Why Pay Something Rather than Nothing? Simulating A Beat-the-Average Game in a Pay-What-You-Want Pricing Scheme*

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Abstract

Pay-what-you-want (PWYW) pricing models have received increased but still comparatively little attention in economics research. However, many businesses run under such a pricing structure. PWYW pricing only works in particular markets for specific goods, and is not always successful. In the first section, I review the current literature on pay-what-you-want (PWYW) pricing methods. In the second section, I develop a general utility model for consumers in a PWYW price setting to explain why the average purchase price is higher and the purchase rate is lower under certain PWYW pricing conditions. In the third section, I simulate a beat-the-average game under a PWYW pricing scheme, in which customers are asked to pay higher than the average price when the average price is unknown to them.

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1 Introduction

Pay-what-you-want (PWYW) pricing is a form of payment that is becoming increasingly common, particularly for sellers of low-cost goods or services. Under a PWYW pricing scheme, a good or service is offered, and the seller accepts any price that the buyer offers to pay; there is no set minimum price, so the buyer is free to choose to pay nothing. Standard neoclassical theory would predict that each customer would choose to maximize his/her utility by paying $0 for any good or service. However, empirical studies as well as real-life examples have proved this to be an inaccurate description of behavior (Regner and Barria, 2009; Gneezy et al., 2012; Kim, Natter, and Spann, 2009; Waskow et al., 2016; Krämer et al., 2017; Gerpott, 2017). Since customers incur not only monetary but also social or moral costs (e.g. fairness, social or self-image costs) it may be rational and utility-maximizing for them to pay a price above zero or even above the "reference price", depending on the customer's respective non-monetary cost functions (Kahsay and Samahita, 2015). The most important of these studies as well as their respective contributions to the overall literature and their applications to this project are all outlined in the Literature Review section.

This paper is divided into two primary sections. Section 1 develops a general utility model to explain the heterogeneity of consumers' chosen prices under a PWYW pricing scheme. Empirical research has demonstrated that there is a large variance in the prices that individuals choose to pay, although the price is almost never zero. Some researchers have attempted to explain this phenomenon through two primary mechanisms: a self-image-augmented utility function and a social-image-augmented utility function. Section 1 attempts to synthesize and generalize these findings to explain the heterogeneity in prices, and to explain how a change in suggested/recommended price can influence the consumer's utility functions. This utility model could serve to explain individual tastes for over- or underpaying: an individual who is more "image-sensitive" gains some utility from paying more than the suggested price, while an individual who image-insensitive has no cost associated with underpaying. Additionally, the model allows for differences between self-image sensitivity and social-image sensitivity, which has not yet been done in the literature. To illustrate, an individual with a high self-image sensitivity and low social-image sensitivity could maximize his utility by paying less than the suggested price only if his social-image cost is less than his self-image gain. A basic model incorporating only self-image has been developed by researchers (Kim, Natter, and Spann 2009). I plan use the previously discussed additions and complications to extend it and generalize it, as well as to apply it to a game-theoretical model that could increase the price that individuals choose to pay.

One of the most ubiquitous findings in the PWYW literature is that PWYW pricing schemes nearly always result in a higher average purchase price and a lower purchase rate; the change in revenue or profit depends on the characteristics of the good itself as well as the elasticity of demand for the good. Section 2 of the paper, which I consider the central contributions of the paper, introduces a beat-the-average game to attempt to bypass the lower purchase rate that comes from increasing the suggested price; this phenomenon is well-documented in empirical research, but the theoretical explanations for its cause, as well as attempts to correct for it, have been underdeveloped. Such a game will induce customers to think strategically about their decision to purchase as well as at what price they purchase, and it should increase the average purchase price to some stable point above the suggested price without resulting in a lower purchase rate. This will be a novel contribution to the literature of pay-what-you-want pricing and may have some applications in game theory.

