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Pay What You Like

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Pay What You Like

Abstract. We show that when a seller of a differentiated good offers the product allowing consumers an option to pay what they like, then all consumers will never free ride in equilibrium when their valuations of the good are positive, and, under certain conditions, all *will* consumers would pay. Further, for the seller this pricing could be more profitable than uniform pricing. If consumers consider the social cost of free riding, or not paying a "fair" price, then our results show that consumers, rather than free riding, may not opt for this option. Instead, they prefer to purchase the good at the market price from a price-setting firm.
Keywords*:* pay-what-you-like pricing*,* self-selection, multidimensional screening, buffet pricing.

1 Introduction

Pay-what-you-like pricing is a quite unusual strategy where consumers can pay what they like, including zero, for a product the firm sells. The firm cannot refuse the price paid by the consumer. We provide a theoretical model of consumer behavior under this pricing to explain: how much consumers are willing to contribute; and, when this type of pricing becomes profitable for the firm? Our model shows that all consumers free riding is *never* an equilibrium when the product provides a positive value; and, under certain conditions, this pricing provides a larger profit than uniform pricing.

Historically, pay-what-you-like (PWYL) pricing has existed in other countries, especially for certain types of services. In most Indian villages, the village priest accepts whatever the host pays for many ceremonies he performs such as naming a newborn, performing a marriage, or other religious services, a tradition that still continues. Doctors in rural India are still paid based on how much a patient can afford. In the United States, it is common place to observe church parishioners practicing PWYL pricing when providing contributions (donations) to the church in support of the services/programs offered by the church.

More recently, PWYL pricing has been used by providers of services such as entertainment, media, and restaurants. The band *Radiohead* offered the download of their album, *In Rainbows* to consumers with a pay-what-you-like option. Between October 1-29, 2007, 1.2 million people worldwide visited the website and among those who downloaded the album, 38 percent worldwide and 40 percent in the U.S., *willingly* paid. Free-riders were as prevalent in the U.S. as in the rest of the world, but in the U.S. a paying customer paid $8.05 compared to $4.64 paid by his international counterpart.[1] Following *Radiohead*, the publisher of *PASTE* magazine also adopted the same policy where subscribers can pay what they like for a year's subscription of the magazine. In 2005, the *New Yorker* magazine reported that a restaurant, *Babu*, in the Village, a quite popular place for both the visitors and the residents of New

[1] See http://www.inrainbows.com; and http://comscore.com/press/release.asp?press=1883; and the Wall Street Journal, October 3, 2007, p.C14.

York City, where for some time the menu was without any price—after finishing their meals consumers paid what they liked.[2] What turned out to be interesting was that most consumers did pay, and some paid considerably more than what the owner had expected, but there were also a few cases of *free riders*.[3] Eventually, the owner did switch to a menu with listed prices. On the other hand, a small (maximum capacity of about 10 people) and exclusive Japanese restaurant, *Mon Cheri*, in an expensive area of Fukuoka City, Japan, has consistently maintained the PWYL pricing for dinners, since 1979. A small and intimate environment of this restaurant with personal interactions has attracted many loyal patrons over a long period of time. Perhaps, these two factors are reasons for the sustained use of this form of pricing practice.[4]

Most recently, Kim, Natter and Spann (2009) in a first empirical study provide evidence on PWYL pricing. Based on three field studies in Germany, the authors report several interesting findings about consumers' responses to this form of pricing, when three different sellers offered three different products for sale and consumers

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[2] See Rebecca Mead, the *New Yorker*, March 21, 2005, for other details. Cabral (2000, p.185) also mentions a restaurant in London that does not list prices in the menu; and each customer is asked to pay what he or she thinks the meal was worth. Recently, many cafes and restaurant in the US have also adopted this practice.

[3] As reported by Kim et al., Lynn (1990) argues that some customers in a restaurant pay more to avoid the impression of looking cheap.

[4] The restaurant owner in the field study also decided to keep this PWYL format in the long run because of positive feedback from the guests (see Kim et al. p.55).

could choose any price they like to pay, *including zero.* Although there was a wide distribution of payments by consumers, surprisingly no one did free ride—*all* consumers paid a positive price. Based on the study, the authors conclude that a consumer's willingness to pay depends mainly on two factors: (i) an internal reference price for each consumer; and (ii) a proportion of consumer surplus a consumer is willing to share with the seller. Based on the estimation results, the authors conclude that the final prices paid were influenced by (a) fairness, (b) satisfaction, (c) market price awareness, and (d) net income (p. 53).

In economic literature such pricing strategies are analyzed as problems of multi-dimensional screening where information about willingness to pay is asymmetric [see a comprehensive most recent review by Rochet and Stole (2003)]. From screening considerations, PWYL pricing and *buffet pricing* (or flat-fee pricing), represent two polar extremes. In PWYL, the buyer decides how much to pay for a given quantity. The opposite is the case in buffet pricing, where the buyer decides how much to consume for a given fixed fee.[5] Under *buffet pricing*, in spite of consumers having an option of unlimited amount of consumption, they do consume only a finite amount. Similarly, under PWYL pricing, even with a free-ride option, not all buyers free ride, as was the case with the *Radiohead* offer, and all consumers paid in

[5] See Nahata, Ostaszewski and Sahoo (1999) and Sundararajan (2004) for other examples and profitability comparison with other linear and nonlinear usage-based pricing strategies.

the above mentioned field study. Indeed, in both types of pricing consumers freely self-select—quantity consumed in buffet pricing and the payment in PWYL option.

Two questions, most relevant for both theoretical and empirical analyses of PWYL pricing are: What motivates consumers to pay when they have an option to free ride?[6] And, recognizing the possibility that PWYL option may result in losses, what motivates the seller in offering such a pricing option?[7] We provide some answers to these questions based on a theoretical economic model.

