II_{PAYW}	$u^* = 0$ consumer abstains			
	Panel 2: PAYW-SP (considering the suggested price)					
Very high	$\min\left(r^p_s, 1\right) < r \leq 1$	$I^a_{PAYW-SP}$	$u^* > 0$ consumer freeloads	$\min\left(r^p_s, 1\right) < r \leq 1$	$III^a_{PAYW-SP}$	$u^* > 0$ consumer buys for $p_{f\lambda}$
High	$\min\left(r^r_s, r^{max}_f\right) < r \leq \min\left(r^p_s, 1\right)$	$I^b_{PAYW-SP}$	$u^* > 0$ consumer freeloads	$\min\left(r^r_s, r^{max}_f\right) < r \leq \min\left(r^p_s, 1\right)$	$III^b_{PAYW-SP}$	$u^* > 0$ consumer buys for $\min\left(p^p_s, p^{max}_f\right)$
Intermediate	$c \leq \gamma \min\left(p^p_s, p^{max}_f\right) < r \leq \min\left(r^r_s, r^{max}_f\right)$	$I^c_{PAYW-SP}$	$u^* > 0$ consumer freeloads	$c < r \leq \min\left(r^r_s, r^{max}_f\right)$	$III^c_{PAYW-SP}$	$u^* > 0$ consumer buys for r
	$cr \leq \gamma \min\left(p^p_s, p^{max}_f\right) \leq \min\left(r^r_s, r^{max}_f\right)$ (1)	$II^a_{PAYW-SP}$	$u^* > 0$ consumer abstains		$IV^a_{PAYW-SP}$	$u^* = 0$ consumer abstains
Low	$\gamma \min\left(p^p_s, p^{max}_f\right) < r \leq c$ (1)	$I^d_{PAYW-SP}$	$u^* > 0$ consumer freeloads	$0 < r \leq c$	$IV^b_{PAYW-SP}$	$u^* = 0$ consumer abstains
Very low	$0 \leq r \leq \gamma \min\left(p^p_s, p^{max}_f\right) \leq c$ (1)	$II^b_{PAYW-SP}$	$u^* = 0$ consumer abstains			
	Panel 3: PAYW-MP					
Very high	$\min\left(\underline{r}^p, 1\right) < r \leq 1$	$I^a_{PAYW-MP}$	$u^* > 0$ consumer buys for $\underline{p}^p$	$\min\left(\underline{r}^p, 1\right) < r \leq 1$	$III^a_{PAYW-MP}$	$u^* > 0$ consumer buys for p_f
High	$r^+ < r \leq \min\left(\underline{r}^p, 1\right)$	$I^b_{PAYW-MP}$	$u^* > 0$ consumer buys for $\underline{p}^p$	$r^+ < r \leq \min\left(\underline{r}^p, 1\right)$	$III^b_{PAYW-MP}$	$u^* > 0$ consumer buys for $\underline{p}^p$

Table 1 (continued)

	Less fair-minded consumers $\gamma \leq 1$			More fair-minded consumers $\gamma > 1$		
Intermediate or low	$0 \leq r \leq r^+$	$II_{PAYW-MP}$	$u^* = 0$ consumer abstains	$0 \leq r \leq r^+$	$IV_{PAYW-MP}$	$u^* = 0$ consumer abstains

(1) restriction only meaningful for $\gamma \leq 1$

u: customer utility

r: consumption utility

c: seller's unit costs

p_f: perceived fair price

γ: advantageous inequity aversion

p_s^p: suggested price

$r_f^{max} = p_f^{max}$: highest possible fair price

$p_{f\lambda} = \lambda r + (1 - \lambda)c$

r_s^p: consumption utility corresponding to suggested price ($r_s^p = \left(p_s^p - (1 - \lambda)c\right)/\lambda$)

r_s^r: consumption utility equal to suggested price ($r_s^r = p_s^p$)

$\underline{p}^p$: minimum price

$\underline{r}^p$: consumption utility corresponding to minimum price ($\underline{r}^p = \left(\underline{p}^p - (1 - \lambda)c\right)/\lambda$)

r^+: critical consumption utility

the domain $[0, 1]$. Less fair-minded consumers (share ω), can be subdivided into non-buyers (Segment II_{PAYW}) whose share is given by:

$$\delta = \int_0^1 \int_0^{\gamma c} \phi(r)h(\gamma)drd\gamma = \int_0^1 \left[\omega h_{[0,1]}(\gamma) \int_0^{\gamma c} dr \right] d\gamma = c\omega\overline{\gamma}_{[0,1]} \tag{6}$$

and freeloaders (Segment I^{a+d}_{PAYW}), whose share is given by

$$\theta = \omega\left(1 - c\overline{\gamma}_{[0,1]}\right) \tag{7}$$

with $\overline{\gamma}_{[0,1]}$: mean of γ in $[0, 1]$. Thus, for higher costs and higher $\overline{\gamma}_{[0,1]}$, more customers will decide not to freeload. More fair-minded consumers, who constitute the remaining consumer base, (share $1 - \omega$, Segments III_{PAYW} and IV_{PAYW}), may be buyers who constitute:

$$(1 - \omega) \int_c^1 \phi(r)dr = (1 - \omega)(1 - c),$$

or non-buyers, who make up $(1 - \omega)c$. This allows us to determine the firm's profits in PAYW which are given by:

$$\pi_{PAYW} = \int_c^1 (1 - \omega)\left(p_f - c\right)\phi(r)dr - c\theta = \int_c^1 (1 - \omega)\lambda(r - c)\phi(r)dr - c\theta. \tag{8}$$

The first term of the profit function includes all paying customers. They pay their perceived fair price and costs c incur at the firm level. The second term describes the firm's costs that result from freeloaders.

When substituting the distribution of consumption utilities, we find that with $\phi(r) = 1$, the profits are given as:

$$\pi_{PAYW} = \frac{\lambda(1 - \omega)(1 - c)^2}{2} - c\omega\left(1 - c\overline{\gamma}_{[0,1]}\right). \tag{9}$$

Online Resource A investigates conditions under which PAYW result in greater profits than PAAP in detail. We only summarize these managerial considerations here:

- Cost c must be sufficiently small for a firm to choose PAYW over PAAP;
- At the same time, less than 50% of the consumers must be less fair-minded (ω);
- In addition, generosity (λ) must be sufficiently large (i.e. $\lambda > 1/(2 + \beta)$);
- Finally, the mean of the distribution of advantageous inequity aversion for less fair-minded customers $\overline{\gamma}_{[0,1]}$ must be considered (i.e. $0 \leq \overline{\gamma}_{[0,1]} \leq \lambda/2$).

3 PAYW with a suggested price: Second extension of CKZ's model

This section introduces PAYW with a suggested price (abbreviated as PAYW-SP hereafter). For PAYW-SP, CKZ proposed two extensions of pure PAYW. On the one hand, they expect two segments of buyers, who either observe the price suggestion p_s (with probability $(1-z)$) or ignore it (with a probability z).[3] On the other hand, half of those who observe this suggestion fully accept it (and adapt this price as lower bound), whereas the other half—when really considering paying for the product—choose the respective consumption utility r as lower bound if $r > c$, or c for $r \leq c$.[4]

We differ from CKZ's previous approach in two aspects. First, we consider the effects of the more nuanced behavior of the less fair-minded consumer segments, ω, identified previously, when accounting for a suggested price. Second, we explicitly set an upper bound for the suggested price. Consumers will not accept suggested prices that exceed the highest fair price p_f^{max}. Empirical research suggests that higher price suggestions could even have adverse effects as they might appear nontransparent and trigger selfish behavior (Carter and Curry 2010).

3.1 Conceptual remarks

We draw particular attention to the fact that in CKZ's model p_s occurs as a (suggested) price but at the same time as consumption utility (when compared with r). This might cause ambiguity in a $(r \times p)$ diagram. Therefore, we use the following notation: for p_s denoting a price (p) we build the pair $\left(r_s^p, p_s^p\right)$ and $r_s^p = \left(p_s^p - (1-\lambda)c\right)/\lambda$ (cf. Fig. 1a, inverse function); for p_s denoting a consumption utility (r) the pair $\left(r_s^r, p_s^r\right)$ and $p_s^r = \lambda r_s^r + (1-\lambda)c$; numerically $r_s^r = p_s^p$ and $r_f^{max} = p_f^{max}$. Using this notation, the fair price is defined as[5]

$$p_f = \begin{cases} \text{for a buyer} & \text{for a nonbuyer} \\ \left\langle \begin{array}{ll} \min\left(p_s^p, p_f^{max}\right) & \text{with probability } 0.5 \\ \min\left(\max(c,r), p_s^p, p_f^{max}\right) & \text{with probability } 0.5 \end{array} \right\rangle & \min\left(p_s^p, p_f^{max}\right) \quad 0 \leq r \leq \min\left(r_s^p, 1\right) \\ \lambda r + (1-\lambda)c & \lambda r + (1-\lambda)c \quad \min\left(r_s^p, 1\right) < r \leq 1 \end{cases} \tag{2b}$$

Figures 1b and 1c contrast PAYW-SP with PAYW (Fig. 1a) for consumers paying attention to the price suggestion and illustrate Eq. (2b). Since the seller does not know the buyer's highest fair price, his price suggestion might be either smaller (cf.