An important reason to pursue this research is to estimate the financial value of the self-image and social costs when to a customer when he underpays, and to explore a way to increase a firm's revenue for a particular good without decreasing the purchase rate; the most likely mechanism to achieve this is through the "endogenous price discrimination" inherent to PWYW pricing as was explored by Isaac, P. Lightle, and A. Norton (2015). Using the utility model derived in Section 1, aided by the findings and estimates of other empirical/theoretical studies – particularly Kim, Natter, and Spann (2009) and Samahita (2013) – Section 2 will provide a game-theoretical simulation of the purchase price under the beat-the-average lottery game.

2 Literature Review

To pay for an item that one could receive for free can be socially rational – or "ecologically rational" as explored by Todd and Gigerenzer (2012). PWYW pricing schemes are sometimes very effective: some studies have shown that PWYW, under the right conditions, can be profitable and more economically beneficial than traditionally set prices (Regner and Barria, 2009; Riener and Traxler, 2012; Greiff, Egbert, and Xhangolli, 2013). Pay-what-you-want pricing is a form of progressive price discrimination in which those consumers who are least able or least willing to pay are allowed to pay nothing, and those consumers who have higher incomes are encouraged to pay more. This type of price discrimination has been termed "endogenous price discrimination" by some researchers (Isaac, P. Lightle, and A. Norton 2015). Its popularity among consumers has led to its increased adoption among different firms, from restaurants to cafes to online music shops which have experience varying degrees of success with the PWYW model. The PWYW model is especially appealing to nonprofit firms or charities, in which the self-image and social-image functions of the each customer may vary widely but is always quite high, since pay zero for a good sold by a nonprofit or charity is likely to result in a highly negative sense of self-worth as well as a sense of judgement by one's peers.

There have also been a few important studies exploring the way that self-image influences PWYW purchase rates and average price. People do not only want to appear fair and generous to others, but they also want to appear that way to themselves (Kahsay and Samahita, 2015; Gneezy et al., 2012). One significant finding is that PWYW models generally result in a lower purchase rate and a higher average price for a specific class of goods such as hot beverages, music, or other goods with low variable costs. For other goods, such luxury goods or goods with high costs, PWYW often results in the opposite effect: a lower average purchase price but a higher purchase rate (Bettray, Suessmair, and Dorn, 2017). Reciprocity and fairness is another important factor that could explain why and how much people pay (Regner and Riener, 2012). For example, many customers report paying for the service out of a sense of fairness – they paid what they thought the good or service was worth, because they want to either show appreciation to the business, make sure the business is successful, or because they value the mission of the business.

The current literature suggests that people prefer to forego a purchase rather than risk "under paying" (Gneezy et al., 2012; Fernandez and Nahata, 2009). Regner and Reiner also showed that reducing anonymity leads to higher payments, but also lower purchase rates (Regner and Riener, 2012). This finding provides strong support for the social-image aspect of the payment; if an individual does not value the product at a price equal or greater to the suggested/recommended price, he would prefer to not purchase it at all. This effect is, of course, lower or entirely absent when the transactions are made entirely anonymous. Studying anonymous transactions could allow us to 'isolate' the self-image pricing effects. The lower purchase rate and higher purchase price under transparent transaction make it unclear if reducing anonymity would lead to more profit for a firm under a PWYW pricing scheme.

Also central to the purpose of this paper, empirical research has demonstrated that raising the suggested or recommended price generally results in lower purchase rates (Gneezy et al., 2012; Isaac, P. Lightle, and A. Norton, 2015). Isaac, P. Lightle, and A. Norton (2015) show that a firm can benefit by setting a suggested price below the profit-maximizing single price, allowing the firm to benefit from "endogenous price discrimination." Increasing this suggested price above the profit-maximizing single price results in lower purchase rates; while the mechanism for this lower purchase rate is easily explained under a fixed price structure, it less easily explained for PWYW pricing. Research from Gneezy et al. (2012) suggests that the most likely explanation is that PWYW pricing schemes are only viable for specific goods; for high cost goods, PWYW pricing is likely to fail since the cost of self-image or social-image may be less than the incentive to realize a large profit. With goods like coffee, tea, music, art, or other lower-cost goods or socially valued goods, the social cost and self-image costs of underpaying is more likely greater than the value received. The research generally is unanimous in saying that PWYW pricing is viable only for low-cost goods.