Kim, Natter and Spann (2009) articulate quite elegantly the behavioral factors that may dissuade consumers from free-riding. Based on the literature from psychology, marketing, and experimental economics, they posit four factors affecting consumers decision to pay. The most common reason given in favor of paying, as opposed to free riding, is *social-norms*, which has also been considered as one of the reasons for tipping.[8] The other factors that may dissuade free riding are: avoiding

[6] On CNN's American Morning, John Roberts asked the question to the owner of the Java Street Cafe in Kettering Ohio, who uses PWYL pricing: what prevents a customer to either free ride or pay a very low price? The owner responded, "...When someone's at the counter and you say, you get to pay what you think is fair, very few people are going to take advantage of that situation." (CNN March 17, 2009, http://www.cnn.com/2009/US/03/017/lippert.quanda/#cnnSTCText

[7] Wall Street Journal (August 28, 2007, p. B8) reports that the motivation for the owner of Terra Bite Lounge in Kirkland, Washington for doing away with set prices was that PWYL pricing can be both profitable and charitable way of doing business. Further, "marketing buzz such a scheme generates can help stand out from the pack."

[8] Tipping for services (e.g, taxi, waiter etc.) is not considered a social norm in Japan and hence tipping is almost non-existent in Japan.

the appearance of looking cheap; fairness, reciprocity; and altruism.[9]

The main focus of this paper is to demonstrate that the traditional framework of utility maximization can provide theoretical support for most of the conclusions reached by Kim et al. by considering behavioral factors. Our main assumption is that a consumer maximizes utility over an infinite time horizon. Our simple model based on this assumption shows that not all consumers have the incentive to free ride because free-riding threatens the survival of the firm, thus making the service unavailable in future periods. This survival consideration is also mentioned in Kim et al. (p.45), but not modelled. They also note that the survival consideration for a smaller firm becomes even more important for consumers and hence, instead of free riding, they tend to pay adequately. This, assumption does have empirical support from the payments made to priests for religious services in Indian villages. If the villagers in India did not pay, the services of the priest will not be available in future periods. This survival consideration could also be the reason why the restaurant in Fukuoka, Japan has survived for the past 30 years. We also extend our basic theoretical model to include behavioral factors considered by Kim et al. and arrive at similar results.

Why should a seller use pay-what-you-like pricing? We offer three possible rea-

[9] Kim, Natter and Spann (2009) survey the literature quite extensively. To conserve space, we avoid duplication and urge the interested readers to refer to their paper and the references included.

sons. First, PWYL pricing practice results in savings because of a reduction in pricing related transactions costs. For example, when savings from reduction in transactions costs are large enough to offset the extra production cost, flat fee becomes more profitable compared to a two-part tariff. Similarly, when the cost of conducting market research to introduce a new product or setting prices for goods and services are significant (the cost of pricing is high), then the seller may let the general public provide the information about willingness to pay at the lowest cost. This is especially true for "experience" goods, such as music and culinary arts. In the case of PWYL pricing, because the cost of setting prices is zero, it results in savings from eliminating the pricing related transactions costs. Hence, PWYL pricing strategies could be more profitable than other commonly used pricing strategies, such as a uniform pricing. Second for heterogeneous consumers under most usage-based strategies, some consumers would be excluded from the market because the market price exceeds their willingness to pay. Since consumers do not compete with each other and choose how much to pay for the good or service themselves, no one would be excluded because of higher price under PWYL pricing, making potential market participation the highest. Third, for a risk-averse firm, such as small Mom-and-Pop stores, the use of uniform pricing may not guarantee a normal profit. But, we show that PWYL pricing not only guarantees positive revenue, but potentially higher profits than uniform pricing.

The rest of the paper is organized as follows. In § 2 we present our basic theoretical model using game theoretic framework. Our first proposition shows that if any consumer has a positive valuation for the good, then all consumers free-riding is not an equilibrium. In Proposition 2, we also show when paying a positive price becomes a dominant strategy. § 3 derives conditions for a for a risk-neutral firm when PWYL pricing is more profitable than uniform pricing. When risk neutrality is replaced by risk-aversion, PWYL pricing becomes even more attractive. We also derive the condition when PWYL becomes more profitable if price-setting is not costless. § 3 extends the model by including behavioral factors, namely, fairness, social norms, reference price etc. The effect of these variables is captured by introducing a "social cost" for free riding or not paying a "fair price." We show the expected result: as the social cost of free riding increases the likelihood of free riding decreases. We show that if the social cost is higher than consumer's reference price, the consumer is not likely to choose PWYL pricing and thus avoids incurring social cost by not purchasing the good from the firm. Both these results are in conformity with the empirical findings of Kim et al., and § 5 concludes.

2 Model

We begin with a simple game theoretical model based on (infinitely) repeated interactions between consumers and the firm to show that free-riding is not an equilibrium. Later we extend the model to include behavioral factors similar to those mentioned in Kim et al.

2.1 Consumers

For simplicity, assume there are only two heterogeneous consumers in the market, $N = 2$ who receive a PWYL offer from a provider of an exclusive or a highly differentiated good. Arguably the assumption of two consumers is rather restrictive, however, our results based on this simple case provides a theoretical support for many empirical results obtained by Kim et al., where several hundred consumers were followed in the survey.

The utility function of consumer i in the current period is:

$$U(v_i, p_i) = v_i - p_i \text{ for } i = 1, 2 \tag{1}$$

where v_i is consumer's valuation for the good and $p_i \geq 0$ is the price paid by consumer i, which she *self-selects*. Consumers are assumed to know both their value for the good and the other consumer's value for the good.[10] Unlike a flat-fee pricing, we assume that consumers maximize their life time utility subject to firm's survival conditional on the contributions of other consumers.[11] We assume that the firm incurs only fixed cost, F (variable costs are assumed be zero). This assumption is quite consistent with the observation by Kim et al. (p. 49), who suggest that PWYL pricing is more suited for products (e.g., in their selection: a cinema hall and a restaurant offering buffet lunch) having a large fixed cost and negligible variable cost.

