The Flat Rate Pricing Paradox: Conflicting Effects of "All-You-Can-Eat" Buffet Pricing

David R. Just
Cornell University

Brian Wansink[*]
Cornell University

November 29, 2008

[*] David R. Just is Associate Professor of Applied Economics and Management also at Cornell University 254 Warren Hall, Ithaca NY 14853-7801 607-255-2086 (drj3@Cornell.edu). Brian Wansink is the John S. Dyson Professor of Marketing and of Nutritional Science in the Applied Economics and Management Department of Cornell University, 110 Warren Hall, Ithaca NY 14853-7801, 607-255-5024 (Wansink@Cornell.edu). The authors thank Karla Monke and Anna Davidowitz for help with data collection and Joost Pennings and James D. Hess for earlier conversations.

The Flat Rate Pricing Paradox:
Conflicting Effects of "All-You-Can-Eat" Buffet Pricing

ABSTRACT

Are price and consumption independent in fixed-price service contexts? A field experiment at an all-you-can-eat pizza restaurant shows that a 50% discount on the price of the meal led customers to consume 27.9% less pizza (2.95 vs. 4.09 pieces). This difference is significant and of similar size when controlling for age, height, gender and the day of participation. Additional analysis suggests that individual ratings of taste may be inversely related to consumption within treatment. Thus those who like it more, may consume less. One interpretation of our result is that, within this flat rate setting, individuals are consuming to get their money's worth rather than consuming until their marginal hedonic utility of consumption is zero.

All-you-can-eat (AYCE) restaurants charge a fixed price for access to food, and then allow customers to consume as much food as they want at no additional charge. Because a customer faces no marginal cost to consumption, conventional utility maximization implies that he or she should continue to eat until the marginal utility of consumption reaches zero. Economic models of consumer behavior commonly assume that utility of consumption is unaffected by the price paid. Rather, price only affects consumption through a budget constraint. If utility of consumption is unaffected by price, the amount paid for entry to the restaurant should not impact the amount of food consumed in an AYCE setting.

Recent research in consumer psychology, suggests that some segments of consumers are driven to "get their money's worth" in various service contexts (Clark and Goldsmith 2005). If true, it might be that increasing the price of an AYCE buffet will increase the amount of food a person eats. More broadly, we seek to understand whether price and consumption are independent in fixed-price settings?

In this paper, we report the results of a field experiment designed to test for the independence of price and quantity in and AYCE setting. We randomly assigned customers to one of two prices at an AYCE pizza buffet restaurant. We found that those assigned to the higher price treatment consumed 38.6% more pizza than those assigned to the lower price treatment. One possible interpretation of this result is that some customers are motivated to get their money's worth. The more pizza they consume, the lower the average cost per slice. If some individuals in an AYCE context derive utility from paying a relatively low average price for consumption, increasing the price should increase the

amount consumed. We use experimental consumption data as well as survey responses to explore this relationship.

The outline of the paper is as follows. In the following section we review the economics literature regarding consumer behavior when facing fixed pricing. We also present the consumer psychology and economics literatures exploring the individuals desire to "get their money's worth." We then propose a basic model of consumption in fixed-price contexts. This model is used to derive several behavioral hypotheses. A field study in an AYCE buffet restaurant is then described where customers are randomly given one of two prices for the buffet. The results are explained in the context of the proposed model. Extensions to future research are then discussed and implications are suggested.

I. Background: Fixed Pricing in Practice

AYCE buffet restaurants were first introduced in the 1970s when California restaurants began to offer salad bars (Auchmutey 2002). Since then, the number of AYCE restaurants has grown at an annual rate of 7% (Nation's Restaurant News 2001), due partly to their wide selection of food and the ability it affords customers to control portion sizes (Peregrin 2001).

Unfortunately, eating at AYCE restaurants can alter eating behaviors in ways that can lead to obesity (Wansink and Payne 2008). For example, Levitsky, Halbmaier and Mrjenovic (2004) report that eating at an AYCE dining hall accounted for 20% of weight gain among college freshman. With obesity increasingly becoming a public health concern (Wolf and Colditz 1998; Allison et al. 1999), understanding how consumers respond to AYCE settings could contribute to the growing national policy debate.

AYCE restaurants offer consumers a flat-rate pricing plan. In other words, consumers are charged a specified price that does not depend upon on the amount of food consumed. Firms may have several motivations for offering flat rate pricing in practice. For example, competitive pricing pressures may lead firms with zero marginal cost of production to offer goods at a flat rate (Fishburn, Odlyzko and Siders 1997). Similar results may apply if the marginal cost of production is relatively low as may be the case with some foods. Flat rate pricing may also be used to reduce transactions costs (Nahata, Ostaszewski, and Sahoo 1999). For example, AYCE restaurants may reduce costs by employing a smaller wait staff. .

In many contexts (such as cell phone service) consumers are offered the choice between several pricing options, including fixed pricing, linear pricing, or a two-part tariff. Linear pricing charges the individual a fixed price for each unit of consumption, while a two-part tariff charges both an access fee and a fixed price for each unit of consumption. Offering various pricing plans potentially allows firms to increase profits through price discrimination (e.g., Miravete and Roller 2003; Sundararajan 2004). Consumers will sort into pricing plans depending on how they value consumption. In particular, consumers may choose the plan that minimizes ex post cost given their forecasted level of cell phone use. Those who value high levels of use should choose the flat rate option to reduce their total cost of consumption. Alternatively, if consumers display misperceptions about their future use of a product, a firm may offer various pricing schemes to exploit these misperceptions.[1] For example, Della Vigna and Malmendier (2006) show that individuals routinely choose flat-rate gym memberships

[1] Behavioral motivations for consumers and firms to choose fixed pricing plans fall generally under the heading of behavioral industrial organization. For a complete summary of this literature, we refer the reader to Ellison (2006), who highlights the general theme of rational firms exploiting irrational consumers through alternative pricing schemes.

when it would be cheaper for them to pay for short-term use given their frequency of use. The average individual in their study could have saved $600 by purchasing short term memberships. They suggest that this is due to an individuals' misperception of future use at the time of membership purchase (see DellaVigna and Malmendier 2004). In a different context, Miravete (2003) finds that cell phone users that choose flat rate pricing tend to be those with heavier call volumes, and thus would not save money with per minute plans.