3 Developing a General Utility Model under PWYW

As discussed in the introduction and literature review, utility under a PWYW pricing scheme differs from utility under a fixed-pricing scheme; quantifying this difference has proven to be a challenging task, particularly due to the varying degrees of success of PWYW pricing schemes across different regions, industries, and goods. There is no perfectly generalizable utility model that can explain the variations in prices chosen by consumers across these different parameters; rather, a utility model must be applied in very precise situations.

For this paper, I will focus solely on developing a utility model for low-cost, homogenous goods, particularly hot beverages. This is done for two reasons: availability of data to draw from, the extent of the current literature, and the feasibility of future experiments. Hot beverages are also one category of the goods that have proven to be successful under a PWYW pricing scheme. The utility model will consist of two parts in addition to the traditional model: a social cost function and a self-image cost function. The model allows for heterogeneity of the consumption utility, self-image-sensitivity, and social-image-sensitivity. This model will be applied in order to estimate the effect of a change in the reference price, or the RP, which will be assumed to be a recommended or suggested price. In other words, the RP will be externally determined by the seller, not internally determined by the buyer.

In their proposed microeconomic model, Kahsay and Samahita (2015) suggest that an increased RP results in a lower purchase rate, which supports the findings from Gneezy et al. (2012); Jung, Perfecto, and Nelson (2016), and others.

Using the current literature and data from Kim, Natter, and Spann (2009), I construct data as outlined below.

4 Data Construction

For the first section of this paper, the data is a simulation from normally distributed parameters using the proposed microeconomic model.

Some of the assumption that I make are drawn from empirical and theoretical economic research papers: the data source for this research is very limited, but I attempt to draw data from Kim, Natter, and Spann (2009). The data was not openly available, so the data that I use for this analysis is an *ad hoc* reconstruction of Kim's data from Study 3 of their 2009 paper. It consists of 813 prices paid by real customers in a PWYW price setting for a hot beverage.

In the second section for the game simulation, I introduce new hyperparameters that follow various probability distributions.

5 The Model

While Kahsay and Samahita (2015) introduce a model in which the buyer guesses the fair price, in this model I examine a PWYW pricing scheme in which the seller has a ”suggested” price that is known to all buyers and potential buyers. This keeps one common reference price for all customers, which removes the variability in individual's assumptions of a fair reference price.

I propose the following utility model, the assumptions of which are outlined in Table 1:

$$U_i(p,s) = \mu_i(x) - p_i + b_i(p_i - s) - a_i(p_i - s)^2, \quad (1)$$

where $U_i(p,s)$ is the utility for individual i for purchasing a good with a vector of characteristics x, p_i is the price that individual i chooses to pay, b_i is the self-image sensitivity of individual i, s is the suggested price set by the seller, and a_i is the coefficient of the quadratic limiting function of individual i.

Using data and results from Gneezy et al. (2012) and Kim, Natter, and Spann (2009), I form the prior belief that b is approximately normally distributed with a mean of 1.10 and variance of 0.075: $b_i \sim N(1.10, 0.075)$. The methods used to develop this prior belief are discussed in the appendix.

Variable	Proposed Distribution
a	$N(0.5, 0.625)$
b	$N(1.10, 0.075)$
$\mu(x)$	$N(4, 0.5)$

Table 1: Assumptions of the Model Parameters for PWYW Pricing: Hot Beverages

Secondly, borrowing from Kahsay and Samahita (2015), I assume that the mean of a_i is 0.50, but I add variability by setting $a_i \sim N(0.5, 0.0625)$.

This model has some useful characteristics that are consistent with the empirical results in the PWYW pricing literature. For example, the mean price paid under PWYW pricing for particular goods such as hot beverages is higher than the suggested price (also referred to as the reference price or recommended price) (Kim, Natter, and Spann, 2009; Gneezy et al., 2012; Regner and Riener, 2012). Secondly, increasing the suggested price results in a lower utility for any given price, and it leads to a higher purchase price (see Equations 3 and 4 below, respectively).