The firm's fixed cost of production is unknown to the consumers, but its distribution G with support: $F \in \left[0, \overline{F}\right]$ is known and consumers have some estimate of the expected cost in mind. For computational simplicity, we adopt the following cumulative density function for the fixed cost.[12]

$$G(x) = \begin{matrix} \sqrt{\frac{x}{\overline{F}}} \text{ for } x \leq \overline{F} \\ 1 \text{ for } x > \overline{F}. \end{matrix}$$

[10] The qualitative results continue to hold when consumers are uncertain about the valuations of other consumers, but know the discrete distribution of valuations amoung the remaining consumers.

[11] Under flat fee consumers maximize their utility only during a limited time period set by the seller, for example, a lunch buffet during some set hours. In PWYL pricing the consumers value the good period after period and want the seller to continue providing the good over infinite time periods. Because of this consideration, and such considerations are stronger for small Mom-and-Pop stores, the consumers pay. If the owner is not "compensated," adequately the services they value in the future may not be available.

[12] G is assumed to have all the common properties of a CDF: $G \in [0, 1]$, $G' > 0$, and $G'' < 0$. Our qualitative results hold for other specifications also.

Because both consumers are *infinitely* lived in this game, they face the same choices each period t,

$$W_i(v, p_{it}, p_{jt}) = \max_{\{p_i\}_1^\infty} \left[\sum_{t=0}^{\infty} \beta^t \Pr(\pi_t\left(p_{it}, p_{jt}\right) > 0) U(v, p_{it+1}). \right]$$

The lifetime utility function can be represented by the following Bellman equation:

$$W_i(v, p_i, p_j) = \max_{p_i} \left[U(v, p_i) + \beta \Pr(\pi_t\left(p_i, p_j\right) > 0) W\left(v, p_i', p_j'\right) \right] \tag{2}$$

where $(')$ indicates values in the next period, $0 \leq \beta < 1$ is the discount factor, p_{jt} is the other consumer's contribution (price), and $W(\cdot)$ is an unknown value function.[13] The value function used here is similar to those used in the analysis of worker effort [see Sparks (1986)]. The probability that the firm is profitable is equal to the probability that the sum of consumer contributions is greater than the firm's fixed cost, $\Pr\left(\pi > 0\right) = \Pr\left(p_{it} + p_{jt} > F\right) = G\left(p_{it} + p_{jt}\right)$.

In this game, the consumers must choose between two potential actions: to free ride or to contribute.

[13] Given the assumptions about the discount factor, β, and the distribution of fixed cost, $G\left(\cdot\right)$, the value function satisfies the quasi-concavity constraint that allows us to find a fixed point in a functional form.

2.1.1 Free-rider

The first solution is based on the *free-rider* strategy. Equation (2) can be re-written such that $W(v, p_{it}, p_{jt}) = W(v, 0, p_{jt}) = W_i^{FR}$

$$W_i^{FR} = \frac{v_i}{1 - \beta G(p_j)}. \tag{3}$$

Note consumer i's value of free riding increases as the contributions made by the other consumer increases.

2.1.2 Consumers contribute

The second solution pertains to the situation when consumers are willing to contribute. A consumer prefers paying a positive price when $W > W^{FR}$. Given the assumption that consumers are infinitely lived, the value function, $W(\cdot)$, can now be treated as an unknown parameter. A consumer's optimal price is found by solving the following first-order condition with respect to (2):

$$\frac{\partial W}{\partial p} = -1 + \frac{\beta W}{2\overline{F}}\left(\frac{p_i + p_j}{\overline{F}}\right)^{-1/2} = 0 \Longrightarrow p_i = \overline{F}\left(\frac{\beta W}{2\overline{F}}\right)^2 - p_j. \tag{4}$$

The marginal cost of contributing is -1, while the marginal benefit is $\frac{\beta W}{2\overline{F}}\left(\frac{p_i+p_j}{\overline{F}}\right)^{-1/2}$. A consumer is willing to contribute \$1 to the survival of the firm as long as the present discounted future return in the form of utility flows is greater than \$1. Note, the equilibrium price p_i increases with both W and β, but decreases as fixed cost $\overline{F}$ increases. The value function, W represents future utility flows. Therefore, a consumer should be more willing to contribute as her valuation increases. The discount factor, β, captures a consumers trade-off between consumption today and consumption in future periods. As the discount factor increases the cost of waiting decreases and consumers are more willing to invest in the firm's survival. As $\overline{F}$ increases the firm's survival probability decreases thereby decreasing the returns of consumer contributions; ceteris paribus.

The value function is solved by first solving for price from the first order condition and substituting this result into equation (2). The value function is dependent on the level of contributions made by other consumers in the following manner

$$W(v_i, p_j) = 2\lambda[1 - \sqrt{1 - (p_j + v_i)/\lambda}], \tag{5}$$

where $\lambda = \frac{\overline{F}}{\beta^2}$ is a constant capturing the contribution that maximizes the free rider's utility.[14] The valuation function is increasing in both the valuation of the good and the contributions made by the other consumers. The reaction function in price is

[14] Details of derivation of this and all subsequent expressions are available from authors upon request.

found by substituting (5) into (4)

$$p_i\left(p_j\right)=\lambda\left(1-\sqrt{1-\left(p_j+v_i\right)/\lambda}\right)^2-p_j, \tag{6}$$

which is increasing in the valuation of the good and decreasing in the amount contributed by other consumers. Consumer contributions are viewed as strategic substitutes when $\frac{(p_j+v_i)}{\lambda}<\frac{3}{4}$ and strategic compliments when $\frac{(p_j+v_i)}{\lambda}>\frac{3}{4}$. The amount contributed by consumer i when consumer j free rides is $p_i(0)=\lambda\left(1-\sqrt{1-v_i/\lambda}\right)^2$. Under the PWYL option, the most a consumer is willing to pay is $\overline{F}$ — the amount that insures firm's survival. Any larger amount only increases the expected profits but does not increase the survival probability of the firm.

2.2 Equilibria

In this section we characterize all price equilibria. Let $v_i>v_j$. There are four cases to consider: (i) neither consumer contributes; (ii) consumer i contributes and consumer j free rides; (iii) consumer j contributes and consumer i free rides; or (iv) both consumers contribute.

