All-You-Can-Eat Buffet: Entry Price, the Fat Tax and Meal Cessation*

Erez Siniver and Gideon Yaniv

Abstract

A widespread meal-serving system commonly blamed for contributing to the obesity epidemic is the all-you-can-eat buffet, where customers can help themselves to as much food as they wish to eat in a single meal for a fixed entry price. The paper offers a rational-choice model for addressing the individual's eating dilemma in an-all-you-can-eat buffet, incorporating the motivation of getting-one's-money's-worth as a behavioral constraint on eating. Contrary to previous findings, the model reveals that the individual will not necessarily overeat beyond the point of fullness and will not necessarily increase eating in response to a higher entry price. An experiment conducted in collaboration with a sushi restaurant supports this conclusion. The paper further shows that a fat tax imposed on both buffet and a-la-carte meals will not affect buffet eating, hence subjecting all-you-can-eat buffets to the fat tax program need not be counter-effective as the literature results imply.

KEYWORDS: all-you-can-eat buffet, a-la-carte meal, optimal eating, fat tax, obesity, sunk cost

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Erez Siniver and Gideon Yaniv: School of Economics, COMAS, Rishon LeZion, Israel.

1 Introduction

Over the past three decades, the prevalence of obesity has more than doubled globally, reaching epidemic proportions, with more than 1 billion adults overweight and at least 300 million clinically obese (WHO, 2010). Apart from being an appearance problem, obesity is a major risk factor for many chronic conditions, including hypertension, cardiovascular disease, type-2 diabetes and certain types of cancer (Taylor, 2011). It is also an economic problem, inflicting different costs borne by governments, employers, insurance companies and the obese individuals themselves (Bhattacharya and Bundorf, 2005). In an effort to reduce the growing prevalence of obesity, economic instruments have been proposed to affect individuals' eating and physical activity choices. The most popular proposal is the 'fat tax' program, which aims at raising the relative price of calorie-dense foods so as to create an economic incentive for switching to low-calorie alternatives. Specifically, the program seeks to tax foods rich in saturated fat and sugars (e.g., pizzas, burgers, French fries, Chinese fast food, snacks, soft drinks), the revenue from which could be used to finance a 'thin subsidy' for healthy foods (e.g., fruits, vegetables, fish). While at the moment there is no fat tax operating in the world, the idea has been supported by the World Health Organization (2010) and is under active consideration by public health scholars and practitioners in several countries (Cash et al., 2004; Leicester and Windmeijer, 2004; Strand, 2004).[1]

A widespread meal-serving system commonly blamed for contributing to the obesity epidemic is the all-you-can-eat buffet, usually offered by restaurants during lunch hours or on Sunday mornings, where customers can help themselves to as much food as they wish to eat in a single meal for a fixed entry price. Examining the connection between obesity and eating behavior at Chinese buffets, Wansink and Payne (2008) found that overweight patrons were more likely to be associated with using larger plates, serving themselves immediately (rather than browsing the buffet before eating), chewing less per bite of food and leaving less food on their plates. Levitski et al. (2004), quantifying the weight gain of freshmen during their first 12 weeks at Cornell University, reported that eating in all-you-can-eat dining halls accounted for 20 percent of the variance in weight gain. Casey et al. (2008), inquiring into the association between obesity and frequency of restaurant dining among adults in rural U.S. communities, confirmed that eating out frequently, specifically at fast food restaurants and all-you-can-eat buffets, were associated with higher rates of obesity. In view of this,

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[1] The concept of a fat tax was pioneered and brought to prominence in the early 1980s by Kelly D. Brownell, Ph.D., director of The Rudd Center for Food Policy and Obesity at Yale.

understanding how people decide how much to eat in an all-you-can-eat buffet is of highly importance to public health practitioners and policy makers seeking appropriate measures to combat obesity.

Traditional economics suggests that the buffet entry price constitutes a sunk cost that should be ignored when deciding how much to eat. Only incremental costs and benefits matter. Hence, since the marginal cost is zero (or rather negligible, involving just the effort of getting up to get more food), eating should cease at the point of fullness, where the marginal utility from eating falls to zero. However, behavioral economics proposes that sunk costs greatly affect human behavior because, being inherently loss aversive and striving to justify the transactions they have made, humans irrationally pay attention to sunk cost when deciding about continuing actions. Consequently, there exists a sunk cost effect: paying for the right to use a good or service will increase the rate at which the good will be utilized (Thaler, 1980). Applied to the present context, Just and Wansink (2011, henceforth J-W) have recently suggested that the sunk cost effect reflects a desire to "get one's money's worth", which motivates the individual to eat more so as to lower the average price per unit of food to the point where he or she feels that they have got a good deal. Solving a simple utility-maximizing model which combines the (hedonic) utility from eating with the (transaction) utility from getting a good deal, J-W show that the individual will overeat beyond the point of fullness and that the higher the price the more he or she will eat. They further conduct an experiment in an all-you-can-eat pizza restaurant which confirms their hypothesis that pizza consumption increases when the buffet price is higher.