[3] The following discussion concentrates on the first segment because the second segment corresponds to pure PAYW. Of course, both segments are considered later on when the overall profit is examined (Sect. 3.2 ff).

[4] CKZ (p. 790) substantiate this assumption by writing that those customers "… who feel embarrassed for not paying p_s may decide not to *purchase* [emphasis added] at all. However, it is also possible that consumers may feel it is justifiable to pay r and *make a purchase* [emphasis added]…".

[5] We use the notation $p_{f\lambda} = \lambda r + (1-\lambda)c$ to distinguish this alternative from the other alternatives of p_f.

Fig. 1b, $p_s^p \leq p_f^{max}$) or larger (cf. Fig. 1c, $p_s^p > p_f^{max}$). This lack of uniqueness necessitates using the min-operator in Eq. (2b).

The optimal utility function of Eq. (1c) remains the same, but care has to be taken whether utilities are positive (in which case the buyer takes the good and pays a certain price or freeloads) or zero (in which case the buyer abstains from taking the good). Subsection 3.2 gives details on this aspect. We note, however, that contrary to the claim of CKZ (p. 785) that "the suggested price does not affect freeloaders", even less fair-minded customers are influenced by a price suggestion above their perceived fair price and, thus, freeloading initiates more advantageous inequity aversion than without this price suggestion (i.e. they replace their level of comparison c by p_s^p). Intuitively, this approach has face validity. Less fair-minded consumers who observe a fair price but still freeload might feel more embarrassed as they, even more obviously in the presence of a suggested price ($p_s^p \geq c$), reveal their true character to the seller in blatantly disregarding social norms. Therefore, considering the suggested price, a higher share of less fair-minded consumers might decide not to freeload if the disutility from the embarrassment outweighs consumption utility.

Online Resource B explicates the consequences of Eqs. (1c) and (2b) in detail. Again, we streamline these derivations and point to Panel 2 of Table 1, which focuses on consumers who consider the price suggestion (with probability $1 - z$); for the other consumers (who ignore the price suggestion—with probability z) Panel 1 is still relevant. Whereas the basic classification of consumers into the four segments remains valid, the situation becomes more complicated because of (i) the need to distinguish between the two cases $p_s^p \leq p_f^{max}$ and $p_s^p > p_f^{max}$; and (ii) half of those consumers who observe the price suggestion accept p_s^p (instead of c) as lower bound for their fair price p_f but for the other half consumption utility r (instead of c) serves as lower bound for p_f. Intuitively, (i) manifests in the use of the min-operator in Panel 2, which formally integrates the two cases represented by Figs. 1b and 1c; (ii) manifests on the one hand in the two-valued p_f-function for $0 \leq r < r_s^r$ (Fig. 1b), $0 \leq r < r_f^{max}$ (Fig. 1c), respectively. On the other hand, segmentation becomes finer grained in that additional Segments $I_{PAYW-SP}^{b,c}$, $II_{PAYW-SP}^{a}$, $III_{PAYW-SP}^{b,c}$, and $IV_{PAYW-SP}^{a}$ emerge.[6] From an interpretational point of view PAYW-SP drives consumers out of the market, i.e. $II_{PAYW-SP}^{a}$ reduces both the segment of freeloaders but also the segment of buyers $IV_{PAYW-SP}^{a}$. Members of $III_{PAYW-SP}^{b,c}$ pay a higher price than under PAYW (cf. Fig. 1b and 1c—under PAYW they would pay p_f).

[6] When browsing through Fig. B1, please remember that γ, λ, and, therefore, p_f^{max} vary across consumers. Please note, that depending on the concrete values of γ, c, p_s^p segments indexed ^{a} might be empty.

3.2 Optimal prices and the firm's profits under PAYW-SP

Next, we turn to the seller's profit (cf. Eq. (8)), distinguishing between sub-cases $p_s^p \le p_f^{max}$ and $p_s^p > p_f^{max}$ from above, and find:

$$\pi_{PAYW-SP} = (1-z)\left((1-\omega)\left(\frac{1}{2}\int_c^{\min\left(r_s^r, r_f^{max}\right)} (r-c)\phi(r)dr \right.\right.$$
$$\left.\left. + \int_{\min\left(r_s^r, r_f^{max}\right)}^{\min\left(r_s^p,1\right)} \left(\min\left(p_s^p, p_f^{max}\right) - c\right)\phi(r)dr + \int_{\min\left(r_s^p,1\right)}^{1} \lambda(r-c)\phi(r)dr\right)\right)$$
$$+ z(1-\omega)\int_c^1 \lambda(r-c)\phi(r)dr - c\left(\theta^{1-z}_{\min\left(p_s^p, p_f^{max}\right)} + \theta_s^z\right). \tag{10}$$

Only paying consumers ($(1-\omega)$ in size) generate revenues. For them, the first integral corresponds to profits from consumers who consider the price suggestion but have a consumption utility below the price suggestion. However, they buy and pay r (Segment $III^c_{PAYW-SP}$). The second integral corresponds to consumers who consider the price suggestion, whose consumption utility is above that of the price suggestion and who, therefore, pay the suggested price p_s^p (or p_f^{max}) (Segment $III^b_{PAYW-SP}$). The third integral describes profits from consumers whose consumption utility is higher than the price suggestion and who pay their perceived fair price $p_{f\lambda}$ (Segment $III^a_{PAYW-SP}$; for $p_s^p > p_f^{max}$ this integral is equal zero). The fourth integral refers to consumers ignoring the price suggestion (cf. Eq. (8)). Losses caused by freeloaders are subtracted.

In PAYW-SP, the seller maximizes his profits by finding the optimal suggested price p_s^* (cf. Online Resource B). The results of this maximization problem are given by:

$$p_s^* = \begin{cases} p_f^{max} \le 1 & \text{if } \left\langle \begin{array}{c} m > 1/2 \\ 0 \le \lambda \le 2(1+m)/3 \text{ and } m \le 1/2 \end{array}\right. \\ c + 2\lambda m(1-c)/(3\lambda - 2) & \text{if } 2(1+m)/3 \le \lambda \le 1 \text{ and } m \le 1/2 \end{cases} \quad \text{with } m = \frac{c\omega\bar{\gamma}_{[0,1]}}{(1-c)(1-\omega)}. \tag{11}$$

Parameter $m > 1/2$ suggests that even for high costs, and a high share of freeloaders or when generosity is low, the fair price should be the highest fair price but cannot exceed it. For high generosity, the suggested price should be below the highest fair price (for more details on m see Online Resource B).

From a more managerial point of view and in summary: depending on the prevailing conditions (given by the set of parameters), Eq. (11) provides the optimal suggested price p_s^* with the following properties:

- There are two options for optimal price suggestions: for low and intermediate generosity levels, the seller should set a rather high price recommendation in order to prevent freeloading behavior; however, if high generosity is prevalent, moderate suggestions might even be better.
- p_s^* increases with cost c ($\delta p_s^*/\delta c \geq 0$). This result is face valid because it does not make sense for the seller to suggest a price lower than their costs, as this will only reduce payments and hurt profitability.
- p_s^* increases with the proportion of less fair-minded consumers ω ($\delta p_s^*/\delta\omega \geq 0$). By raising the suggested price, the seller influences the inequity perceptions of these less fair-minded customers. The higher the suggested price, the more inequitable and, therefore, the more psychologically costly it becomes to freeload. Therefore, if there is a higher share of less fair-minded consumers in the market, raising the suggested price enhances profitability.
- p_s^* increases with the mean advantageous inequity aversion of less fair-minded consumers $\overline{\gamma}_{[0,1]}$ ($\delta p_s^*/\delta\overline{\gamma}_{[0,1]} \geq 0$), that is, a higher share of these non-payers refrains from freeloading and does not take the product. Therefore, the seller will set a higher suggested price if less fair-minded consumers have a higher degree of advantageous inequity aversion. If the share of potential freeloaders is very high, the firm will try to discourage them from buying by increasing the suggested price. This is particularly true when the costs, c, the share of less fair-minded consumers, ω, and the mean of advantageous inequity aversion, $\overline{\gamma}_{[0,1]}$ are simultaneously high. In this case ($m > 1/2$), the seller should focus on deterring the freeloading of less fair-minded consumers and set a very high suggested price; i.e.$p_s^* = p_f^{max} \leq 1$.
- p_s^* increases with increasing generosity ($\delta p_s^*/\delta\lambda > 0$) for all consumers in the case for $m > 1/2$ and for less generous consumers ($\lambda \leq 2(1+m)/3$ and $m \leq 1/2$); that is, the price suggestion serves the purpose of driving potential freeloaders into paying or abstaining customers. However, p_s^* decreases with increasing generosity ($\delta p_s^*/\delta\lambda \leq 0$) for more generous consumers ($\lambda > 2(1+m)/3$ and $m \leq 1/2$). Intuitively this property implies that sufficiently generous consumers will pay voluntarily and others with a lower consumption utility might not be discouraged by a smaller price suggestion and purchase rather than abstain from buying.