Utility is maximized when the individual's self-image sensitivity is equal to the difference in price and the reference price/suggested price:

$$\frac{\delta U}{\delta p} = 0 \text{ when } p_i - s = b_i \tag{2}$$

The derivative of utility with respect to suggested price is negative; a higher suggested price results in lower utility. Considering the marginal individual, if this change in suggested price leads to a utility less than zero then he or she will choose to not purchase the good. This can aid in explaining why purchase rates are lower under PWYW pricing.

$$\frac{\delta U}{\delta s} < 0 \tag{3}$$

The derivative of price with respect to suggested price is greater than zero; a higher suggested price results in a higher purchase price. This is also in line with the empirical data for certain goods such as hot beverages.

$$\frac{\delta p}{\delta s} > 0 \tag{4}$$

Considering a profit-maximizing fixed price of 1.75 euros as was the case in Study 3 of Kim, Natter, and Spann (2009), the PWYW utility-maximizing average price is 1.94 euros. Figure 1 below illustrates the model as a function of price.

Figure 1: At a constant suggested price, s, utility is maximized at $p_i = b_i * s$

It can be demonstrated that at the utility-maximizing price of 1.94 euros, the derivative with respect to suggested price is less than zero, as the model requires:

$$\frac{\delta U}{\delta s} = -0.92 \tag{5}$$

This finding is represented in Figure 2 below.

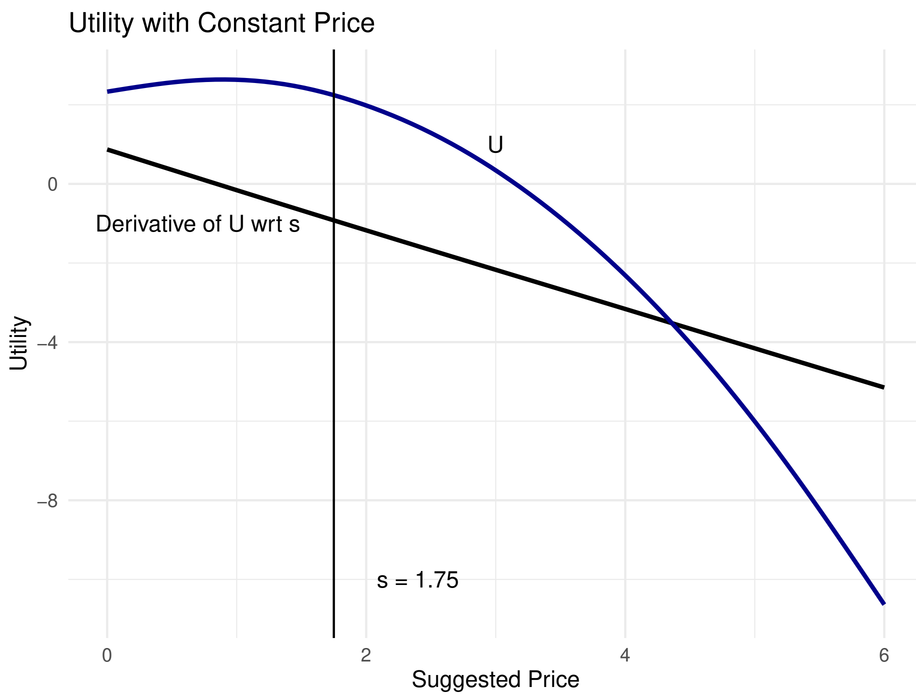

Figure 2: A graphical representation of Equation 3 using a constant price of 1.94 euros

Figure 2 obscures the significant variation in individuals' utilities.

Figure 3: There is significant noise in the data from the underlying uncertainty in the parameters

6 Introducing a Beat-the-average Game to Increase Purchase Price

One finding that is consistent in empirical studies of PWYW pricing schemes is that the purchase rate is lower under PWYW than under a standard fixed-price model. For certain low-cost goods such as hot beverages or music, the average purchase price is often above the profit-maximizing fixed price. This means that the effect on revenue or profit is indefinite.