All Free Ride. When neither consumer contributes, the product is only offered in the first period and each consumer receives the single-period value of the good, $W_i^{FR}=v_i$ and $W_j^{FR}=v_j$.

Proposition 1. *For two heterogeneous consumers case, if for at least one consumer the valuation v is greater than zero, then free riding is never an equilibrium.*

Proof. To show that free riding is not optimal for both consumers, it is sufficient to show that at least one consumer is willing to contribute ($p_i > 0$) when the other free rides. If consumer j is a free rider, then consumer i maximizes her utility by choosing $\max\left[\, W\left(v_i, 0\right), v_i\right]$. Given these conditions, we solve for the level of v_i such that consumer i contributes a positive price

$$\begin{aligned} W\left(v_i, 0\right) &> v_i \Longrightarrow 2\lambda\left(1-\sqrt{1-v_i/\lambda}\right) > v_i \\ &\Longrightarrow \left(\tfrac{v_i}{2\lambda}\right)^2 > 0. \end{aligned}$$

Since v is non-negative, and $\lambda > 0$ by construction, $\left(\frac{v_i}{2\lambda}\right)^2 > 0$ is always true. The intuition behind this result stems form a simple investment model. A consumer is willing to invest in a bond when the present discount value of the bond's payout is greater than the initial investment. In the "pay-what-you-like" case, a consumer is willing to contribute to the firm if the discounted present value of future utility flows exceeds the initial contribution amount.

One or both consumers contribute

There are three possibilities to consider.

Consumer i contributing and j free riding. For this case, consumer i pays $p_i =$

$\lambda\left(1-\sqrt{1-v_i/\lambda}\right)^2$ and receives utility $W\left(v_i,0\right)=2\lambda\left(1-\sqrt{1-v_i/\lambda}\right)$. Consumer j free rides and gets utility equal to

$$W^{FR}\left(v_j,v_i\right)=\frac{v_j}{\sqrt{1-v_i/\lambda}}. \tag{7}$$

Note, the free-rider amount is increasing in both consumer j's value v_j, and consumer i's value, v_i.

Consumer j contributing and i free riding. This case is symmetric to the case above, so the utility derived in this case for each consumer is found by switching v_i and v_j in the contribution value function, $W\left(v_j,0\right)$, and the *free-rider* value function, $W^{FR}\left(v_i,v_j\right)$.

Both contributing. The Nash equilibrium to equation (6) gives the equilibrium contribution amounts. The intersection of the reaction functions gives the following closed form solution

$$p_i=\min\left[\max\left[0,\frac{\lambda[4+3(v_i-2v_j)/\lambda-2\sqrt{4-3(v_i+v_j)/\lambda}]}{9}\right],\overline{F}\right] \tag{8}$$

where the equilibrium price p_i increases both in the valuation of the good v_i, and λ. The difference in contribution amounts is exactly equal to the difference in the valuations of the good, $p_i-p_j=v_i-v_j$. Consumer i's value function for contributing equals

$$W^*(v_i, v_j) = \frac{2\lambda[1-\sqrt{5-3(v_i+v_j)/\lambda-2\sqrt{4-3(v_i+v_j)/\lambda}}]}{3}. \tag{9}$$

Note, both consumers receive the same amount of utility, but consumer i contributes more towards the good than consumer j.

The normal-form game below summarizes the utilities under each case.

	consumer j	
consumer i	$p_j > 0$	$p_j = 0$
$p_i > 0$	$W^*(v_i, v_j), W^*(v_j, v_i)$	$W(v_i, 0), W^{FR}(v_j, v_i)$
$p_i = 0$	$W^{FR}(v_i, v_j), W(v_j, 0)$	v_i, v_j

The equilibrium outcome is dependent on both the relative difference in consumer valuations, $\Delta v = v_i - v_j$, and the magnitude of each individual value v.

Proposition 2 states the necessary bounds on a consumer's value, v when one or both consumers contributing is an equilibrium.

Proposition 2. *If a consumer's value, v_i is greater than $\overline{v}_i = -4\lambda\left(1 - v_j/\lambda - \sqrt{1 - v_j/\lambda}\right)$ then an equilibrium in pure strategies exists such that : (i) $[v_i > \overline{v}_i, v_j < \overline{v}_j]$, consumer i has a dominant strategy to contribute and consumer j free-rides; (ii) $[v_i < \overline{v}_i, v_j > \overline{v}_j]$, consumer j has a dominant strategy to contribute and consumer i free-rides; (iii) $[v_i > \overline{v}_i, v_j > \overline{v}_j]$, both consumers contribute; and (iv) $[v_i < \overline{v}_i, v_j < \overline{v}_j]$, a mix-strategy equilibrium ex-*

ists.

Proof. Consider the case where both consumers contribute versus consumer i free riding, $W(v_i, p_j) > W^{FR}(v_i, v_j)$. Note, $W(v_i, p_j) > W(v_i, 0)$ because the likelihood of the firm surviving in the next period increases with contributions made by consumer j holding contributions made by consumer i constant. Therefore, it is sufficient to show that for some v_i consumer i prefers to contribute and have consumer j free ride than vice-versa $W(v_i, 0) > W^{FR}(v_i, v_j)$. This condition holds when

$$v_i > -4\lambda\left(1 - v_j/\lambda - \sqrt{1 - v_j/\lambda}\right) = \overline{v}_i(v_j)$$

and contributing becomes a dominant strategy for consumer i. At first, this result may appear puzzling as to why one person would prefer to pay and have the other consumer free ride than visa versa. Consider two people enjoying a meal at a restaurant. If the low-value consumer contributes, she would make a contribution level that may not maximize the utility of high-value person even with the high person free riding. The lower contribution decreases the likelihood of survival of the firm thereby decreasing the high value consumer's free riding utility. In these cases, the high-value consumer may consider choosing to pay for the meal and allow the low-value consumer to free ride. Both parties are made better off in this situation leading to a Pareto-improvement and the firm receives more revenue.