4 PAYW and the minimum price: Third extension of CKZ's model

4.1 Conceptual remarks

Another variant of participatory pricing is PAYW with a minimum price (abbreviated as PAYW-MP in the sequel); that is, buyers must pay at least a minimum price, $\underline{p}$, for the product. Obviously, such a policy perfectly screens out potential freeloaders. Conceptually, three main differences to pure PAYW result therefrom.

(a) Consumers might experience disadvantageous inequity (if the minimum price is higher than the fair price, $\underline{p} \geq p_f$). As a consequence, a consumer's utility function of Eq (1a) simplifies to[7]

$$u = r - \underline{r}^r - \beta(\underline{p}^p - p_f). \tag{1d}$$

Consumers will buy the product if their consumption utility is higher than the minimum price and the disutility from disadvantageous inequity (i.e. $u > 0$). We denote the critical consumption utility that must be exceeded in order to buy as r^+

$$r^+ = \min\left(\underline{r}^r + \frac{\beta(1-\lambda)\left(\underline{r}^r - c\right)}{1+\lambda\beta}, 1\right). \tag{12a}$$

The *min*-operator in Eq. (12a) restricts the critical consumption utility r^+ to its feasible domain. Algebraic transformation of Eq. (12a) results in:

$$\underline{p}^p \leq \left(1 + \beta p_f^{max}\right)/(1+\beta); \tag{12b}$$

that is, a minimum price above this threshold would restrain everybody from purchasing this good and, in turn, result in zero profits.[8] The difficulty with this pricing policy is finding the right balance between a rather low minimum price (not sufficiently discouraging freeloading) and a rather high minimum price (unduly discouraging potential buyers).

:

(b) The fair price p_f in PAYW-MP remains as in PAYW, Eq. (2a). However, the range of possible prices has a lower bound given by the minimum price:

$$\underline{p} = \begin{cases} \underline{p}^p & 0 \leq r \leq \min\left(\underline{r}^p, 1\right) \\ \lambda r + (1-\lambda)c & \min\left(\underline{r}^p, 1\right) < r \leq 1 \end{cases} \tag{2c}$$

that is, if $\underline{p}^p > p_f^{max}$ the concept of generosity in p_f does not apply anymore because the minimum price surpasses an even perfectly generous customer. A consumer in this region will experience disadvantageous inequity for sure (cf. Fig. 1e).

(c) Despite $\beta > 0$, Eq. (1a) implies γ and β to be independent of each other. Therefore, consumers still experience advantageous inequity if $\gamma > 0$ and $p_f > \underline{p}^p$. Thus, the optimal utility function is as follows (details are discussed below):

[7] As before, $\underline{p}$ occurs as a (minimum) price but at the same time as consumption utility. Therefore, we use the following notation: for $\underline{p}$ denoting a price we build the pair $\left(\underline{r}^p, \underline{p}^p\right)$ and $\underline{r}^p = \left(\underline{p}^p - (1-\lambda)c\right)/\lambda$ (cf. Fig. 1a); for $\underline{p}$ denoting a consumption utility the pair $\left(\underline{r}^r, \underline{p}^r\right)$ and $\underline{p}^r = \lambda\underline{r}^r + (1-\lambda)c$; numerically $\underline{r}^r = \underline{p}^p$. Similarly, we build $\left(r^+, p^+\right)$ and $p^+ = \lambda r^+ + (1-\lambda)c$.

[8] The right-hand side of Eq. (12b) monotonically decreases with increasing β from 1 to p_f^{max}.

$$u^* = \begin{cases} r - \underline{r}^r \leq 0 & r \leq r^+ < \underline{r}^p \text{ do not buy } p_f \leq \underline{p}^p \\ r - \underline{r}^r > 0 & r^+ < r \leq \underline{r}^p \;\; p^* = \underline{p}^p \quad p_f \leq \underline{p}^p \\ r - \gamma p_f > 0 & \gamma \leq 1 \qquad\quad p^* = \underline{p}^p \quad p_f > \underline{p}^p \\ r - p_f > 0 & \gamma > 1 \qquad\quad p^* = \underline{p}^p \quad p_f > \underline{p}^p. \end{cases} \tag{1e}$$

In their model, CKZ do not consider disadvantageous inequity aversion in most of their paper (i.e. by assuming $\beta = 0$ on page 783). Setting $\beta = 0$, however, would induce that consumers do not care that the seller introduces a minimum price if the minimum price is higher than their fair price. This means that even if the seller sets an exploitative minimum price and if buyers feel that the seller tries to scam most consumers, they will without any grief accept the price as long as it is below their consumption utility. Moreover, more fair-minded consumers would be assumed to pay even more than the minimum price voluntarily, provided that their consumption utilities are sufficiently large. We relax this restriction in line with many empirical studies showing that (i) the introduction of a minimum price lowers overall prices (Johnson and Cui 2013; Jung et al. 2016); that (ii) consumers do indeed care for disadvantageous inequity; and that (iii) some consumers are driven out of the market when a minimum price is set.

Domain of $\underline{p}^p$: A minimum price below cost, $\underline{p}^p <$ c, does not affect fair-minded consumers (i.e. $\gamma > 1$), as they never buy below the fair price which is always above c. Less fair-minded consumers (i.e. $\gamma \leq 1$) either pay $\underline{p}^p$ or do not buy. Therefore, a minimum price either turns freeloaders into buyers or relieves the seller from freeloaders. Considering profits, there is no benefit from setting $\underline{p}^p$ below c. As in the case of a suggested price, the seller does not know the buyer's highest fair price, thus the minimum price $\underline{p}^p$ might be either smaller (see Fig. 1d, $\underline{p}^p \leq p_f^{max}$) or larger (see Fig. 1e, $\underline{p}^p > p_f^{max}$) than p_f^{max}.

Online Resource C explicates the consequences of Eqs. (1e) and (2c) in detail, Panel 3 of Table 1 streamlines these derivations. The classification of consumers into the four segments applies again, but the minimum price prevents from freeloading. As a consequence, members of $I_{PAYW-MP}^{a+b}$ pay $\underline{p}^p$ for the good.[9]

4.2 Optimal prices and the firm's profits under PAYW-MP

Distinguishing between customer segments above, the firm's profits are as follows[10]:

$$\pi_{PAYW-MP} = (1-\omega)\left(\int_{r^+}^{\min(\underline{r}^p,1)} \left(\underline{p}^p - c\right)\phi(r)dr + \int_{\min(\underline{r}^p,1)}^{1} \lambda(r-c)\phi(r)dr \right) + \omega \int_{r^+}^{1} \left(\underline{p}^p - c\right)\phi(r)dr. \tag{13}$$

[9] For $\underline{p}^p > p_f^{\max}$ segments indexed ^{a}, for $r^+ = 1$ segments indexed ^{b} are empty.

[10] For $r^+ \geq 1$, nobody buys the product and profits are zero.

The first term pertains to the profits made from more fair-minded consumers ($(1-\omega)$ in size). The first integral determines revenues for Segment $III^{b}_{PAYW-MP}$; these consumers buy the good and pay the minimum price. The second integral determines the revenues for Segment $III^{a}_{PAYW-MP}$; these consumers buy the good and pay their fair price. The third integral describes the revenues for Segment $I^{a+b}_{PAYW-MP}$ (ω in size); these consumers buy the good and pay the minimum price. For all consumers, the seller incurs costs c.