Lambrecht and Skiera (2006) provide a comprehensive review of behavioral studies examining consumer choices between flat rate and pay as you go options. Consumers may choose the flat rate option for many other reasons: 1) To insure against the possibility of large bills due to overconsumption (Miravete 2002), 2) because they enjoy flat rate pricing more than piece rate pricing (Prelec and Loewenstein 1998), or, 3) due to the inconvenience associated with choosing the correct plan (Winer 2005).

While the previous studies examine consumer choice between pricing plans, our interest lies in determining the drivers of consumption behavior given flat-rate pricing. Thaler (2004) hypothesizes a relationship between the particular price paid and consumption behavior given flat rate pricing. Thaler popularized the notion that individuals derive utility from feeling as if they have gotten a good deal. His work decomposes the total utility from purchasing a good into acquisition utility and transaction utility. Acquisition utility, which we will refer to as *hedonic consumption utility*, is determined by the consumer's valuation of consuming the good minus the money used in acquiring the good. Transaction utility is the value to the individual of obtaining a good deal on the purchase of the item.

Thaler's notion of transaction utility suggests consumers feel better off when they have paid a low average price for the goods consumed. This is particularly important in a flat rate context where increasing consumption decreases the per unit price. Thus, if consumers are strongly motivated by transaction utility, they may increase their consumption in an AYCE context in order to get a better deal. In the traditional economic model of consumption, an individual's marginal utility from consumption declines as one consumes more.

Consider Figure 1, which illustrates a hypothetical hedonic utility of consumption function for pizza with utility on the vertical axis and the quantity consumed on the horizontal axis. If the individual considered only his or her hedonic utility of consumption, the individual should consume enough pizza to reach the maximum of the utility function – and no more.[2] The hedonic utility of consumption in Figure 1 has a distinct optimum at x^*. Consuming less than x^* might leave them physically hungry or feeling deprived of a sensory experience. Consuming more than x^* may leave them uncomfortably full or having experienced a displeasurable sensory experience. Transaction utility may lead the individual to consume more than x^* if their marginal transaction utility exceeds the marginal hedonic displeasure they experience. Higher flat rate prices will increase the amount that must be consumed to obtain the same average cost per slice of pizza. This results in the individual trading hedonic displeasure for a lower average cost of pizza.

[Insert Figure 1]

The sunk cost fallacy occurs when an individual's decision to continue an endeavor is positively influenced by the amount of money or effort already expended.

[2] Often a satiation point is modeled using a quadratic utility function with a negative second order term.

More specifically, the sunk cost fallacy requires that (i) some amount of money or effort be expended toward consumption, (ii) the object of *marginal* consumption becomes undesirable and (iii) the individual continues to consume trying to recover the sunk costs. Reasoning such as "I have spent too much to quit now," is often associated with the sunk cost fallacy. In his landmark article incorporating behavioral phenomena into models of consumer choice, Thaler (1980) cites some anecdotal evidence for the sunk cost fallacy. [3] He notes that experimental evidence would be necessary to confirm the sunk cost fallacy in practice. For this purpose, Arkes and Blumer (1985) randomly assigned season ticket prices to potential theater goers. They found that those paying more for their tickets attended significantly more plays within the first half of the season, but about the same number of plays within the second half of the season.

We suggest that searching for correlations between the level of price paid and the amount of level of consumption provides a weak test of the sunk cost fallacy for two reasons. First, failing to find such a correlation between price and consumption could result from artificial constraints on consumption (e.g., theater ticket packages with a predetermined number of tickets within a package). When such constraints exist, it is possible that the marginal net benefit from continued consumption does not become negative before the individual has consumed the full amount allowed. In this case we should expect no correlation between the level of fixed expense and consumption.[4] Thus an ideal test of the sunk cost fallacy would not place artificial limits on consumption.

---

[3] Near the end of the section describing this phenomenon Thaler inserts an important footnote that contains nearly all of the evidence for the sunk-cost fallacy (Thaler, 1980, p. 48):*I also plan some experiments to test the sunk cost effect. In one pilot study undertaken by one of my students, Lewis Broad, customers at an AYCE pizza restaurant were randomly given free lunches. They, in fact, ate less than the control group who paid the $2.50 normal bill.*

[4] The same would be true for goods for which the marginal net benefit of consumption becomes *severely* negative after consuming *n* of the good (such as a food that may induce indigestion). In this case, the marginal net benefit may outweigh any perceived benefit from further consumption even at higher prices.

Secondly, a correlation between price paid and consumption could be caused by some unrelated factor such as self-selection. For example if the flat rate is high, those who place less value on consuming larger quantities may simply decide not to buy. If the flat rate is reduced, more "light users" will purchase lowering the average quantity of consumption. Thus, a spurious correlation between price and consumption may be caused by selection bias.

A correlation between price and consumption may also result if the individual's preferences for the item (irrespective of their desire to get their money's worth) is affected by the fixed price. For example, if paying a higher price lead one to enjoy the taste of a slice of pizza more, then the individual may increase consumption as a natural result. Thus, a stronger test of the sunk cost fallacy would ensure that all participants would be willing to purchase at both high and low prices. As well, individual ratings of taste for the good may be important in determining the behavioral motivation for any correlation between price and consumption.

II. Theory

The standard economic model of consumption behavior supposes that the individual maximizes their utility of consumption, which is a function of the quantity of various goods consumed, subject to a budget constraint. In this model, price does not enter directly into the utility function, but only through the budget constraint. Within the context of an AYCE restaurant, once the individual has paid the entry fee, they no longer face any budget constraint. Let $U^c(q|\theta)$ be the hedonic utility of consumption function, with q the quantity of food consumed and θ a parameter representing the amount of consumption that maximizes the utility of consumption function. With no budget constraint, the most intuitive extension of the standard consumption model would

suppose that the individual will always choose $q^* = \theta$. The model supposes that individuals are only motivated by hedonic utility and, thus, the flat fee paid should not have any impact on consumption. We will refer to this as the standard model.