However, deriving greater pleasure the better the deal obtained does not really guarantee that the individual ends up getting his or her money's worth. For this to happen, the average price per unit of food must be reduced down to (at least if not below) the price of a competing unit offered elsewhere in a fast food counter or an a-la-carte restaurant. It thus follows that in order to fully capture the effect of one's desire to get his or her money's worth on eating cessation it should be introduced as a behavioral constraint on the maximization problem. A-priori, it is not unlikely that if the buffet entry price is sufficiently low relative to the competing unit price, the individual will already be getting his or her money's worth *before* reaching the point of fullness.

The present paper re-addresses the individual's eating dilemma in an-all-you-can-eat buffet, incorporating the getting-one's-money's-worth motivation as a behavioral constraint on eating. Furthermore, allowing the individual to consume a subsequent a-la-carte meal in the same day, the paper examines the effects of changes in the buffet entry price and the a-la-carte unit price on eating in each meal and on the total amount of food consumed during the day. Contrary to J-W, it is shown that the individual will not necessarily overeat beyond the point of fullness and will not necessarily increase eating in response to a higher price. Specifically, when the behavioral constraint on eating lies above the point of fullness, the constraint is binding and the individual will overeat beyond the point of fullness. However, when the constraint lies below the point of fullness, it is not binding and the individual will cease eating when reaching fullness. Consequently, an increase in the buffet entry price will increase eating in the former case, but will not affect eating in the latter.

To test this theoretical conclusion, we conducted an experiment in collaboration with a sushi restaurant on campus. Normally, the restaurant offers a-la-carte sushi meals only, at the average price of NIS 2 per unit. In the experiment, we offered students an all-you-can-eat sushi buffet during four hours at lunch time for the pre-advertised price of NIS 45. However, upon arriving for the buffet, predetermined to eat at the advertised price, a randomly selected two-thirds of the students were surprised to hear that they would actually be charged lower prices, NIS 30 and NIS 20. The experiment revealed that uncontrolled sushi consumption declined from an average of 24.50 units, consumed by students who paid the advertised price, to an average of 18.56 and 18.33 units, consumed by those who paid the lower prices of NIS 30 and NIS 20, respectively. Controlling for other explanatory variables, such as gender, Body Mass Index, and food quality, sushi consumption exhibits a statistically significant decline of 6.86 units from the NIS 45 group to the NIS 30 group, but only a minor and statistically insignificant change across the lower price groups. The results thus support our hypothesis that at relatively low buffet prices, participants would already get their money's worth before reaching fullness (after consuming 15 and 10 units in the NIS 30 and NIS 20 groups, respectively), hence a rise in price, from the third to the second group, need not affect the quantity consumed which is likely to be their bliss point.

While J-W’s result shed doubt on the desirability of subjecting all-you-can-eat buffets to the fat tax program, the present model suggests more optimistic results. First, if the behavioral constraint is not binding, the imposition of a fat tax will not increase the amount of food consumed. Second, since the fat tax is due not just on all-you-can-eat buffets but also on their counterpart a-la-carte items (e.g., on both pizza buffets and a-la-carte pizza slices), the behavioral constraint, which is determined by the buffet/a-la-carte price ratio, will remain intact, implying that the amount consumed at the buffet will not increase even if the constraint is binding. Third, a higher buffet price is found to reduce eating in the a-la-carte meal, so even if the behavioral constraint is binding and eating in the buffet increases, the imposition of a fat tax may reduce *daily* eating, the condition for which is formally derived. It thus follows that imposing a fat tax on all-you-can-eat buffets need not be counter-effective as J-W's result imply.

The paper is organized as follows: Section 2 develops the theoretical model; Section 3 examines the effects of price changes on optimal eating; Section 4 describes the experiment's setting, method and results; Section 5 discusses policy implications; Section 6 concludes with some related remarks.

2 The model

Consider a utility-maximizing individual who is in the habit of dining at home the whole week with the exception of one day (henceforth, "Sunday"), when he or she eats out two meals (henceforth, "brunch" and "dinner"). Brunch is eaten at a restaurant which offers an all-you-can-eat buffet for a fixed entry price, p_b. Dinner is eaten a-la-carte, for a fixed price per unit, p_c. The individual derives utility from the quantities of food he or she consumes at brunch, q_b, and at dinner, q_c, as well as from money spent on the consumption of other goods and services during the week, m. While the utility function increases monotonically in m, it is *non-monotonic* in q_b and q_c. Specifically, the utility curve reflecting the pleasure derived from eating in either meal (holding food consumption in the other meal constant) has an inverted-U shape: increasing, at decreasing marginal rates, up to a level of eating which generates a sensation of fullness, $\tilde{q}$, and declining thereafter as discomfort begins to develop. Also, because both meals are consumed in the same day, the marginal utility of q_c decreases with an increase in q_b, and vice versa.