The functions $\overline{v}_i(v_j)$ and $\overline{v}_j(v_i)$ provide bounds on consumers' action set. Consumer i has a dominant strategy to contribute a positive price when her value is greater than $\overline{v}_i(v_j)$. The functions $\overline{v}_i$ and $\overline{v}_j$ intersect at $(0,0)$, $\left(\frac{24}{25}\lambda, \frac{16}{25}\lambda\right)$, $\left(\frac{16}{25}\lambda, \frac{24}{25}\lambda\right)$, and $\left(\frac{8}{9}\lambda, \frac{8}{9}\lambda\right)$. These points of intersection provide the necessary bounds of consumer values, satisfying each of the four possible cases.

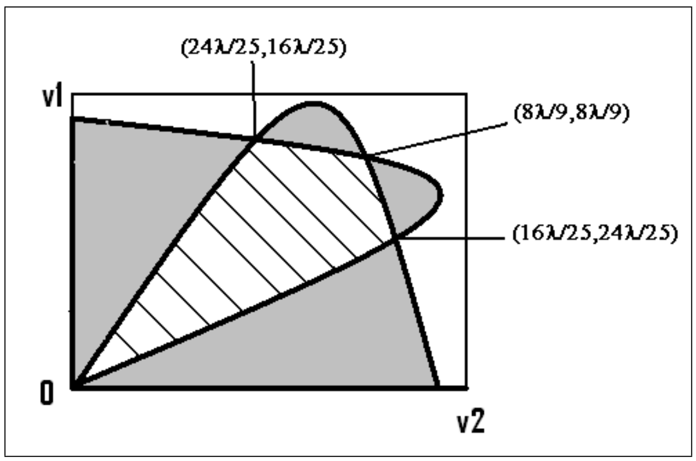

Figure 1: Three Possible Equilibria

The white area represents the values of (v_i, v_j) where both consumers contribute. The gray area represents the area where one players has a dominant strategy to contribute. The hatched area represents the values of (v_i, v_j) where neither player has a dominant strategy, but a mix strategy exists. Let σ_i be the probability consumer i contributes. The mixed strategy equilibrium for consumer i, σ_i, is given by the equation (10).[15]

$$\sigma_i = \frac{W(v_j, 0) - v_j}{W^{FR}(v_j, v_i) - W(v_j, v_i) + W(v_j, 0) - v_j}. \tag{10}$$

In reference to Figure 1, consumer heterogeneity in values plays an important role in determining "who contributes." As consumers become more alike, i.e., v_i is closer to v_j, it is more likely to observe consumers randomly choosing when to contribute following the mixed strategy outcome. As consumers become more heterogenous, v_i is farther from v_j, it becomes more likely that one consumer always pays and the other always free rides.

3 Profit

This section compares the profitability of PWYL pricing with uniform pricing, thus extending the empirical analysis of Kim et al. by evaluating profit incentive for PWYL option. Although what happens to profits was not the focus of their field study, the owner of the delicatessen inferred a positive impact on profits under PWYL. Our results provides support to the inference made by the owner.

Assume consumers' values are drawn from a uniform distribution with the support

[15] Consumer j's mixed strategy is symmetric to consumer i's strategy and by symmetry we can write, $\sigma_j = \frac{W(v_i,0)-v_i}{W^{FR}(v_i,v_j)-W(v_i,p_j)+W(v_i,0)-v_i}$

$[0, \overline{v}]$. For a risk-neutral firm, the optimal uniform price per consumer is $\frac{\overline{v}}{2}$ and the total expected profit $\pi^u = \frac{\overline{v}}{2} - F$, where F is the fixed cost. Under PWYL option, the minimum revenue the firm receives is:

$$p_i = \left\{ \begin{array}{c|c} \lambda \left[1 - \sqrt{1 - v_i/\lambda}\right]^2 & \text{for } v_i \leq \frac{\overline{F}(2-\beta)}{\beta} \\ \overline{F} & \text{for } v_i > \frac{\overline{F}(2-\beta)}{\beta} \end{array} \right\}, \tag{11}$$

because free riding for both players is never an equilibrium (Proposition 1) and consumers are not willing to pay more than $\overline{F}$ when their valuation $v_i > \frac{\overline{F}(2-\beta)}{\beta} = \widehat{v}$. Thus, the firm is guaranteed a positive revenue when $v_i > 0$ and the profit is

$$\pi^{PWYL} = \min \left[\overline{F}, \lambda \left[1 - \sqrt{1 - v_i/\lambda}\right]^2 \right] - F. \tag{12}$$

From the two profit functions one can determine when $\pi^{PWYL} > \pi^u$.

Consider when one consumer values the product by more than $\widehat{v}$, i.e., $\overline{v} > v_i > \widehat{v} > \frac{\overline{v}}{2}$. For this case, not only is PWYL more profitable, but the firm earns at least normal profit, $\pi^{PWYL} = \overline{F} - F \geq 0$.

Next consider the case when a single consumer cannot guarantee a positive profit, $\overline{v} > \widehat{v} > v_i$. In this case, PWYL pricing provides higher expected profits, $\pi^{PWYL} > \pi^u$, when $\lambda \left[1 - \sqrt{1 - v_i/\lambda}\right]^2 > \frac{\overline{v}}{2}$ $\left(\text{or } v_i > -\frac{\overline{v}}{2} + \sqrt{2\overline{v}\lambda}\right)$. The probability of this event is $\Pr\left(v_i > -\frac{\overline{v}}{2} + \sqrt{2\overline{v}\lambda}\right) = \max\left[\frac{3}{2} - \sqrt{\frac{2\lambda}{\overline{v}}}, 0\right]$ and is greater than zero when

$\overline{v} \geq \frac{8}{9}\lambda$. This is a lower bound that assumes only one consumer pays. The probability will increase when both consumers contribute.