Alternatively, Thaler (2004) proposes that the consumer is motivated by both a desire to get a "good deal" (transaction utility) and to increase their hedonic utility. Specifically, let the consumer who has already paid for an AYCE buffet solve

$$\max_q U^t(q \mid p) + U^c(q \mid \theta), \tag{1}$$

where p is the flat fee, $U^t(\cdot|\cdot)$ is transaction utility of consuming q given the price paid, p, assuming continuous differentiability of both utility functions and that $U^t_q > 0$, $U^t_{qq} < 0$, $U^t_p < 0$, $U^c_q(\theta \mid \theta) = 0$, $U^c_{qq}(\cdot \mid \theta) < 0$.[5] We will refer to this as the transaction utility model.

Within this model, Thaler's notion of transaction utility requires that $U^t_{qp} > 0$, or, that the marginal transaction utility of consumption increases with price. This model supposes that transaction utility and hedonic consumption utility are compensatory. In other words, one who pays very little for poor quality pizza may be as well off as if they had paid a greater amount of money for a similar quantity of very high quality pizza.

The first order conditions that solve (1) can be written as

$$U^t_q(q^* \mid p) + U^c_q(q^* \mid \theta) = 0, \tag{2}$$

By monotonicity of U_t, the first term in (2) must be positive, so $U^c_q(q^* \mid \theta) < 0$. Thus, the marginal hedonic consumption utility is negative on average at the optimal consumption level, reflecting that the consumer will over-eat (relative to hedonic

[5] At most AYCE restaurants, the individual must make periodic decisions to return to the buffet to acquire more food. We ignore the intertemporal nature of these decisions in favor of a simple static model.

consumption utility) in order to increase transaction utility. This will always be the case if $U_q^t(\theta \mid p) > 0$. Moreover, totally differentiating (2) with respect to p and q results in

$$\frac{dq}{dp} = -\frac{U_{qp}^t(q^* \mid p)}{U_{qq}^t(q^* \mid p) + U_{qq}^c(q^* \mid \theta)}, \tag{3}$$

which is positive if $U_{qp}^t > 0$. In other words, if increasing the price also increases the marginal benefit of consumption in terms of transaction utility, then increasing the fixed price must increase consumption. Thus the higher the price, the more the individual will eat. This is the primary way in which the standard model differs from the transaction utility model. We wish to test for the influence of price on consumption to differentiate between these two behavioral hypotheses.

It is also of interest to know if the price paid may directly influence the hedonic evaluation of the food. One alternative hypothesis that might explain why consumption in an AYCE context might depend on price is that price may directly affect hedonic utility. Suppose, for example, a higher fixed price leads the individual to take more or less pleasure in the taste. In this case price should influence consumption even if the individual does not consider transaction utility when they consume. Thus, a third model of consumption supposes that (1) can be rewritten as

$$\max_q U^c\left(q \mid \theta(p)\right) \tag{4}$$

so that now the optimum of the utility function is now a function of price, and the individual will consume $\theta(p)$. We will refer to this as the hedonic-price utility model.

Unlike the standard and transaction utility models, within the hedonic-price model, reported enjoyment of the pizza should depend on the price paid. Price could influence hedonic utility through two possible mechanisms. First, individuals may take

price as a suggestive signal of quality, and may thus believe that the pizza is better quality when they have paid more for it. In this case, $\theta_p > 0$, leading the individual to consume more when higher prices are charged. This behavior would be identical to that caused by the transaction utility effect. However, the root cause of the behavior is different. Thus, it is important to differentiate whether price is affecting hedonic pleasure, or simply changing consumption through desire to obtain a better deal.

Alternatively, individuals may set taste expectations according to price, and evaluate taste in comparison to the price paid. In this case, we would expect $\theta_p < 0$, leading those who face higher prices to give poorer evaluations of the food. If this is the case a higher price leads to lower hedonic utility of consumption. Thus, a positive relationship between price and consumption must certainly be due to the transaction utility effect.

Using the AYCE context of a pizza buffet, we want to examine whether the fixed price a person pays for their buffet influences how much they eat, and how much they enjoy what they eat. We hypothesize that the amount of food a person will eat is positively correlated with how much they paid for the food. Thus those who pay more will eat more, contradicting the standard utility model. Further, we hypothesize that price will impact taste evaluations negatively. If price impacts taste negatively but impacts consumption positively, we can reject the hedonic-utility of consumption model as the cause of increased consumption.

III. Methods

To make accurate comparisons across different price conditions, it was necessary to find an all-you-could-eat restaurant where consumption volume could be unobtrusively measured and where calorie content per unit of volume would be reasonably similar. A uniformly cut pizza fits these criteria because it is generally served in discrete amounts (slices) and can be measured by observing the number of pieces consumed.

Cooperation to conduct our study was given by the Pizza Garden, an AYCE pizza restaurant one mile south of Champaign, Illinois. The restaurant had an exclusive AYCE pizza luncheon buffet served on weekdays, and an optional buffet or menu service provided on evenings and weekends. The study was conducted during the exclusive lunch buffet hours on a Tuesday, Wednesday, and Thursday in early April 2005. The between-subjects randomized block design involved a control group who bought the regular price pizza buffet ($5.98) and the treatment group who were given a coupon for 50% off this regular price ($2.99).

When approaching the restaurant door, participants were asked by one of four experimenters if they would be willing to participate in a short survey related to the restaurant. After agreeing and providing informed consent, they were asked two open-ended restaurant-selection questions which were intended to distract them from the true purpose of the study (Bradburn, Sudman and Wansink 2004): (1) "What other places did you consider for lunch?" and (2) "Why did you choose this restaurant?" They were then thanked and offered a coupon if they would agree to answering a short series of questions when they finished their meal. Participants were randomly given a coupon for a free drink (control condition) or a coupon for a free drink and 50% off the price of a buffet (treatment condition).