To maximize profits, the firm chooses the optimal minimum price (see Online Resource C for proofs). The optimal minimum price for the above equation is[11]

$$\underline{p}^* = c + (1-c)k\lambda$$
$$\text{with } k = \begin{cases} 1 & \lambda \leq \frac{1}{2+\beta} \\ \frac{\omega(1+\beta\lambda)}{(2+\beta(1+\omega))\lambda-1+\omega} & \lambda > \frac{1}{2+\beta} \end{cases} . \tag{14}$$

In line with the similarities apparent from Figs. 1b–1e, the general pattern of $\underline{p}^*$ and p_s^* is identical: for small generosity λ they coincide with p_f^{max} and thus increase with increasing λ; for $\lambda \to 1$ they decrease and approach $c+(1-c)\omega/(1+\omega)$, $c+2m(1-c)$, respectively (cf. Fig. 3 in Chapter 5).[12] However, whereas $\underline{p}^*$ starts shrinking at least for $\lambda > 1/2$ (i.e. $\lambda > 1/(2+\beta)$), p_s^* does so not earlier than $\lambda > 2/3$ (i.e. $\lambda > 2(1+m)/3$). Moderately generous consumers are thus treated differently. PAYW-MP focuses on not losing too many of them by setting too high a minimum price, PAYM-SP relies on the option that consumers might not follow the suggestion if they do not find it appropriate. Alternatively, PAYW-MP might be regarded as a mix between PAAP and PAYW. The minimum price allows the firm to screen out freeloaders while benefiting from the additional consumption utility of fair-minded consumers with a high consumption utility. However, as in PAAP, there is a dark side for a minimum price that exceeds the perceived fair price of the consumers. These customers will be driven out of the market, although they would contribute to the seller's profits when paying their fair price.

From a more managerial point of view we therefore summarize:

- $\underline{p}^*$ increases with cost c ($\delta\underline{p}^*/\delta c \geq 0$);
- $\underline{p}^*$ increases with the share of less fair-minded consumers ω ($\delta\underline{p}^*/\delta\omega \geq 0$);
- $\underline{p}^*$ decreases with disadvantageous inequity aversion β ($\delta\underline{p}^*/\delta\beta \leq 0$); if the minimum price is perceived as being unfairly high, consumers with high levels of disadvantageous inequity aversion will shy away from purchasing the product, leading to a foregone profit opportunity for the seller. Therefore, the more dis-

[11] Considering Eq. (12b), $\underline{p}^*$ is always feasible, i.e. $\underline{p}^* \leq p_f^{max}$.

[12] In more detail, there is an intersection of $\underline{p}^*$ with p_s^* for $2(1+m)/3 \leq \lambda \leq 2(1+m+m/\omega)/3$ if $m \leq 1/2$ and $\omega \geq 2m(1+\omega)$.

advantageously inequity averse the buyers are, the lower the optimal minimum price $\underline{p}^*$.

- No general conclusions with respect to generosity can be made since $\delta \underline{p}^* / \delta \lambda$ might be either less than, equal to, or larger than 0 (depending on β, λ, and $\overline{\omega}$; see Online Resource C for details). This situation needs further scrutiny: For low levels of generosity ($\lambda \leq 1/(2+\beta)$), the seller's minimum price will be p_f^{max}. As p_f^{max} increases linearly with λ, the optimal minimum price also rises with higher generosity. This allows the seller to extract more profits from Segment $I^b_{PAYW-MP}$ and $III^b_{PAYW-MP}$. For high levels of generosity ($\lambda > 1/(2+\beta)$), the optimal minimum price depends on ω and β (cf. Table C1 in Online Resource C). If the share of less fair-minded consumers ω and the degree of disadvantageous inequity aversion β are low, the minimum price decreases with higher generosity. In this case, the seller wants to expand on Segment $I^b_{PAYW-MP}$ and, particularly, on Segment $III^b_{PAYW-MP}$ by converting Segments $II_{PAYW-MP}$ and $IV_{PAYW-MP}$ consumers into buyers. However, in markets with high levels of disadvantageous inequity aversion and a high share of less fair-minded consumers, the firm increases the minimum price with higher generosity. If β is high, Segments $I^b_{PAYW-MP}$ and $III^b_{PAYW-MP}$ are small (cf. Fig. C1b in Online Resource C). Hence, if ω is high, the seller will increase the minimum price in the case of higher generosity levels in order to increase revenues from less fair-minded consumers with high consumption valuations (Segment $I^a_{PAYW-MP}$).

5 Choosing the best pricing schemes

5.1 Comparison of different pricing schemes

The previous considerations allow us to compare the different pricing schemes (PAAP, PAYW, PAYW-SP, and PAYW-MP). Figures 3 and 4 provide summary illustrations for optimal prices, and corresponding optimal profits, respectively. The functional forms of the optimal prices under PAYW-SP (cf. Eq. (11)) and PAYW-MP (cf. Eq. (14)) depend on generosity λ, which highlights the particular importance of this parameter. Therefore, generosity is selected for the horizontal axis and the vertical axis represents prices (Fig. 3), or profits (Fig. 4). For presentational convenience the other parameters, β, $\overline{\gamma}_{[0,1]}$, c, ω, and z, are kept constant. This example represents a market with moderate costs ($c = 0.25$), moderate disadvantageous inequity aversion ($\beta = 1.5$), small share of less fair-minded consumers ($\omega = 0.05$), intermediate advantageous inequity aversion ($\overline{\gamma}_{[0,1]} = 0.5$), and half of the consumers being influenced by the seller's suggestion ($z = 0.5$). For a reader looking for a real-world market that resembles this setting, we suggest imagining a restaurant, where we typically see very few freeloaders (e.g. Riener and Traxler (2012) report 0.53% of all consumers freeloading), low cost (Raab et al. 2009), and sensitivity to the suggested price

(Kim et al. 2014). Furthermore, the levels of disadvantageous inequity aversion roughly correspond to that of the Dutch population (Bellemare et al. 2008).

In addition, to this illustrative example below, we offer an interactive Mathematica code (see Online Resource D). This allows us to assess optimal prices, market coverage, the size of the freeloader segment (Segment I), and the profits under all four pricing schemes for all parameter combinations. For an example, please refer to Fig 2.

5.1.1 Optimal prices

The PAAP prices and the expected price of PAYW increase with generosity.[13] In the case of PAAP, higher generosity levels allow the seller to set a higher price without the buyer considering it as unfair. Similarly, higher generosity levels imply that consumers' average prices for PAYW will be higher (but, naturally, less than PAAP prices). The prices for PAYW-SP and PAYW-MP follow a different pattern. When generosity is low ($\lambda \leq 1/(2+\beta)$), the seller should set the highest fair price, p_f^{max}, as the minimum or suggested price. However, for intermediate and high generosity ($\lambda > 1/(2+\beta)$), the minimum price primarily serves to drive freeloaders out of the market. Setting a higher minimum price will exclude fair-minded consumers who would otherwise pay cost-covering prices. Therefore, the minimum price decreases with increasing generosity. Similarly, for high generosity ($\lambda > (2+m)/3$), the suggested price will decrease as it would otherwise exclude fair-minded consumers who might feel discouraged by the high suggested prices.

5.1.2 Optimal profits

We note that all profit functions increase with generosity λ and that—tentatively—PAAP dominates for small λ, PAYW-SP for intermediate λ, $\left(\lambda_>^+ \leq \lambda \leq \lambda_<^+\right)$, and PAYW-MP for large λ. PAYW is never the preferred option.

Using these observations on prices and profit functions, we suggest normative guidelines for the seller's optimal pricing schemes. In the sequel, we provide recommendations for the dominant pricing policy given certain market conditions. These recommendations are based on analytic considerations (Table 2) and a comprehensive computational study (Fig. 5). In addition, real-world cases confirm that such pricing policies are applied in practice.

5.1.3 Set-up of the computational study

Whereas Online Resource D allows to compare the different pricing schemes for given parameter settings, Fig. 5 provides a structured overview which should help to intuit the pricing scheme optimal under a certain condition. Its structure is as follows:

[13] Since there are no "optimal" prices for pure PAYW, Fig. 3 shows $E\left[p_f\right]$ (i.e. the expected fair price, Eq. (2a), with uniformly distributed consumption utilities: $\phi(r) = 1$) and Fig. 4 plots $\pi_{PAYW}\left(E\left[p_f\right]\right)$ as a means of comparison for PAYW.