3.1 Price-setting not costless

So far, it is assumed that the cost of setting price by the firm is zero. However, Wernerfelt (2008) questions this commonly held assumption in most economic models that the act of price setting is costless and makes persuasive arguments in support of price-setting being costly. In reality, price-setting incurs various types of costs , for example, costs related to collecting information about a consumer's willingness to pay through market research. Let m be the associated cost of all transactions related to setting a particular price. When a seller uses PWYL pricing, the seller's cost of price setting is zero or negligible because consumers set prices for themselves. Again, PWYL pricing results in higher expected profits when $\pi^{PWYL} > \pi^u - m$. Therefore one would expect profits under PWYL pricing to be higher when consumer's valuation $v_i > \lambda\sqrt{\frac{\overline{v}}{2\lambda} - \frac{m}{\lambda}}\left(2 - \sqrt{\frac{\overline{v}}{2\lambda} - \frac{m}{\lambda}}\right) = \underline{v}$. Further, the lower bound on consumer valuation $\underline{v}$ decreases as the cost of pricing increases, $\frac{\partial \underline{v}}{\partial m} < 0$. Intuitively, this suggests that PWYL pricing becomes more attractive as the transaction cost associated with pricing increases.

A second probable reason for higher profits may be due to risk aversion. Under uniform pricing, there exists a positive probability that the firm does not receive any revenue. A risk averse firm (e.g., Mom-and-Pop stores) would be more likely to set a price below $\frac{\overline{v}}{2}$ to reduce the probability of not receiving any revenue. Under PWYL pricing, the firm is insured a positive revenue as long as $v > 0$. Therefore, if the commonly used assumption of risk neutrality is replaced with the assumption of risk aversion, then PWYL pricing becomes even more attractive to smaller firms than facing a gamble under uniform pricing.

4 Fairness, Social Cost and Reference Price

One would expect, and Kim et al. provide empirical support, that reference prices affect how much a consumer would pay, when she pays. We introduce a reference price in our model by considering two firms: Firm 1 sets the market (reference) price that a consumer is familiar with; and Firm 2 uses PWYL pricing.[16] The two firms are located at the two endpoints of a linear city and each consumer is familiar with both firms.[17] A consumer may choose to purchase the good from either firm or decide

[16] We consider the reference price to be the same as market equilibrium price, however we recognize that the reference price could vary for each consumer depending on factors such as location, information etc. We allow the variation in the reference prices by considering the difference between P_r and P_i .

[17] This framework is similar to Hotelling's model for analyzing horizontal differentiation. This also allows us to capture the role of exclusiveness of the product, or other forms of differentiation.

not to consume the good at all. If a consumer chooses not to consume her utility is zero. Otherwise, consumer i's utility function depends on the firm from which she purchases the good. If she purchases the good from the price setting firm, then her utility function is

$$U_{i1} = v - tx_i^2 - P_r \tag{13}$$

where v is her valuation of the good, t is the per unit transportation cost, x is the consumers current location on the linear city, and P_r is the reference or the market price.

For the firm using PWYL pricing, in addition to a reference price, behavioral factors such as "guilt-feeling" from breaking with social norms, fairness, looking cheap etc., are also included. These behavioral factors are similar to those mentioned by Kim et al. We capture the effect of these behavioral factors by introducing a catch all social cost parameter α. Now, a consumer's utility under PWYL pricing is a function of the reference price, P_r, and the social cost parameter α, such that

$$U_{iPWYL} = \underbrace{v - t\left(1 - x_i\right)^2 - p_i}_{\text{Consumer Surplus}} - \underbrace{\alpha\left[\frac{P_r - p_i}{P_r}\right]}_{\text{Social cost}}, \tag{14}$$

where $L\left(\alpha, P_r, p_i\right) = \alpha\left[\frac{P_r - p_i}{P_r}\right]$ is a function capturing the degree of social cost of not paying a fair price.[18] Note, when the price p_i is equal to the reference price, P_r, the good is purchased *guilt* free or without incurring any social cost. When a consumer free-rides, $p_i = 0$, she incurs the highest social cost α

Consumer i prefers PWYL pricing when $U_{iPWYL} - U_{i1} > 0$ or the consumer's relative utility is given by

$$U(P_r, p_i) = P_r - p_i - t(1 - 2x_i) - \alpha \left[\frac{P_r - p_i}{P_r} \right], \tag{15}$$

where the single period consumer surplus of free riding is $U(P_r, 0) = P_r - t(1 - 2x_i) - \alpha$.

As in the previous section, consumer behavior is determined by a dynamic model based on contributions by the consumers together with the consideration of firm's survival. The following two period Bellman equation summarizes the dynamic model.

$$W(P_r, p_i, p_j) = U(P_r, p_i) + \beta \left(\frac{p_i + p_j}{F} \right)^{1/2} W\left(P'_r, p'_i, p'_j\right), \tag{16}$$

Two equilibria when consumers contribute are derived. The first equilibrium is the free rider outcome. In this case, consumer i's contribution is set to zero, $p_i = 0$.

[18] This function can be interpreted as an index of social cost similar to the Lerner Index of monopoly power.

The value function reduces to an geometric series having the well know solution

$$W^{FR}\left(P_r,0,p_j\right)=\frac{U(P_r,0)}{1-\beta\left(p_j/\overline{F}\right)^{1/2}}, \tag{17}$$

where $W^{FR}\left(P_r,0,p_j\right)$ is increasing in both contributions by consumer j and the discount factor β, but it is decreasing as the social cost α increases. In the absence of contributions made by consumer j, the dynamic model collapses to a one-shot static outcome of $U\left(P_r,0\right)$ and the PWYL firm fails.