People who arrived in groups (such as those who arrived in the same car) were all assigned to the same coupon condition. Groups were assigned to conditions in alternating order. That is, the first group was offered the discounted coupon and drink, while the second group was

offered only the drink. The data was collected from 11:30 to 1:30, and the weather was sunny and warm throughout the three days.

Of the 20 groups of people (79 individuals) who were approached, all but four groups (13 people) fully participated. Three groups declined to participate (three emergency medical technicians, four men dressed in suits, and a male and female couple) and one group of four police officers left in the middle of their meal. Thus, of the 70 people who originally agreed to be in the study, complete data was collected from 66. It is important to underscore that the pizza restaurant exclusively served the pizza buffet during lunch times when the experiment was administered. No menu was provided to order ala cart. People who had selected to eat at this restaurant would have already decided to eat the buffet at the higher price. Indeed, no individuals included in either treatment failed to purchase the pizza buffet or decided not to eat pizza.

While in the restaurant, pizza consumption was measured by three assistants who served as hostesses. These assistants were blind to the purpose of the study and had no knowledge of which patrons had been randomly assigned to which conditions. They noted how many pieces of pizza each person brought back from the buffet table and how much was left uneaten after they completed their meal. Because these hostesses were continually responsible for busing tables, this was possible to do without raising suspicion. Uneaten pizza was weighed in a back room to more accurately assess what percentage of the pizza taken was actually eaten. Thus, the amount of pizza consumed was recorded as a continuous variable in terms of fractional number of slices. A wide variety of pizza was served (8 pieces/pizza), and an analysis by a dietician indicated that the average piece contained 358 calories and 13 grams of fat. Because of difficulty in precisely identifying the types of residual pizza remaining (often crusts), averages were used to calculate caloric and fat intake for this analysis.

Participants were intercepted after they paid at the cash register following the meal, and each was given a short questionnaire which asked for demographic information along with a variety of questions asking how much they believed they ate, and their taste and quality evaluations of the pizza. Other than questions involving numerical estimates, most questions asked their agreement with a number of statements on 9-point Likert scales (1="strongly disagree"; 9 = "strongly agree"). Table 1 presents summary statistics for each of the consumption and socio-demographic variables as well as the taste and quality evaluations.

[Insert Table 1]

IV. Results and Discussion

Pizza consumption may differ based on gender, age, height, and how many people a person is dining with (Wansink 2004). Specifically, it may be important to control for gender, age, height, and the number of individuals eating in the group. We will refer to these factors as the *socio-demographic* factors. We employ regression techniques to control for these socio-demographic differences. In addition to standard regression analysis, we also make use of the matching technique developed by Abadie et al. (2001). This technique uses minimum distance measures to match observations from both treatments based on socio-demographic variables. It has been shown that the number of people eating in a group can significantly affect the amount of food eaten (DeCastro 2000). In each of our regression analyses, we include group-size as a linear variable.[6]

A. The Relationship between Price and Consumption

[6] In accordance with DeCastro (2000), consumption is expected to be a non-linear increasing function of group size. However, with groups ranging in size only from 1 to 7, there is not sufficient variation (particularly in larger groups) to allow precise estimation of more sophisticated relationships. This should be less of a problem when using matching techniques.

As reported in Table 1, people who paid the regular price for the pizza buffet tended to eat more pizza (4.09 slices versus 2.94; $F(1,64) = 6.52$, p-value = 0.013). Figure 2 displays the average consumption and taste ratings by treatment. A permutation test of the difference in mean consumption results in an exact p-value of 0.006 with 10000 replications. Table 2 contains the estimated treatment effects for several outcome variables (after controlling for socio-demographic variables using the minimum distance matching estimator controlling for heteroskedastic treatment effects[7]). On average, each person paying the full price ate 1.117 more slices – an increase of 31.77%. This translated into 410 more calories (1054 vs. 1464) and 14.9 more grams of fat (38.3 vs. 53.2). Thus, we find evidence that higher prices lead to greater pizza consumption.

Returning to Table 1, when paying half-price, the average amount paid per slice declines by $0.65 (from $1.98 to $1.33). This result is of a similar size and significance when controlling for socio-demographic variables ($0.57, see Table 2). Thus, those paying less are still getting a better deal. However, the decline in average price is smaller than the decline in average price predicted by the standard utility model where consumption is unaffected by price. In this case the decline should be $0.99 (50% of the average price paid by those in the higher priced treatment,$1.98).

[Insert Figure 2 and Table 2]

Table 3 displays regression analysis of the relationship between price and pizza consumed. Results were obtained using Tobit[8] estimation, with standard errors clustered by

[7] Heteroskedasticity is controlled using the same matching technique. See Abadie et al. (2001) for a description. Sizes of the coefficients do not change substantially when controlling for heteroskedasticity, although the significance is somewhat reduced.

[8] The smallest amount consumed was one slice of pizza, with 7 consuming exactly one piece.

group with which the individual entered the restaurant.[9] The results are similar when controls for socio-demographic variables are included, as well as when the date of participation is included. In each of these regressions, in the matching treatment effect estimation and in the uncontrolled summary statistics, paying half price reduces consumption by about one slice of pizza on average, or about one quarter of total consumption. Thus we see robust evidence that price paid has is positively correlated with consumption of pizza in an AYCE setting, refuting the standard utility model presented earlier.

[Insert Table 3]

Although the amount of wasted food was sizable with all consumers, plate waste doubled in the regular price buffet condition (from 0.22 to 0.43 pieces; F=2.09; p=0.15). This difference was significant when controlling for socio-demographic variables (-0.302 pieces left, p=0.079, see Table 2). When paying half-price for a buffet, 19% left food on their plate, but this nearly doubled to 37% when paying full price. Many consider the crust of the pizza to be inferior. Hence, those paying more may have attempted to consume more of the parts of the pizza they enjoy most by reducing consumption of the crust. Informal observation of participants suggests that this is the case.