As demonstrated in Equation 3, the seller's choice to increase the suggested price results in lower utility among the buyers. This is results in a higher purchase price (Equation 4), but does not necessarily increase revenue.

To solve this issue, I propose a beat-the-average game to increase the average purchase price with neutral effect on the purchase rate:

6.1 The Game

For the game, we consider the case of a cafe operating under a PWYW pricing model. This decision is made to keep the findings from Kim, Natter, and Spann (2009) relevant, as well as due to the fact that many cafes use this price structure today. Furthermore, PWYW pricing has the largest image effects among small homogeneous goods such as coffee, tea, or other beverages (Gneezy et al., 2012; Regner, 2015; Kim, Natter, and Spann, 2009).

Each customer is offered to participate in the following game: if she pays more than the average purchase price – which is unknown to her – then she will be entered to win free coffee for a certain period of time. The results of such a game would be fascinating because the ”prize” is not truly a prize – the customer could come in to the cafe to get a free coffee every day if she wished. The ”market price,” then, of the prize is zero dollars. The only cost to obtaining a free coffee every day are the self-image costs and social-image costs. People want to appear fair not only to those operating the cafe but also to themselves (Gneezy et al., 2012), and this is why the vast majority of people refuse to do such a thing, which they consider unfair.

Any price that the customer pays over their utility-maximizing price from Equation 1 reflects a ”bid” for the ability to ignore these image costs. In other words, ”winning” the free goods gives the customer the right to pay zero dollars consistently, thereby negating the self-image or social-image effects, since there is no longer a concern for fairness or social judgment.

The purpose of this game is to increase the average purchase price without decreasing the purchase rate; since the game is optional, any customer can choose not to participate by paying whichever price she wishes. Under the assumption that the offer of the game itself does not influence the purchase price of a customer who chooses not to participate, the game should have no effect on purchase rate.

The game is very similar to the guessing game presented by Nagel (1995), but whereas Nagel limits her analysis to a guessing game to $j < 1$, I propose a game with a $j > 1$, which has no dominated strategies.[1] For any price that the customer chooses, she could improve her payoff by choosing a higher price.

This game is different than a standard guessing game for a few obvious reasons: playing the game is optional, playing involves a monetary payment, and the game would take place in a real-life situation.

[1]Here I use j instead of Nagel's use of p to avoid confusion with price

6.2 Parameters of the Game

Due to lack of data, I use the following assumptions to simulate the effects of introducing this game: the goal is to pay a price greater than or equal to some constant j times the average price $\bar{p}$ s.t. $p_i = j_i \bar{p}$. To model this, I assume that customers attempt to pay a minimal amount above what they believe is the average purchase price s.t:

$$j \sim Inv - \chi^2 + 1, \text{with d.f} = 20. \tag{6}$$

To allow for variability in the level of strategic thinking of each customer, it is necessary to augment the guessed price according to the following equation:

$$p_i = \bar{p} {j_i}^{r_i} \tag{7}$$

The level of strategic thinking often centers around 0 or 1 (Nagel, 1995), with the probability of level-r strategic thinking decreasing with each level. With this assumption, it is convenient to model r as a beta-binomial distribution:

$$r \sim Beta - Binom, \text{ with size = 6, } \alpha = 2, \text{ and } \beta = 5 \tag{8}$$

6.3 Simulating the Game

Before the game is offered, each customer chooses her price according to the model in Equation 1, choosing the price which maximizes the utility function s.t:

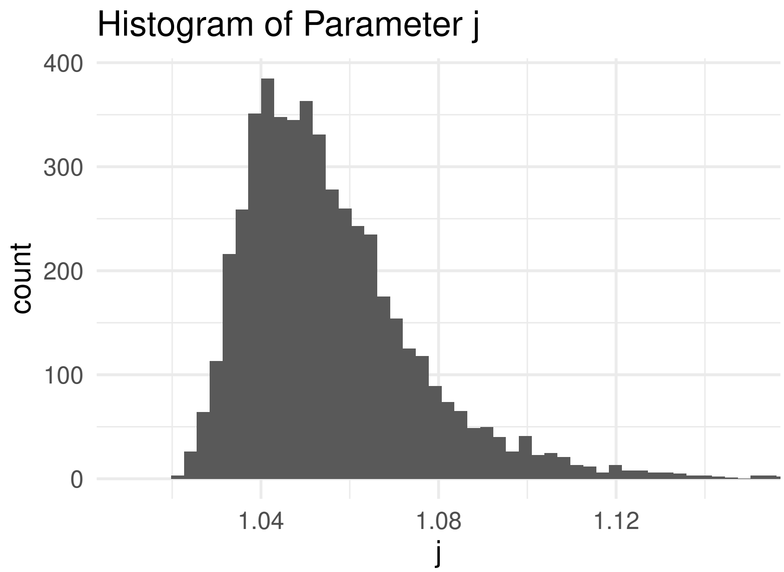

Figure 4: Parameter j

Figure 5: Parameter r

$$p_i = \frac{2a_i s_i + b_i - 1}{2a_i} \tag{9}$$

Using the parameters as outlined in Table 1 and with an exogenous suggested price of 1.75 euros, I simulate 10,000 prices. I remove all prices greather than 10 standard deviations from the mean as well as any observations where utility is less than zero. I then draw a subsample of 5000 of these observations.

The resulting prices before the game is offered results in a mean purchase price of 1.95, as specified in the model and as it aligns with the results from Kim, Natter, and Spann (2009):

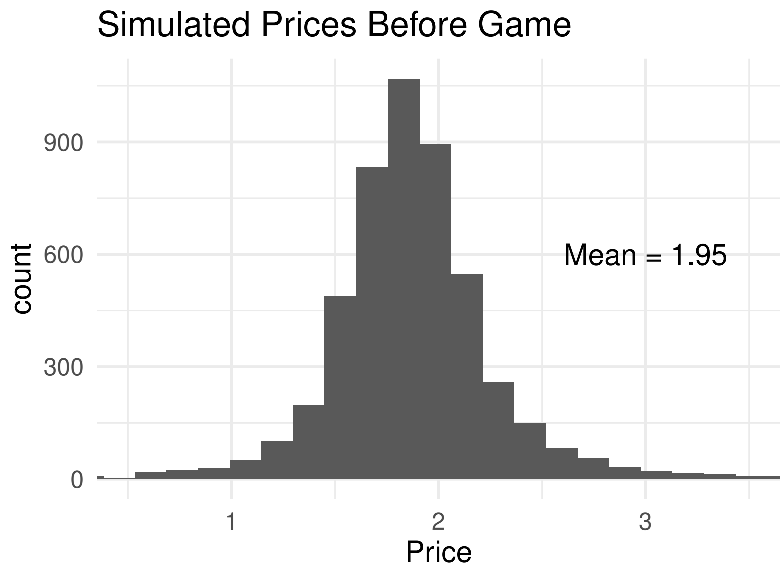

Figure 6: Before the Game is Introduced

The game is simulated using the pre-game price for each individual i, p_i^k, to create a new price for that individual, p_i^t, so that:

$$\text{if } p_i^k {j_i}^{r_i} \geq \bar{p}_i^k, \text{ then: } p_i^t = p_i^k {j_i}^{r_i}, \text{ else: } p_i^t = p_i^k \tag{10}$$

Simulating 5000 observations with the above equation and hyperparameters results in an average price 8.3% higher than the average price prior to the game:

Running this game four times, I obtain the following results:

The pattern from Table 2 continues, creating a very long right tail in the distribution of prices. The game, of course, has no point of convergence; average price quickly diverges to greater than