The second equilibrium is an interior solution to the consumer's objective function. The first order condition with respect to consumer i's level of contribution is

$$\frac{\partial W(P_r,p_i,p_j)}{\partial p_i}=-1+\frac{\alpha}{P_r}+\frac{\beta W\left(P_r',p_i',p_j'\right)}{2F}\left(\frac{p_i+p_j}{F}\right)^{-1/2}=0$$

where the marginal cost of contributing, $1-\frac{\alpha}{P_r}$, is decreasing with the social cost, α, but increasing with respect to the reference price, and the marginal benefit of contributing to the survival of the firm is $\frac{\beta W\left(P_r',p_i',p_j'\right)}{2F}\left(\frac{p_i+p_j}{F}\right)^{-1/2}$. The optimal contribution level and value function are solved using similar methods as those previously described in the basic model. The consumer value function is equal to

$$W\left(P_r,p_i,p_j\right)=\frac{2\lambda P_r}{P_r-\alpha}\left[1-\sqrt{1-\left(\frac{P_r\left(\gamma_i-\alpha\right)}{P_r-\alpha}+p_j\right)/\lambda}\right] \tag{18}$$

where $\lambda = \overline{F}/\beta^2$ and $\gamma_i = -t(1-2x_i)$. The value function that includes fairness consideration reduces to the baseline case when $\alpha = 0$ and γ_i is interpreted the same as v_i in the previous model. Consumer i's contribution level can be expressed as a function of consumer j's contributions by substituting the optimal value function, $W(P_r, p_i, p_j)$, into equation (4.6). The reaction function in contribution levels is given by

$$p_i(p_j) = \lambda \left[1 - \sqrt{1 - \left(\frac{P_r(\gamma_i - \alpha)}{P_r - \alpha} + p_j \right) / \lambda} \right]^2 - p_j, \tag{19}$$

where contributions are strictly increasing with the reference price, $\frac{\partial p_i}{P_r} > 0$ and consumer i's relative value, γ_i. The strategic interaction between consumers is dependent on the levels of contributions. The marginal effect of an increase in the contribution made by consumer j on consumer i's contribution is

$$\frac{\partial p_i}{\partial p_j} = -2 + \frac{1}{\sqrt{1 - [p_j + P_r(\gamma_i - \alpha)/(P_r - \alpha)]/\lambda}},$$

which is positive (strategic compliments) when $p_j > \frac{3\lambda}{4} - \frac{P_r(\gamma_i - \alpha)}{P_r - \alpha}$ and negative otherwise (strategic substitutes). Contributions made by consumer j above this threshold provides an incentive to consumer i to contribute the necessary funds that insures the firm's survival. A marginal increase in the social cost of fairness, α, increases the optimal contribution if a consumer's value for the good is higher than the reference price, $\gamma_i > P_r$, else contributions decrease as the social cost increases. If consumer j does not contribute, then consumer i's optimal contribution is

$$p_i\left(0\right) = \lambda \left[1 - \sqrt{1 - \frac{P_r\left(\gamma_i - \alpha\right)}{\lambda\left(P_r - \alpha\right)}}\right]^2$$

and consumer j's free rider utility is

$$W^{FR}\left(\gamma_j, \gamma_i\right) = \frac{P_r + \gamma_j - \alpha}{\sqrt{1 - \frac{P_r(\gamma_i - \alpha)}{\lambda(P_r - \alpha)}}}$$

The reaction function for consumer j is symmetric to that of consumer i.

The Nash equilibrium in contributions is the point of intersection of the two reactions functions. At this point, the optimal contribution level for consumer i is

$$p_i = \max\left[0, \frac{\lambda[4 + \frac{3P_r}{P_r - \alpha}\left(\gamma_i - 2\gamma_j + \alpha\right)/\lambda - 2\sqrt{4 - \frac{3P_r}{P_r - \alpha}\left(\gamma_i + \gamma_j - 2\alpha\right)/\lambda}]}{9}\right]$$

and the difference in contribution levels between consumers is proportional to each consumer's value for the good, $p_i - p_j = \frac{P_r(\gamma_i - \gamma_j)}{P_r - \alpha}$. The lifetime utility of consumer i when both consumers contribute is found by replacing p_j in equation (18) with the

Nash equilibrium contributions.

$$W^*\left(\gamma_i, \gamma_j\right) = \frac{2\lambda P_r[1 - \sqrt{5 - \frac{3P_r}{P_r - \alpha}\left(\gamma_i + \gamma_j - 2\alpha\right)/\lambda - 2\sqrt{4 - \frac{3P_r}{P_r - \alpha}\left(\gamma_i + \gamma_j - 2\alpha\right)/\lambda]}}}{3(P_r - \alpha)}$$

The normal-form game in the presence of "fairness" is summarized in the table below.

	consumer j	
consumer i	$p_j > 0$	$p_j = 0$
$p_i > 0$	$W^*\left(\gamma_i, \gamma_j\right), W^*\left(\gamma_j, \gamma_i\right)$	$W\left(\gamma_i, 0\right), W^{FR}\left(\gamma_j, \gamma_i\right)$
$p_i = 0$	$W^{FR}\left(\gamma_i, \gamma_j\right), W\left(\gamma_j, 0\right)$	$P_i + \gamma_i - \alpha$, $P_i + \gamma_j - \alpha$

The equilibrium outcome is dependent on the relative difference in consumer's values, $\Delta\gamma = \gamma_i - \gamma_j$, the social cost parameter, α, and the reference price, P_r.

Proposition 3 states the necessary bounds on a consumer's relative value, γ when one or both consumers contributing is an equilibrium.

Proposition 3. *If a consumer's value, γ_i is greater than $\overline{\gamma}_i\left(\gamma_j\right)$, where$\overline{\gamma}_i\left(\gamma_j\right)$ is the value of γ_i such that $W\left(\gamma_i, 0\right) = W^{FR}\left(\gamma_i, \gamma_j\right)$, then an equilibrium in pure strategies exists such that : (i) $\left[\gamma_i > \overline{\gamma}_i, \gamma_j < \overline{\gamma}_j\right]$, consumer i has a dominant strategy to contribute and consumer j free-rides; (ii) $\left[\gamma_i < \overline{\gamma}_i, \gamma_j > \overline{\gamma}_j\right]$, consumer j has a dominant strategy to contribute and consumer i free-rides*; (*iii*) $\left[\gamma_i > \overline{\gamma}_i, \gamma_j > \overline{\gamma}_j\right]$, *both consumers contribute; and (iv)* $\left[\gamma_i < \overline{\gamma}_i, \gamma_j < \overline{\gamma}_j\right]$, *a mixed-strategy equilibrium exists. The mixed-strategy equilibrium for consumer* i, σ_i, *is given by the equation* (20)[19].