B. The Relationship between Price and Taste

Without controlling for socio-demographic variables (recall Table 1), we see that although taste evaluations are higher on average when participants paid less, the difference is not statistically significant. However, when controlling for socio-demographic variables (see Table 2), paying less for pizza positively influenced the taste of the first slice of pizza (p-value = 0.043). The effect is also positive but not significant overall or for the last slice of pizza (p-value = 0.393). While the data do not convincingly support a negative relation between price and taste

[9] Results for coefficients on the treatment variable do not change substantially when including clustering. However, the significance of the height variable is somewhat improved with clustered standard errors.

evaluations, they contradict the notion of a positive relationship. This evidence casts doubt on the hedonic-price utility model which explains the increase in consumption under higher prices through an increase in hedonic utility of consumption.

C. The Relationship between Taste and Consumption

To examine how taste influences pizza consumption, we again used Tobit regression analysis with standard errors clustered by group with which the individual entered the restaurant. By examining within treatment effects (see Table 4), we are able to control for any impact of price on taste evaluations. Interestingly, in each of the regressions, taste is negatively associated with consumption, with the taste of the first slice being the only significant variable (Model 2) in the half price treatment, and the taste of the last slice and overall taste rating the only significant variables in the no discount treatment (Model 1 and Model 3).[10] Additionally, when combining both treatments, all three taste ratings have a significantly negative impact on consumption.[11] It seems odd that the better the taste, the less total pizza one ate. These results do not change sign or relative magnitude when we omit controls for socio-demographic factors, though some significance levels change.

[Insert Table 4]

While this modest negative relationship between taste and pizza consumption seems perverse, perhaps it should not be unexpected. Intuitively, it takes a more low-quality pizza to get one's money's worth than it does high-quality pizza. If pizza is of an inferior quality, transaction utility may play a more significant role in determining the optimal stopping point ,

[10] Note that the sign of the gender variable changes between the models estimated for half price and no discount treatments respectively, though none of the positive coefficients are significant. The dummy variable is set equal to one when the participant is male and hence one would assume it should have a positive sign. This could be evidence that females are more susceptible to the sunk cost fallacy than males. However, our data is so skewed toward males that such a relationship might be purely coincidental. Further study is needed to determine if there is a differential gender relationship.

[11] Consistent with our previous analysis, Table 4 indicates that reducing price by 50% appears to reduce consumption by about one slice of pizza.

thereby leading the consumer to eat more when they like it less. Unfortunately, all taste measures were administered ex post and may display significant bias. An alternative explanation for this result is that individuals who ate more were simply uncomfortable and this feeling biased their assessment of taste. Additional research will be needed to clarify this potentially new paradox, perhaps by randomly varying the quality of the pizza by treatment. Such an approach could reduce the subjective nature of taste measures.

V. Discussion

The sunk cost fallacy is one of the more frequently noted violations of rational behavior. Here we present some evidence that the sunk cost fallacy prevails in a transparent market setting that many people have experienced previously. We draw attention to two critical findings. First, our results suggest that the higher the fixed price people pay for food, the more they appear to consume. Second, our results leave open the possibility that increasing the price reduces hedonic consumption utility. Finally, our study raises a new question: When paying a flat-rate , will one eat more when they like it less? The implications of this could extend to other fixed price experiences such as day passes for golfing, recreation, and other such services.

Insofar as hedonic utility of consumption declines, a resulting decrease in one's evaluation of the food could simply represent their diminished marginal hedonic utility of consumption. That is, instead of rating the peak level of quality, one may tend to recall the most recent consumption experience when evaluating the overall taste or quality of the food. This is the phenomenon described and documented by Kahneman, Wakker and Sarin (1997) in their exploration of the meaning of utility. In this case, the correlation between consumption quantity and taste ratings may be spurious.

Our study examines consumption behavior given an individual's decision to eat at an AYCE restaurant. Because flat-rate pricing was the only option available to our participants, we cannot compare our results to behavior under linear pricing. Many have suggested that AYCE pricing increases consumption relative to linear pricing (e.g., Levitsky, Halbmaier and Mrjenovic 2004), linking this pricing mechanism to the current obesity and health policy debate. Within our study, many individuals believed they had eaten too much upon leaving the restaurant; this included 48.6% of those paying full price and 41.9% of those paying half price. The fact that nearly half of all participants believed they had eaten too much suggests that individuals appear to use systematically different mechanisms to evaluate the optimal stopping point *while* they eat than they use to evaluate *after* they have eaten. Oddly, while we find that those in the higher priced treatment ate substantially more pizza, they were not significantly more likely to admit to having overeaten ($p = 0.64$). This may suggest that individuals consider price when evaluating how much they have eaten.

To conduct this research, it was necessary to find an AYCE restaurant which did not allow other dining options. In this way, we could be guaranteed that the influence of pricing was conditioned on the prior decision to eat at the buffet. However, the set of individuals who select an AYCE restaurant for lunch may not be representative of the population as a whole. For example, our sample contains a disproportionate percentage of males (see Table 1). It may be that the type of person who chooses to go to an AYCE restaurant buffet is different in the way they perceive the value of food or in the way they make quantity-quality trade-offs. If a different group of people – perhaps ones who are not predisposed to frequenting buffets – were put in this situation, it is not known if the treatment effect would be as strong or whether it might even be stronger. For instance, people who choose an AYCE restaurant may be those who have a relative advantage in controlling their behavior in this context.

Because of legal and public relations concerns, we did not directly manipulate the stated price of the meals. We instead offered half-off discounts for the treatment group. It is worth noting that price discounts may not always be perceived by consumers as equivalent to a lower price (Anderson and Simester 1998; 2001). In such a case, behavior might be driven more by the proportion of the discount than by the final price, with consumers perceiving discounted items to be of poorer quality (Kahneman, Knetsch and Thaler 1991). In contrast, participants in our study rated the discounted pizza as being of higher quality than the undiscounted pizza. This could be due to the framing of the taste and quality evaluation questions used in prior studies. In these studies, individuals were asked to rate the quality of discounted items relative to full price items. The effect of price paid on consumption might have been stronger in a context where the price had instead been lowered instead of discounted.