Input values

Costs (c)	Generosity (λ)	Less fair-minded consumers (ω)
0.25	0.5	0.05

Mean generosity of less fair-minded consumers ($\overline{\gamma}_{[0,1]}$)
0.5

Disadvantageous inequity aversion (β)	Share ignoring suggestion (z)
1.5	0.5

Output values

	Price	Market coverage	Freeloader Segment	Profit
PAAP	0.51	0.38	0	0.098
PAYW	0.39	**0.76**	**0.044**	0.12
PAYW-SP	**0.63**	0.66	0.039	**0.14**
PAYW-MP	0.29	0.69	0	0.13

Fig. 2 A tool for comparing different pricing schemes (with $\beta = 1.5$, $\overline{\gamma}_{[0,1]} = 0.5$, $c = 0.25$, $\omega = 0.05$, $z = 0.5$, $m = 1/114$)

- Generosity, λ, and share of less fair-minded customers, ω, are of particular importance and, therefore, Fig. 5 offers a full enumeration of $0 \le \lambda, \omega \le 1$. The inner horizontal/vertical axes of the mappings in Fig. 5 correspond to λ, and ω, respectively.
- The domain of costs, c, is assumed to be $[0, 1]$. Small c might occur for digital goods. However, because consumption utilities r cannot exceed 1, profits are only possible for $c < 1$. Therefore, the outer horizontal axis of Fig. 5 considers $c \in \{0;0.25;0.5;0.75\}$.
- We follow CKZ (pp. 789f.) and consider disadvantageous inequity aversion, $\beta \in \{0;1.5;4;6.5;9\}$ on the outer vertical axis of Fig. 5.
- Different shadings of the mappings represent the regions where a certain pricing policy dominates the other policies (i.e. PAAP—green shading, PAYW-SP—blue, PAYW-MP—red). Partitions on the inner horizontal axis represent different levels of generosity λ: $2(1 + m)/3$ depends on ω which results in the curvilinear progression (for $c > 0$), i.e. the bold black line on the right-hand side of each diagram); for $(\lambda = 1)$, $2(1 + m)/3$ intersects with $m = 1/2$ (blue horizon-

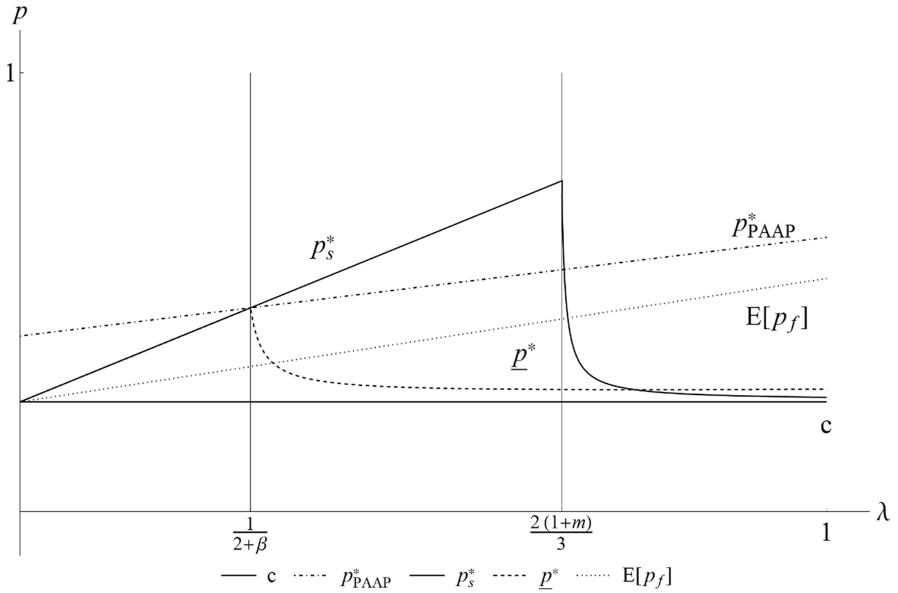

Fig. 3 Comparison of optimal prices for different pricing schemes (with $\beta = 1.5$, $\overline{\gamma}_{[0,1]} = 0.5$, $c = 0.25$, $\omega = 0.05$, $z = 0.5$, $m = 1/114$)

tal line in each mapping). The left column of Fig. 5 corresponds to mappings with $c = 0$ and, therefore, $2(1+m)/3 \equiv 2/3$ and $m = 1/2$ is displayed at $\omega = 1$ which makes these mappings appear less "crowded". Finally, the "red" line corresponds to the threshold $\lambda^+(\omega)$ which separates regions for which PAYW-SP dominates PAAP (i.e. for $\lambda > \lambda^+_>$) and PAYW-SP dominates PAYW-MP (for $\lambda < \lambda^+_<$).

- In order not to overload Fig. 5 and because of their minor impact on profits, the mean of advantageous inequity aversion of less fair-minded customers, $\overline{\gamma}_{[0,1]}$, and the probability of observing the price suggestion, z, are kept constant (i.e. both equal to 0.5).

5.2 Results of computational comparisons

5.2.1 Result 1 (Focus on PAYW pricing scheme)

As discussed in Sect. 2.2, PAYW can be more profitable than PAAP for sufficiently small c, sufficiently small ω and sufficiently large λ. A customer's utility as induced by a standard *homo oeconomicus* model (i.e. neglecting both types of inequity aversion) will never be smaller than the utility according to Eq. (1a). From the seller's

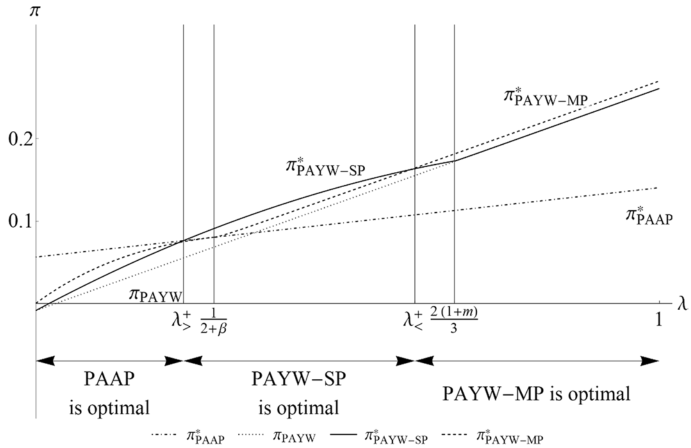

Fig. 4 Comparison of optimal profits for different pricing schemes (with $\beta = 1.5$, $\overline{\gamma}_{[0,1]} = 0.5$, $c = 0.25$, $\omega = 0.05$, $z = 0.5$, $m = 1/114$)

perspective, however, profits according to Eq. (1a) might be larger, if there is a sufficient share of fair-minded customers willing to contribute. This implies a small ω and $\lambda > 0$. From an analytical point of view, PAYW (Eq. (9)) matches PAAP (Eq. (4)) if $\beta = 0$, $\omega = 0 \Rightarrow m = 0$, and $\lambda = 1/2$ (compare entries of Row 1 in Table 2 with entries in Row 3, Column $\lambda = 1/(2 + \beta)$). As a general guideline, the seller should consider (variants of) PAYW if customers are sufficiently fair and generous (i.e. $(1 - \omega)$ substantial, λ high) and PAAP otherwise (cf. Fig. 5).

The case study described by León et al. (2012) presents a travel agency offering different holiday packages at PAYW prices and serves as empirical evidence of a market situation in which PAAP is optimal: in PAYW consumers primarily care about their own consumption utility and are not admonished to ethical behavior by social pressure. So, switching to PAAP is the best option for the seller. Furthermore, we see that pure PAYW is not very often the case and many sellers that have used pure PAYW in the past (e.g. *HumbleBundle.com, stacksocial.com*) have switched from pure PAYW to PAAP, PAYW-SP or PAYW-MP.

When comparing PAYW to PAYW-SP, making allowance for consumers who ignore the price suggestion causes the nested structure of PAYW (cf. Eqs. (9), (B5 in Online Resource B)) within PAYW-SP. PAYW-SP is identical to PAYW for $z = 1$ and dominates PAYW for $z < 1$ (cf. Figs. 1a and 1b and the discussion provided in Online Resource B); differences in profits between PAYW-SP and PAYW decrease with increasing generosity λ and $\lambda \geq 2(1 + m)/3$ (cf. Fig. 4).

If the minimum price is set to zero, PAYW-MP corresponds to PAYW. Therefore, PAYW is nested within PAYW-MP and profits under PAYW-MP cannot be less than profits under PAYW. Thus, PAYW-MP is always preferred against PAYW, if $\omega > 0$ (cf. Eqs. (9), (C3 in Online Resource C)). Consequently, we will exclude PAYW in favor of PAYW-MP and PAYW-SP from further analysis of the optimal pricing scheme.