$$\sigma_i = \frac{W\left(\gamma_j, 0\right) - \left(P_r + \gamma_j - \alpha\right)}{W^{FR}\left(\gamma_j, \gamma_i\right) - W\left(\gamma_j, \gamma_i\right) + W\left(\gamma_j, 0\right) - \left(P_r + \gamma_j - \alpha\right)}. \tag{20}$$

The inclusion of social cost provides some interesting insights. First, consumers are only willing to free ride when $P_r + \gamma_i - \alpha > 0$ or $x_i > \frac{t - P_r + \alpha}{2t}$. As the lump sum social cost increases, fewer consumers are willing to free ride, but the participation constraint becomes less binding as the reference price increases. Second, consumers are only willing to contribute if and only if both $P_r > \alpha$ and $\gamma_i > \alpha$. If the social cost exceeds the products value, $\gamma_i < \alpha$, then consumers are better off by not opting for the PWYL pricing. If the reference price is less than the social cost, i.e., $P_r < \alpha$, then consumers can avoid the social cost by purchasing the good from the price-setting firm at price P_r. Only those consumers located at $\frac{t - P_r + \alpha}{2t} < x_i < \frac{t + 2\alpha}{2t}$ are willing to free ride and not contribute. The introduction of social cost could effectively price some consumers out of the market. This result parallels the traditional result where when a consumers's reservation price is lower the market price, the consumer does not enter the market. Here a reference price lower than social cost discourages the

[19] Proof is similar to other Propositions and to conserve space is not included, it is available upon request.

consumer to participate in pay-what-you-like offer.

4.1 Duopoly. Competition

We now attempt to answer the question: When could PWYL pricing be profitable? We assumed that for PWYL to work, the good should be differentiated. Most of the examples given earlier (e.g., *Radiohead*, the village priest, the exclusive restaurant in Japan etc.) support the conjecture that product differentiation plays a very important role for PWYL pricing to be profitable. Below we show the importance of the "exclusiveness" of the product.

We incorporate degree of differentiation by using a traditional duopoly model, where one firm uses Bertrand pricing and compare price (and profit) with the other firm that uses PWYL pricing. In the traditional Bertrand model with two firms located at the either end of a linear city (measuring the degree of horizontal product differentiation), the demand for firm 1, located at $x_1 = 0$ is given by $D_1(p_1, p_2) = \left[\frac{p_2 - p_1 + t}{2t}\right]$ and the profit function is

$$\pi_1 = p_1 D_1(p_1, p_2) - F = p_1 \left(\frac{p_2 - p_1 + t}{2t}\right) - F$$

where F is the firm's *realized* fixed cost. The reaction functions in prices can be found by solving the first-order condition, $p_1 = \frac{p_2 + t}{2}$. Firm 2's reaction function is symmetric to that of firm 1. The Nash equilibrium in prices results in a market price equal to the transportation cost, $p = t$. In equilibrium, both firms earn the same profit, $\pi_1 = \pi_2 = \pi = \frac{t}{2} - F$.

Under PWYL pricing, one firm is a price setter (Firm 1) and the other firm (Firm 2) uses PWYL pricing. For a price-setting firm 1, the captive consumers are those consumers who are unwilling to free ride by going to the firm offering the good using PWYL pricing. Demand for the price-setting firm is $D_1(p_1, \alpha) = \left[\frac{\alpha - p_1 + t}{2t}\right]$. Consumers located at $x_i > \frac{\alpha - p_1 + t}{2t}$ will prefer to purchase the good from the PWYL firm. Firm 1's profit function is

$$\pi_1 = p_1 \left(\frac{\alpha - p_1 + t}{2t}\right) - F.$$

The first order condition

$$\frac{\partial \pi_1}{\partial p_1} = \left[\frac{\alpha - p_1 + t}{2t} - \frac{p_1}{2t}\right] = 0$$

gives the equilibrium price as $p_1 = \frac{\alpha + t}{2}$. The equilibrium price increases with the social cost and can be higher than the traditional outcome when $\alpha > t$. However, if $\alpha > t$, then *no* consumer is willing to contribute to the PWYL firm (Proposition 3), Firm 2 is better off competing in prices, and the equilibrium price becomes the traditional duopoly result of $p = t$. In order for PWYL pricing to exist, the product must be sufficiently differentiated to overcome any social cost stigma, $\alpha < t$. Intuitively, this result implies that PWYL pricing would be more successful in sectors where products are more differentiated (or have fewer substitutes) such as music and specialty foods, but would fail in sectors where the service or product is homogenous (or has many close substitutes) such as gasoline.

5 Conclusions

The main contribution of the paper is that our simple model provides a theoretical economic framework that captures both the seller and consumers behavior under pay-what-you-like option. Our results support the empirical findings of Kim et al. We show that in equilibrium even without accounting for social cost, not all consumers free ride as was observed in the case of *Radiohead* and many other places. Our results show that all consumers contributing is also an equilibrium as observed by Kim et al. Our extended model that incorporates social cost resulting from not paying a "fair market price" shows that when a consumer does take into account the social cost of free riding and when this cost is sufficiently high, then consumer may not participate under pay-what-you-like pricing and whether a consumer chooses to pay, free ride or not to participate at all depends on the size of the social cost.

Under certain conditions, for a risk neutral firm, PWYL pricing could be more profitable than uniform pricing and hence there is an incentive for the firm to use this pricing. For risk averse firms this incentive becomes even stronger. Additionally, this form of pricing becomes more attractive from a profit standpoint when savings resulting from eliminating costs related to price setting, especially when the cost of setting a price is large.

Finally, using a simple duopoly model, we show that if the good or the seller of the good is not sufficiently differentiated (e.g., art, music or artist or a musician, etc.) then pay-what-you-like pricing is not suited and the firm should compete in prices with other firms. But, when it sufficiently differentiated it facilitates a voluntary segmentation based on consumers' self selection thus making a first-degree price discrimination feasible, but without incurring the cost such practice generally requires.

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