To keep the dining experience natural and unobtrusive, it was necessary to measure ex-post evaluations of both the consumption stopping point and taste evaluation. Measuring these variables after they occur may not fully capture the process of consumption decisions in a buffet context. Taste ratings compiled ex post need to be interpreted with care. For instance, those consuming more may feel physically uncomfortable, potentially biasing their assessment. In this case it is unclear how that bias would affect assessments of the first, last and overall slices differently. It would be useful to add a time component to this evaluation process. For instance, the often mentioned notion that our evaluation of satiety lags (some say up to 20 minutes) behind our actual satiety might suggest physiological cues may compromise an individual's ability to evaluate the appropriate stopping point over the course of a meal. . Future studies could measure this orientation, and model it as a part of the choice framework. . Further, intentionally randomizing the quality of the pizza could allow for a robust test of any causal relationship between taste and consumption quantity in and AYCE setting.

VI. Conclusion

The general purpose of this article is to demonstrate the sunk cost fallacy in an AYCE context. Our results suggest that in an AYCE setting, price positively influences consumption. Additionally, consumption appears to be *negatively* related to individual evaluations of taste within treatment. In contrast to the standard utility model of consumption, our results provide some support for the notion that individuals consider price in evaluating their marginal utility of consumption – even when there is no marginal cost for additional consumption. Several limitations apply to our results, offering promising frontiers for additional investigations into the relationships between price, consumption quantity, hedonic evaluation, and utility. We provide a methodological benchmark for future investigations in this area of fixed price research as it relates to a wide range of contexts, and introduce a new potential paradox—that of eating more when one likes it less.

References

Abadie, A., D. Drukker, J. L. Herr, Guido W. Imbens (2001). "Implementing Matching Estimators for Average Treatment Effects in Stata," *The Stata Journal*, 1:1; 1-18.

Arkes, H.R. and C. Blumer. (1985). "The Psychology of Sunk Cost." *Organizational Behavior and Human Decision Processes* 35: 124-140.

Allison David B., Kevin R. Fontaine, JoAnn E. Manson, June Stevens, and Theodore B. VanItallie (1999), "Annual Deaths Attributable to Obesity in the United States," *Journal of the American Medical Association,* 282 (16), 1530-1538.

Anderson E.T. and Simester D.I. (1998), "The Role of Sale Signs," *Marketing Science*, 17:2, 139-155.

Anderson E.T. and Simester D.I. (2001), "Are Sale Signs Less Effective When More Products Have Them?" *Marketing Science* 20:2, 121-142.

Auchmutey, J. "All You Can Eat: Buffet Restaurants Satisfy Our Appetite for Endless Bounty," *Atlanta Journal-Constitution*, 2002; April 7, Features, 1+.

Bradburn, N. M., S. Sudman, and B.Wansink (2004), *Asking Questions: The Definitive Guide to Questionnaire Design – For Market Research, Political Polls, and Social and Health Questionnaires*, San Francisco, CA: Jossey-Bass.

Clark, R.A. Ronald E. Goldsmith. (2005) Market mavens: Psychological influences. *Psychology and Marketing* **22**:4, 289-312

DeCastro, J.M. , "Eating Behavior: Lessons From the Real World of Humans," *Ingestive Behavior and Obesity* (2000), 16, 800-813.

DellaVigna, S. and U. Malmendier (2004) "Contract Design and Self-control: Theory and Evidence," *Quarterly Journal of Economics* 119: 353-402.

DellaVigna, S. and U. Malmendier (2006) "Paying to Not Got to the Gym," American Economic Review, 96: 694-719.

Ellison, G. (2006) "Bounded Rationality in Industrial Organization" In Blundell, R., W.K. Newey and Torsten Persson (eds.) *Advances in Economics and Econometrics: Theory and Applications, Ninth World Congress*, Volume 2, Econometric Society Monographs. New York: Cambridge University Press, 142 – 174.

Fishburn, P.C., A. M. Oldyzko, and R.C. Siders (1997), "Fixed Fee versus Unit Pricing for Information Goods: Competition, Equilibria, and Price Wars" *First Monday*, 7.

Kahneman, D., P.P. Wakker and R. Sarin (1997) "Back to Bentham? Explorations of Experienced Utility." *Quarterly Journal of Economics* 112: 375 – 405.

Kahneman, D., J.L. Knetsch and R.H. Thaler (1991) "The Endowment Effect, Loss Aversion and Status Quo Bias" *Journal of Economic Perspectives* 5, 193 – 206.

Lambrecht A and B. Skiera (2006), "Paying Too Much and Being Happy About It: Existence, Causes, and Consequences of Tariff-choice Biases." *Journal of Marketing Research*, 43:2, 212-223.

Levitsky, D.A., C.A. Halbmaier and G. Mrdjenovic, (2004). "The Freshman Weight Gain: A Model for the Study of the Epidemic of Obesity" *International Journal of Obesity* 28, 1435 – 1442.

Miravete, E.J. (2002) "Estimating Demand for Local Telephone Service with Asymmetric Information and Optional Calling Plans," *Review of Economic Studies* 69, 943 – 71.

Miravete, E.J. (2003) "Choosing the Wrong Calling Plan? Ignorance, Learning and Risk Aversion." *American Economic Review* 93:297-310.

Miravete, E.J. and L.-H. Roller (2003), "Competitive Non-Linear Pricing in Duopoly Equilibrium: The Early U.S. Cellular Telephone Industry." *CEPR* Discussion Paper No. 4069. Available at http://ssrn.com/abstract=470844

Nahata, B., K. Ostaszewski, and P. Sahoo (1999), "Buffet Pricing," *Journal of Business*, 72:2, p. 215-228.

Nation's Restaurant News. "All-you-can-eat still rules most college food programs," *Nation's Restaurant News*, 2001; December 13, 31.

Peregrin T. "A super-size problem: Restaurant chains piling on the food," *Journal of the American Dietetic Association*, 2001; 102 (June), 122.