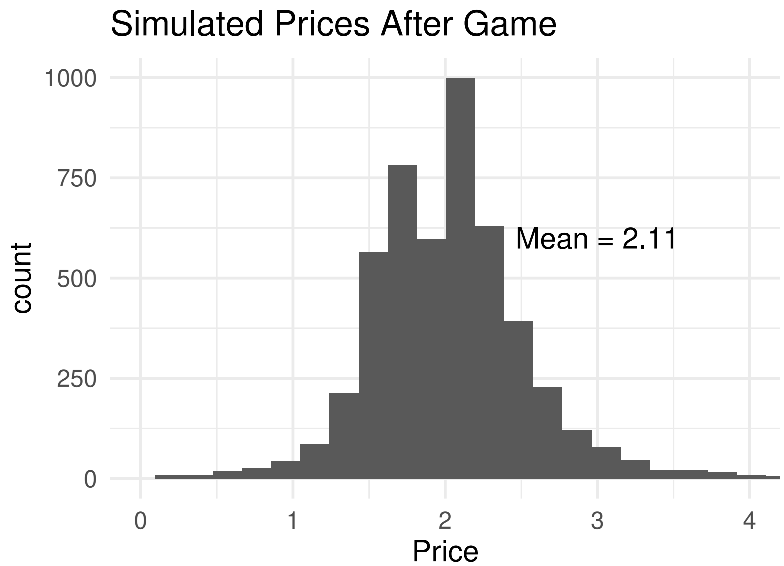

Figure 7: Simulated Prices After One Shot of the Game

Table 2: Change in Average Price from Previous

	Game 1	Game 2	Game 3	Game 4
1	8.3%	9.3%	10.5%	12.1%

100 euros.

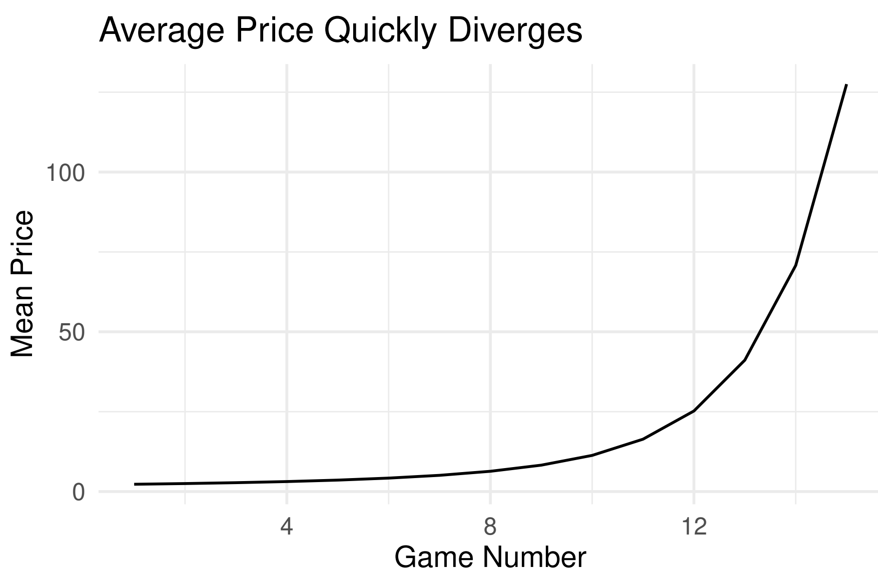

Figure 8: Rapid Divergence

Considering these results, the price that any individual pays is only bounded by her willingness-to-pay. If any individual participates in the game, then the average price will increase. Due to the voluntary nature of the game, no change in purchase rate should occur.

7 Conclusion

In this paper, I have added to the findings of the research on pay-what-you-want pricing in two ways. Firstly, I have developed a microeconomic model of utility under PWYW pricing. Similar work has been done by Kahsay and Samahita (2015), but I add variability in the hyperparameters and consider the case where the reference price is exogeneously set by the seller in the form of a suggested or recommended price. I choose these hyperparameters from forming beliefs based on the current literature and setting starting estimates according to empirical data from Kim, Natter, and Spann (2009). This simple model aligns well with the current literature on PWYW pricing as outlined in Section 2.

In the second part of the paper, Section 6, I simulate a beat-the-average game in order to increase the average purchase price under PWYW without decreasing the purchase rate. The simulation suggests that such a game could have the desired outcome. Although there is no dominant strategy for any buyer, the average price in each offering of the game increases. To truly test the effectiveness of such a game, future experimental studies testing its effect on purchase price and purchase rate are necessary.

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