Table 2 Optimal profits for selected levels of generosity

$\pi^*\left(\beta,\lambda,\omega,\overline{\gamma}_{[0,1]}\mid z=0\right)$	$\lambda=0$	$\lambda=\frac{1}{2+\beta}$[e]	$\lambda=\frac{2}{3}$	$\lambda=1$	Row
PAAP					
$\beta^{min}=0$	$\frac{(1-c)^2}{4}$	$\frac{(1-c)^2}{4}$	$\frac{(1-c)^2}{4}$	$\frac{(1-c)^2}{4}$	1[a]
$\beta^{max}\rightarrow\infty$	0	$\frac{(1-c)^2}{2(2+\beta)}\geq 0$	$\frac{(1-c)^2}{6}$	$\frac{(1-c)^2}{4}$	2
PAYW					
$\overline{\gamma}_{[0,1]}=0$	$-c\omega$	$\frac{(1-\omega)(1-c)^2}{4}-c\omega$	$\frac{(1-\omega)(1-c)^2}{3}-c\omega$	$\frac{(1-\omega)(1-c)^2}{2}-c\omega$	3
$\overline{\gamma}_{[0,1]}=\frac{(1-c)(1-\omega)}{2c\omega}$	$\frac{(1-c)(1-\omega)c}{2}-c\omega$	$\frac{(1-\omega)\left(1-c^2\right)}{4}-c\omega$	$\frac{(1-\omega)(1-c)(2+c)}{6}-c\omega$	$\frac{(1-\omega)(1-c)}{2}-c\omega$	4[b]
$\overline{\gamma}_{[0,1]}=1$	$c^2\omega-c\omega$	$\frac{(1-\omega)(1-c)^2}{4}+c^2\omega-c\omega$	$\frac{(1-\omega)(1-c)^2}{3}+c^2\omega-c\omega$	$\frac{(1-\omega)(1-c)^2}{2}+c^2\omega-c\omega$	5[c]
PAYW-SP					
$\overline{\gamma}_{[0,1]}=0$	$-c\omega$	$\frac{5(1-\omega)(1-c)^2}{16}-c\omega$	$\frac{(1-\omega)(1-c)^2}{3}-c\omega$	$\frac{(1-\omega)(1-c)^2}{2}-c\omega$	6[d]
$\overline{\gamma}_{[0,1]}=\frac{(1-c)(1-\omega)}{2c\omega}$	$\frac{(1-c)(1-\omega)c}{2}-c\omega$	$\frac{(1-\omega)(1-c)(9-c)}{16}-c\omega$	$\frac{(1-\omega)(1-c)(4-c)}{6}-c\omega$	$\frac{(1-\omega)(1-c)(3-c)}{4}-c\omega$	7[b]
$\overline{\gamma}_{[0,1]}=1$	$c^2\omega-c\omega$	$\frac{5(1-\omega)(1-c)^2}{16}-\frac{c\omega(1-c)}{2}$	$\frac{(1-\omega)(1-c)^2}{3}+c\omega\left(\frac{c+2}{3}\right)-c\omega$	$\frac{(1-\omega)(1-c)^2}{4}$	8[c]
PAYW-MP					
$\beta^{min}=0$	0	$\frac{(1-c)^2}{4}$	$\frac{(1-c)^2(1+2\omega)}{3(1+3\omega)}$	$\frac{(1-c)^2}{2(1+\omega)}$	9[d]
$\beta^{max}\rightarrow\infty$	0	0	$\frac{(1-c)^2}{3(1+\omega)}$	$\frac{(1-c)^2}{2(1+\omega)}$	10

Properties valid across pricing policies and entire parameter domains: $\pi^*\left(\beta,\lambda,\omega,\overline{\gamma}_{[0,1]}\right)$ monotonically decreases in β (Rows 1, 2 and 9, 10) and c; monotonically increases in λ (columns left to right), ω and $\overline{\gamma}_{[0,1]}$

[a]Constant over the domain of λ

[b]Corresponds to $m=1/2$ and $c,\omega>0$

[c]Corresponds to $m>1/2$ and $c,\omega>0$

[d]Profit functions for PAYW-SP and PAYW-MP consist of three/two different individual functions, depending on λ. Nevertheless, profit functions are continuous in the whole domain of λ because functional values for different individual functions are identical at the switching points, for example, $\pi^{*(1)}_{PAYW-MP}(\lambda=1/(2+\beta))=\pi^{*(2)}_{PAYW-MP}(\lambda=1/(2+\beta))$, cf. Eq. (C.3 in Online Resource C). Therefore, Table 2 does not explicitly distinguish between these individual functions.

[e]Entries in Rows 3–8 of this column correspond to $\beta^{min}=0$; entries in Column $\lambda=0$ correspond to values for $\beta^{max}\rightarrow\infty$

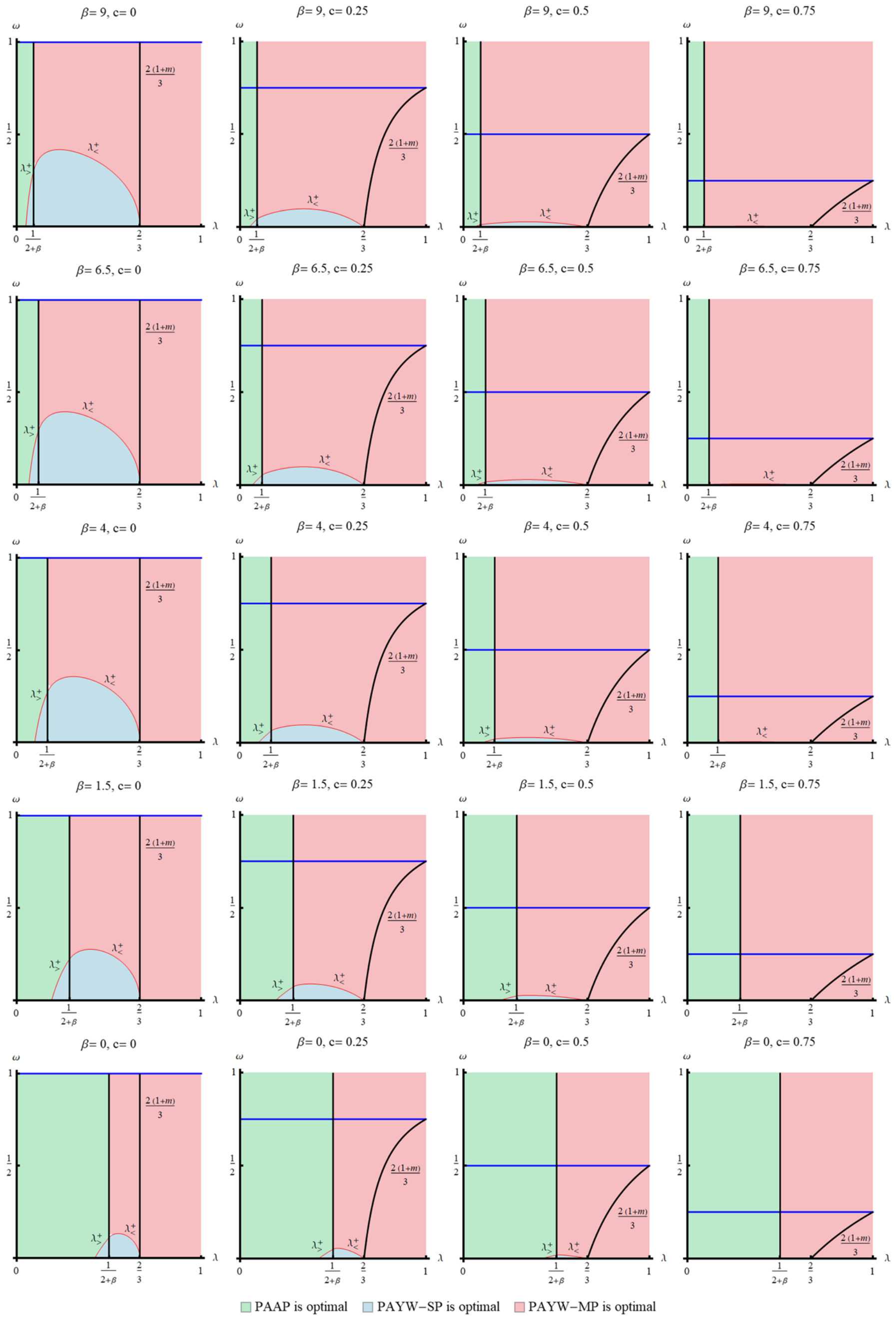

Fig. 5 Choice of optimal pricing schemes depending on costs (c, outer horizontal axis), disadvantageous inequity aversion (β, outer vertical axis), generosity (λ, inner horizontal axes) and share of potential freeloaders (ω, inner vertical axes) for fixed $\overline{\gamma}_{[0,1]} = 0.5$ and $z = 0.5$

The retailer of digital goods stacksocial.com is a real-world example of the use of PAYW-MP in a case with a high share of less fair-minded consumers and high disadvantageous inequity aversion. This merchant, who most probably faces a high number of freeloaders (because of the anonymity of the internet) and only low to moderate levels of generosity, sells partly using PAYW-MP. Offering these goods under PAAP appears to be difficult as digital goods are often also easily available for free from dubious sources, which might also serve as a reference for a fair price.