Assuming, for simplicity, that the utility derived from m is separable from the utility derived from Sunday dining, the utility function, W, is formally expressed as

$$W = V(m) + U(q_b, q_c), \tag{1}$$

where: $V'(m) > 0;\ V''(m) \le 0;$

$$U_{q_i}(q_b, q_c) \gtreqless 0 \ \ if \ \ q_i \lesseqgtr \tilde{q}\,;\ \ U_{q_i q_i}(q_b, q_c) < 0\,,\ for\ \ i = b,\ c.$$

The individual's budget constraint is given by

$$m + p_c q_c + p_b = I\,, \tag{2}$$

where I denotes weekly income. Evidently, the budget constraint is independent of q_b. Therefore, maximizing the utility function (1) with respect to q_b (holding q_c constant) so as to determine the optimal amount of eating in the all-you-can-eat buffet, trivially yields $U_{q_b}(q_b, q_c) = 0$. Hence, by the assumptions on the utility function, $q_b = \tilde{q}$: because dining in the all-you-can-eat buffet has no incremental cost, it is worth the individual's while to eat until the point of fullness where the marginal utility from eating falls to zero. Continuing eating beyond fullness is undesirable because the marginal utility from eating becomes negative.

Apparently, this rationally optimal result is due to the fact that the maximization problem abstracts from any behavioral motivation that may underlie practical eating decisions in an all-you-can-eat environment. As discussed in the Introduction, J-W suggest that the decision of how much to eat in an all-you-can-eat buffet is influenced not just by the joy of eating, but also by the desire to get one’s money’s worth, which is manifested in an attempt to lower the average price per unit of food consumed to the point where the individual feels that he or she has got a good deal. Solving a simple model which combines the hedonic utility from eating with the transaction utility from getting a good deal, J-W conclude that the individual will overeat beyond the point of fullness. However, deriving greater pleasure the better the deal does not really guarantee that the individual ends up getting his or her money’s worth. For this to happen, the average price per unit of food must be reduced down to (at least if not below) the price of a competing unit in an a-la-carte meal. It thus follows that in order to fully capture the effect of one’s desire to get his or her money’s worth on eating, it should be introduced as a behavioral constraint on the maximization problem.

Consider now the individual’s problem of maximizing the utility function (1) subject to the budget constraint (2) and the behavioral constraint on the average price, $p_b / q_b \le p_c$. Rearranging, the behavioral constraint requires that the quantity consumed at brunch is sufficiently high to satisfy $q_b \ge p_b / p_c \equiv \tilde{p}$. Substituting the budget constraint in the utility function, the individual is assumed to choose q_b and q_c so as to maximize the Lagrangian

$$L = V(I - p_c q_c - p_b) + U(q_b, q_c) + \lambda\left(q_b - \tilde{p}\right), \tag{3}$$

where λ is a Lagrange multiplier. The Kuhn-Tucker conditions for an optimum solution are:

$$L_{q_c} = U_{q_c}(q_b, q_c) - p_c V'(m) = 0 \tag{4}$$

$$L_{q_b} = U_{q_b}(q_b, q_c) + \lambda = 0 \tag{5}$$

$$\text{where: } \lambda \geq 0; \quad q_b - \tilde{p} \geq 0; \quad \lambda\left(q_b - \tilde{p}\right) = 0.$$

Proposition 1 *When the behavioral constraint on buffet eating is binding,* $\tilde{p} > \tilde{q}$ *, and the individual will cease eating at* $q_b = \tilde{p}$*. However, when the behavioral constraint is not binding,* $\tilde{p} \leq \tilde{q}$*, and the individual will cease eating at* $q_b = \tilde{q}$*.*

Proof: When the behavioral constraint is binding, $\lambda > 0$. Condition (5) may then be written as $U_{q_b} = -\lambda < 0$, implying, by the assumptions on the utility function, that $q_b > \tilde{q}$. Also, since $\lambda > 0$, the Kuhn-Tucker conditions require that $q_b = \tilde{p}$, hence $\tilde{p} > \tilde{q}$. However, when the behavioral constraint is not binding, $\lambda = 0$. Condition (5) then reduces to $U_{q_b} = 0$, implying that $q_b = \tilde{q}$. Also, since $\lambda = 0$, the Kuhn Tucker conditions require that $\tilde{p} \leq q_b$, hence $\tilde{p} \leq \tilde{q}$. Q.E.D.