Prelec, D. and G. Loewenstein (1998). "The Red and the Black: Mental Accounting of Savings and Debt," *Marketing Science* 17, 4 – 28.

Sundararajan, A. (2004) "Nonlinear Pricing of Information Goods" *Management Science* 50, 1660 – 1673.

Thaler, R. H. (1980), "Toward a Positive Theory of Consumer Choice," *Journal of Economic Behavior and Organization*, 1, 39-60.

Thaler, R.H. "Mental Accounting Matters." In Camerer, C.F., G. Loewenstein, and M.Rabin (eds.) *Advances in Behavioral Economics.* Russell Sage Foundation. Princeton, NJ: Princeton University Press, 2004, 74 – 103.

Wansink, B. (2004) "The All-You-Can-Eat Buffet: Eating More But Enjoying Less," Conference presentation, Boston, MA: 5th Pangborn Sensory Science Symposium.

Wansink, B. and C.R. Payne (2008) "Eating Behavior and Obesity at Chinese Buffets, *Obesity*, 16:8 (August), 1957-60.

Winer, R.S. (2005), *Pricing.* Cambridge, MA: Marketing Science Institute.

Wolf, A.M. and G.A. Colditz (1998), "Current Estimates of the Economic Cost of Obesity in the United States," *Obesity Research*, 6 (2), 97-106.

Table 1. How All-You-Can-Eat Buffets Influence Consumption and Satisfaction[1]
(Standard Deviations in Parentheses)

	Labels		*Significance*
	Half-Price Buffet (n=31)	**Regular Price Buffet (n=35)**	**F-test (1,64)** (p-value)
Actual Consumption			
- Actual number of pieces of pizza taken	3.16(2.08)	4.52(2.39)	5.97(0.02)
- Actual number pieces of pizza consumed	2.94(1.66)	4.09(1.95)	6.52(0.01)
- Dollars paid per slice of pizza consumed	$1.33(0.74)	$1.98(1.40)	5.30(0.03)
- Average number of calories of pizza eaten	1054(594)	1464(698)	6.52(0.01)
- Average grams of fat consumed	38.3(21.6)	53.2(25.3)	6.52(0.01)
- Plate waste (Actual taken less actual consumed)	0.22(0.53)	0.43(0.65)	2.09(0.15)
Perceived Consumption			
- "How many pieces of pizza did you eat today?"	3.00(1.83)	4.17(2.02)	6.04(0.02)
- "How many calories of pizza do you think you ate?	716(668)	697(468)	0.01(0.90)
- "How many pieces does the typical person eat?"	3.94(1.40)	5.75(6.24)	2.50(0.12)
Taste Perceptions			
- "The pizza, in general, tasted really great"	6.87(1.68)	6.26(1.52)	2.36(0.13)
- "The first piece of pizza I ate tasted really great"	7.10(1.47)	6.51(1.67)	2.24(0.14)
- "The last piece of pizza I ate tasted really great"	6.71(1.64)	6.49(1.56)	0.32(0.57)
- "The pizza is high quality"	6.16(1.75)	5.60(1.58)	1.88(0.18)
Other Potential Utility Measures			
- "I am very satisfied with the quality of pizza I ate"	6.43(1.36)	6.00(1.21)	1.85(0.18)
- "I am very satisfied with the quantity of pizza I ate"	6.74(1.65)	6.45(1.66)	0.48(0.49)
- "I ate more pizza than I should have"	5.20(2.81)	5.14(2.84)	0.01(0.94)
- "I ate enough pizza to get my money's worth"	7.10(1.97)	7.24(2.00)	0.09(0.77)
Socio-Demographics			
- Age	34.03(12.74)	36.17(11.79)	0.50(0.48)
- Gender (percent male)	0.74(0.44)	0.85(0.36)	1.37(0.25)
- Height (meters)	1.76(0.16)	1.79(0.09)	1.44(0.23)
- Number in group	3.97(1.52)	4.43(1.67)	1.37(0.25)

[1] All scaled questions are measured 1 = strongly disagree to 9 = strongly agree.

Table 2. The Effect of Paying Half Price Controlling for Socio-Demographic Variables[a]

Outcome Variable	Effect	Z-Statistic	P-Value
Number of Slices Eaten	-1.117	-2.31	0.021**
Dollars per Slices Eaten	-0.573	-2.20	0.028**
Overall Taste Rating	0.597	1.40	0.163
Taste Rating of First Slice	0.857	2.03	0.043**
Taste Rating of Last Slice	0.397	0.85	0.393
Plate Waste	-0.302	1.76	0.079*

n = 63, * $P<0.10$, ** $P<0.05$

a. Results are derived using a minimum distance matching estimator (Abadie et al. 2001). Matching is based on age, gender, height and number of members in the party. Standard errors correct for heteroskedastic treatment effects.

Table 3. The Effect of a Price Discount on Pizza Consumption[a]

Variables	Model 1	Model 2	Model 3
Half Price	-1.209**	-1.096**	-1.097**
	(0.484)	(0.475)	(0.497)
Gender	--	0.357	0.353
		(0.768)	(0.764)
Age	--	-0.033	-0.033
		(0.020)	(0.020)
Height	--	3.848**	3.861**
		(1.701)	(1.698)
Group	--	0.060	0.061
		(0.118)	(0.129)
Day 2	--	--	0.026
			(0.669)
Day 3	--	--	0.008
			(0.511)
Constant	4.017***	-2.262	-2.299
	(0.223)	(2.393)	(2.602)
Pseudo-R^2	0.022	0.055	0.049
	(n = 66)	(n = 63)	(n = 63)

a. Consumption is measured continuously in slices consumed, calculated by comparing total number of pizza slices taken minus the total plate waste divided by the average weight of a slice of pizza. Estimates result from Tobit estimation with a lower limit of 1 piece of pizza consumed. Standard errors are clustered by party with which the individual arrived.