5.2.2 Result 2 (Focus on costs)

$(1-c)^2$ is a multiplicative element of all profit functions and thus important for the absolute magnitude of profits rather than for discriminating between different pricing policies. The structure of the different mappings of Fig. 5 is similar. However, because of freeloading behavior, PAYW-SP suffers from high unit cost c and is not recommended in such cases. For higher costs, the seller must safeguard against freeloading by choosing PAYW-MP or PAAP. This is in line with empirical findings, as Kim et al. (2014) also report that higher costs typically rule out PAYW and PAYW-SP.

5.2.3 Result 3 (Focus on fairness $\boldsymbol{\lambda}$, disadvantageous inequity aversion $\boldsymbol{\beta}$, share of less fair-minded consumers $\boldsymbol{\omega}$)

Equations (11) and (14) reinforce the need to distinguish three different levels of generosity. Accordingly, Table 2 evaluates the profit functions for the different pricing policies for the corresponding generosity boundary values.[14] Because of continuity and monotonicity (in c, λ, β, $\omega, \overline{\gamma}_{[0,1]}$), these evaluations offer boundaries for the profit functions' domains.

5.2.3.1 Result 3a (generosity $\boldsymbol{\lambda}$ is small: $\boldsymbol{\lambda} \leq 1/(2+\boldsymbol{\beta})$) In accordance with Eqs. (3) and (14) Fig. 3 highlights that $p^* \leq p^*_{PAAP}$ in this domain. Furthermore, Fig. 4 and Table 2 provide evidence that PAAP dominates PAYW-MP (Rows 1–2 and 9–10); that is, $\pi^*_{PAYW-MP} \leq \pi^*_{PAAP}$.

The domain of π^*_{PAAP} and the domain of $\pi^*_{PAYW-SP}$ might overlap (in particular for small ω, intermediate λ) which requires a more detailed investigation provided in Online Resource E.[15] Given the fact that for small λ, $p^*_s = p^*$ this discrepancy between PAYW-SP and PAYW-MP is remarkable. Intuitively, this goes back to the assumption that half of the consumers, who observe to the price suggestion, choose

[14] To facilitate argumentation, we set $z = 0$ for PAYW-SP. This implies that all consumers consider the price suggestion and, therefore, favor this pricing policy. This is a tentative not a structural advantage only because $z > 0$ adds a segment of customers opting for PAYW. Computational comparisons of Fig. 5 and computational evaluations provided in Online Resource D consider $z > 0$.

[15] In essence, Online Resource E analyses conditions where the difference between two profit functions $\pi_1 - \pi_2$ is positive/negative which implies that policy 1 is preferred over policy 2 or vice versa. Profit functions depend on a set of parameters which makes formal derivations tedious. Because of the prominent role of generosity λ, we determine the critical threshold (function) $\lambda^+(\omega)$ for which $\pi_1(\lambda^+) = \pi_2(\lambda^+)$. This implies that for $\lambda < \lambda^+$ policy 1 dominates policy 2 and vice versa for $\lambda > \lambda^+$.

their respective consumption utility as price suggestion which is below p_s^* (see Subsect. 3.1, Fig. 1b, c). In Figs. 3, 4 and 5 their share is $\frac{z}{2} = \frac{1}{4}$, which substantiates the small area of superiority of PAYW-SP in Fig. 5.

For low levels of costs c, and a small share of less fair-minded consumers ω, PAYW-SP might be more profitable than PAAP if generosity, λ, exceeds a critical threshold $\lambda > \lambda_>^+$ (e.g. mapping in Columns 1 and 2 of Fig. 5). In these cases, the suggested price might have deterred some customers from freeloading. On the contrary, PAAP is the optimal pricing scheme when the share of less fair-minded consumers (i.e. the share of potential freeloaders), ω, is high.

For higher levels of disadvantageous inequity aversion β, consumers who dislike being duped by the seller drop out of the market and limit the seller's prices which in turn hurts profitability in PAAP (the green area in Fig. 5 diminishes for larger β). The profitability under PAYW-SP, however, is not affected by a change in disadvantageous inequity aversion β. Therefore, PAYW-SP becomes optimal at the expense of PAAP for large β and small c.

An example from practice for the use of PAYW-SP in such a low generosity, low share of less fair-minded consumers' set-up might be a self-cutting flower field where sellers often suffer from consumers' underpayment (Schlüter and Vollan 2015). PAYW sellers typically set a suggested price in these cases. Furthermore, disadvantageous inequity aversion is probably very high, as consumers who cut the flowers by themselves might not accept 'unfair' (and given) prices making PAAP less profitable than PAYW-SP.

5.2.3.2 Result 3b (intermediate generosity: $1/(2+\beta) < \lambda \leq 2(1+m)/3$) As outlined in Fig. 4 and proven in Online Resource E the dominance of PAYW-SP over PAAP continues (for intermediate λ, small ω). Meanwhile, Rows 1–2 and 9–10 of Table 2 demonstrate the dominance of PAYW-MP over PAAP. At the same time, the domains of $\pi^*_{PAYW-MP}$ and of $\pi^*_{PAYW-SP}$ might overlap which requires a more detailed investigation provided in Online Resource E (threshold (function) $\lambda(\omega) < \lambda_<^+$ for which PAYW-SP might dominate PAYW-MP).

When there are few less fair-minded consumers, ω, the firm can obtain higher prices from more fair-minded consumers while also deterring some potential freeloaders by the suggested price. As soon as the share of less fair-minded consumers, ω, increases, the firm should decide for excluding all freeloaders and extracting higher payments from more fair-minded consumers by implementing PAYW-MP. In addition, increasing generosity levels make the price suggestion obsolete as the perceived fair price is high already and allows the firm to charge a profitable minimum price without triggering disadvantageous inequity aversion on the consumer side.

In practice, this situation corresponds to restaurants and bars that let the consumer decide the price for their meals and drinks. In generous markets where the share of potential freeloaders is low, we typically observe PAYW-SP (e.g. Die Weinerei, a restaurant which is located in a privileged area of Berlin), while for markets with higher levels of potential freeloaders we observe PAYW-MP (e.g. Weine und Geflügel, a restaurant which is located in a less privileged neighborhood in Berlin).

5.2.3.3 Result 3c (generosity λ is high: $\lambda > 2(1+m)/3$) The dominance of PAYW-MP over PAAP continues and in addition, the upper bound for $\pi^*_{PAYW-SP}$, $((1-\omega)(1-c)^2/4)$, is smaller than the lower bound for $\pi^*_{PAYW-MP}$, $((1-c)^2/(2(1+\omega)))$—compare Table 2 Row 8, Column $\lambda = 1$ vs. Row 10, Column $\lambda = 2/3$. Thus, PAYW-MP is the preferred choice in this case.

This is in line with several fundraising campaigns: donors are typically very generous; the seller sets a minimum price, but buyers often still largely overpay. For instance, some private schools operate on a solidarity pricing scheme, similar to PAYW. Generosity and the community spirit are high, and parents must pay a minimum fee but are asked to pay more if they can afford it.

5.2.4 Result 4 (Focus on $\overline{\gamma}_{[0,1]}$ and z)

The mean of advantageous inequity aversion of less fair-minded consumers, $\overline{\gamma}_{[0,1]}$, only effects PAYW-SP; that is, an increasing $\overline{\gamma}_{[0,1]}$ increases profits (cf. Eq. (B5)). Therefore, PAYW-SP might dominate at the expense of PAAP and PAYW-MP for large $\overline{\gamma}_{[0,1]}$. Obviously, there is also some interdependency between ω and $\overline{\gamma}_{[0,1]}$: a large $\overline{\gamma}_{[0,1]}$ diminishes losses due to large values of ω.[16] Jung et al. (2017) report an example of such behavior. In a field experiment, the authors sold reusable grocery bags and doughnuts under PAYW with or without a charitable component added to the PAYW pricing system. As a consequence, freeloading became more despicable when parts of the revenues were donated to charity. Thus, when a donation is present, even less fair-minded consumers may experience some advantageous inequity aversion. In fact, the purchase rate decreased in the presence (vs. absence) of a charitable component because some consumers abstained from freeloading.

With increasing z, that is when more consumers ignore the suggested price and, thus, the segment of PAYW consumers increases, PAAP and PAYW-MP dominate at the expense of PAYW-SP (see Fig. 4). This result is intuitively appealing because only PAYW-SP is affected by this probability z.[17] As an example from practice, we refer to the Metropolitan Museum of Art in New York. This institution switched from PAYW-SP to PAAP because the number of visitors who paid the suggested price declined by 73 percent over a 13-year span (Weiss 2018).

5.2.5 Summary

Whereas PAYW is never the preferred pricing policy, PAAP, PAYW-SP or PAYW-MP might be optimal, mainly depending on different levels of generosity (see Online Resource E for details):

(i) Low levels of generosity ($0 \leq \lambda \leq 1/(2+\beta)$)[18]:

[16] A more detailed analysis for different levels of $\overline{\gamma}_{[0,1]}$ is available upon request from the authors.

[17] A more detailed analysis for different levels of z is available upon request from the authors.

[18] Equation (E.1 in Online Resource E) specifies $\lambda^+_>$.

PAAP is optimal, if there exists no feasible solution for $\lambda^+_>$ or if $\lambda \leq \lambda^+_>$;
PAYW-SP is optimal, if there exists a feasible solution for $\lambda^+_>$ and if $\lambda > \lambda^+_>$

(ii) Intermediate levels of generosity $(1/(2+\beta) < \lambda \leq 2(1+m)/3)$[19]:

PAYW-MP is optimal, if there exists no feasible solution for $\lambda^+_<$ or if $\lambda \geq \lambda^+_<$;
PAYW-SP is optimal, if there exists a feasible solution for $\lambda^+_<$ and if $\lambda < \lambda^+_<$.

(iii) High levels of generosity $(2(1+m)/3 < \lambda \leq 1)$: PAYW-MP is optimal.

5.3 The parameter range in PAYW pricing: Measurement and empirically observed parameter ranges

In the analysis of the PAYW model, we used a substantial number of parameters to determine the optimal pricing scheme. This raises two important questions: (1) How can a seller assess the parameters for their market? (2) What are the likely ranges of parameters for which PAYW pricing schemes are profitable? This is especially important as not every combination of parameters is equally likely. In practice, the dominance of the PAAP scheme indicates that some combinations of parameters are more prevalent than others.

To answer these two questions, we borrow approaches from consumer behavior and behavioral economics. Table 3 offers some suggestions for how to measure these parameters and provides an overview from empirical studies of the observed ranges of the parameters for making PAYW profitable (in addition, Online Resource G.5 provides four real-world cases): utility (r), generosity (λ), disadvantageous inequity aversion (β), advantageous inequity aversion (γ , $\overline{\gamma}_{[0,1]}$, ω), and the consumer's susceptibility to the price suggestion (z). Online Resource F offers a detailed explanation of these suggestions.

If a direct measurement of parameters at consumer level is not feasible, sellers could use a trial phase for PAYW to estimate the parameters or use heuristics to approximate the price-response function (Gahler and Hruschka 2023).

6 Discussion and conclusion

The present research aimed to model PAYW pricing by taking a realistic view of freeloading behavior and setting an upper boundary on the suggested price. This work serves as a substantial extension of the paper of CKZ.[20] From a conceptual point of view, we identified two types of consumer segments that have been neglected so far.

[19] Equation (E.2 in Online Resource E) specifies $\lambda^+_<$.

[20] For a detailed comparison of our results and those of CKZ, see Online Resource G.

Table 3 Suggestions for the measurement of model parameters and empirically observed values

Suggestions for measurement	Range observed in the literature
1. Consumption utility r	
Apply procedures similar to the measurement of *willingness to pay* (e.g. lotteries)	Broad range observed
2. Generosity λ	
Start with the measurement of the fair price p_f. Subjects evaluate a list of prices according to response categories "not fair for the buyer", "not fair for the seller", and "fair for both sides" (adapted *Guttman scale*) Determine λ by solving Eq. (2a) for λ ($\lambda = \left(p_f - c\right)/(r - c)$ based on p_f, costs c are known, r has been determined in Step 1)	Jang and Chu (2012) find great differences Tentatively: $0.2 \leq \lambda \leq 0.7$
3. Disadvantageous inequity aversion β	
Apply a series of adopted *ultimatum games*. Subjects evaluate various prices p_β for the good under consideration ($p_f \leq p_\beta \leq r$) and must make a "take it or leave it" decision. Determine lower bound for β by solving Eq. (1d) for β ($\beta \leq \left(r - p_\beta\right)/\left(p_\beta - p_f\right)$, and r, p_f have been determined in Steps 1, 2)	No directly comparable measure is available, Eckel and Gintis (2010) find $0.31 \leq \beta \leq 1.89$
4a. Advantageous inequity aversion γ	
Apply a series of adopted *dictator games*. Subjects evaluate various consumption utilities r_γ for the good under consideration (r_γ is framed as a *gross* consumption utility and systematically varied, i.e. there are taxes/discounts which increase or decrease the consumption utility) and need to choose between "freeloading", "paying a fair price p_f", "abstaining" Determine the lower bound for γ by solving Eq. (1c) for ($\gamma \leq r_\gamma/c$)	No directly comparable measure is available as behavioral economics restrict γ: $0 \leq \gamma \leq 1$ Eckel and Gintis (2010) find $\gamma < \beta$
4b. Advantageous inequity aversion $\overline{\gamma}_{[0,1]}$	
Average of individual estimates for γ (from Step 4a) if $\gamma \leq 1$	Eckel and Gintis (2010) find large differences $0.12 \leq \overline{\gamma}_{[0,1]} \leq 0.80$
4c. Advantageous inequity aversion ω	
Share of subjects with $\gamma \leq 1$ (from Step 4a)	Reports on $0 \leq \omega \leq 0.97$
5. Consumer's susceptibility to the suggested price (z)	
Directly ask subjects	Reports cover a broad range $0.25 \leq z \leq 1$

First, there are customers who are not very advantageously inequity averse but still do not freeload when a seller offers participatory pricing, because they perceive the corresponding consumption utility as insufficient, as pointed out by Akbari and Wagner (2022). For the PAYW seller, the existence of such a segment will decrease his costs (see Online Resource G.1). In addition, this behavior is also relevant under PAYW-SP because a higher suggested price (partially) discourages consumers from freeloading (see Online Resource G.2). Therefore, PAYW and PAYW-SP are more profitable than previously assumed.

Second, there are buyers who are characterized by substantial disadvantageous inequity aversion. Neglecting them would result in an unwarranted overestimation of PAYW-MP as the minimum price might screen out otherwise paying consumers (see Online Resource G.3). These findings add behavioral realism to the PAYW model. Such people are also present in the field. Neglecting their existence not only oversimplifies consumer behavior in PAYW but also leads to an erroneous assessment of the profitability of (variants of) PAYW.

Modelling PAYW pricing with Fehr-Schmidt-preferences results in a more sophisticated picture of consumption behavior than previously thought. In our effort to be more concise and extensive, we uncover different consumer segments and sub-cases that have so far been masked. The effects of this adjustment are substantial. A numerical investigation of the discrepancies between CKZ's model and the revised model identified percentage errors of about 20 percent for PAYW and PAYW-MP and about 30 percent for PAYW-SP. Furthermore, CKZ's deviations would lead to an erroneous choice of pricing policy in about 20 percent of the cases (see Online Resource G.4).

From a managerial perspective, guidelines for optimal minimum and suggested prices are updated, and conditions for the optimal participating pricing policy have been sharpened. With respect to the suggested price, we find that the seller can deter less fair-minded consumers from entering the market by setting a high suggested price. Thus, when less fair-minded consumers are numerous, care moderately for advantageous inequity aversion, and costs are high, the seller should set the highest fair price as the price suggestion. Moreover, also in other cases, setting a higher suggested price deters less fair-minded consumers from entering and is beneficial for the seller. In addition, we restrict the upper bound of the suggested price to the highest possible fair price. This assumption limits the suggested price to an acceptable range, a crucial condition for an effective suggested price (Jung et al. 2016).

With respect to the minimum price, the consideration of disadvantageous inequity aversion suggests that the seller needs to charge the highest fair price when generosity is low. However, when generosity is high, he needs to charge a lower minimum price, allowing more fair-minded consumers to enter the market.

When choosing the optimal pricing scheme, PAYW-MP and PAYW-SP are more effective than previously determined. We observe that increasing disadvantageous inequity aversion, on the one hand, leads to the choice of PAYW-MP over PAAP and, on the other hand, to PAYW-SP over PAYW-MP and PAAP.

Furthermore, we provide an interactive online tool to determine profits for the different pricing schemes conditional on parameter values specified by the user. We also offer suggestions on the measurement of the model parameters allowing practitioners to use the model in the field.

Taken together, these results suggest that modeling PAYW is more complex than previously assumed. However, the findings also become more realistic and explain some of the contradictory empirical observations regarding the profitability of PAYW.

The generalizability of these results is subject to certain limitations. The present model only considers one-time purchases and constrains consumers to buy one unit. Factors like repeated buying, varying quantities, diverse quality levels, and multiple products may impact consumer preferences and optimal pricing choices. Furthermore, different distributions of consumption utility and interdependencies between parameters could be further studied (e.g. the proportion of consumers that accept the suggested price could depend on the value of the suggested price). These considerations present intriguing opportunities for further investigation.

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