Table 4. The Effect of Taste on Pizza Consumption for those Receiving No Discount and All Treatments[a] (Standard Errors in Parentheses)

	Half Price			Full Price (No Discount)			All Treatments	
Variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2
Overall Taste Rating	-0.160 (0.168)	--	--	-0.240** (0.116)	--	--	-0.204** (0.096)	--
Taste Rating of First Slice	--	-0.457** (0.230)	--	--	-0.068 (0.092)	--	--	-0.251* (0.141)
Taste Rating of Last Slice	--	--	-0.289 (0.197)	--	--	-0.334* (0.202)	--	--
Half Price	--	--	--	--	--	--	-0.976** (0.434)	-0.949** (0.458)
Gender	0.830 (1.069)	0.897 (0.894)	0.984 (0.937)	-1.272* (0.663)	-1.076 (0.810)	-0.893 (0.815)	0.209 (0.822)	0.378 (0.736)
Age	-0.030 (0.039)	-0.023 (0.030)	-0.030 (0.036)	-0.042 (0.031)	-0.047* (0.028)	-0.031 (0.033)	-0.032 (0.021)	-0.031 (0.020)
Height	3.071 (2.335)	2.278 (1.673)	2.681 (2.204)	6.518* (3.433)	5.971* (3.226)	5.008* (2.999)	3.835** (1.613)	3.266** (1.303)
Group	-0.069 (0.271)	0.012 (0.22)	-0.000 (0.253)	0.140 (0.088)	0.179* (0.101)	0.112 (0.128)	0.047 (0.121)	0.034 (0.126)
Constant	-0.804 (1.814)	2.109 (1.667)	0.307 (1.503)	-4.097 (6.012)	-4.354 (5.349)	-1.354 (5.649)	-0.806 (2.063)	0.421 (1.657)
Pseudo-R^2	0.047	0.081	0.060	0.045	0.038	0.052	0.061	0.066
	(n = 30)	(n = 31)	(n = 31)	(n = 32)	(n = 32)	(n = 32)	(n = 62)	(n = 63)

a. Consumption is measured continuously in slices consumed, calculated by comparing total number of pizza slices taken minus the total plate waste divided by the average weight of a slice of pizza. Estimates result from Tobit estimation with a lower limit of 1 piece of pizza consumed. Standard errors are clustered by party with which the individual arrived.

Figure 1. A Hypothetical Utility of Pizza Consumption Function

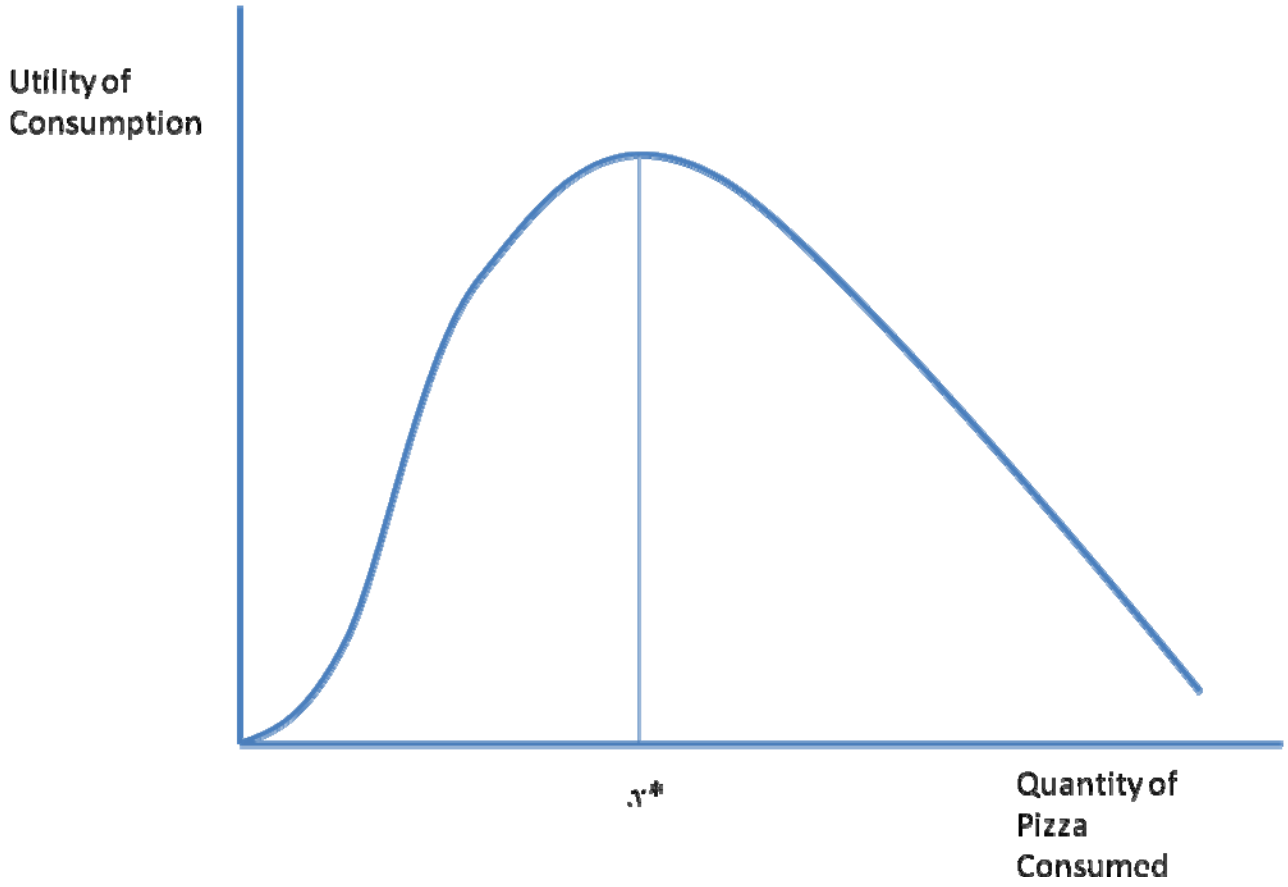

Figure 2.
The Effect of AYCE Buffet Prices on Consumption and Taste Evaluation