Proposition 1 suggests that the individual will continue eating at brunch beyond the point of fullness only if the behavioral constraint lies above that point. Otherwise, if the behavioral constraint lies below or at the point of fullness, he or she will cease eating when reaching fullness. This proposition differs from J-W's, who conclude that the individual will always continue eating beyond the point of fullness. It is graphically illustrated in Figure 1. If the buffet entry price is sufficiently low relative to the a-la-carte unit price, the behavioral constraint, $\tilde{p}_1$, lies below the point of fullness, $\tilde{q}$. Hence, the individual is already getting his or her money's worth *before* reaching fullness. Since eating further increases utility without additional cost, it is rationally optimal to continue eating until reaching fullness. However, if the buffet entry price is high relative to the a-la carte unit price, the behavioral constraint, $\tilde{p}_2$, lies above the point of fullness. Only then, and despite experiencing increasing discomfort, the fixation to get his or her money's worth will drive the individual to continue eating further. Eating will cease at the point where the average price per item has fallen enough to match the a-la-carte unit price. While J-W's formulation highlights the latter case, it fails to capture the former.

Proposition 2 *At the a-la-carte dinner, the individual will cease eating at* $q_c < \tilde{q}$*.*

Proof: Rearranging condition (4), we have $U_{q_c} = p_c V'(m) > 0$. The assumptions on the utility function thus imply that $q_c < \tilde{q}$ at the optimum. Q.E.D.

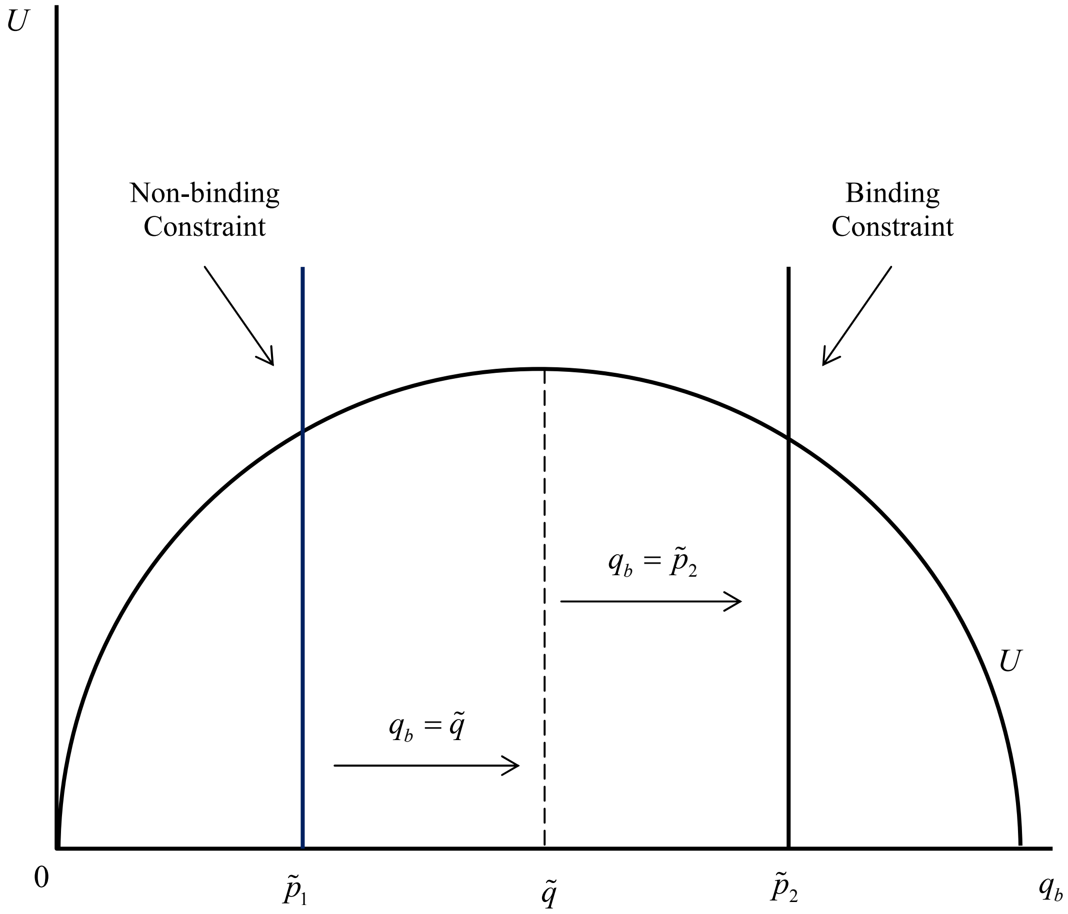

Figure 1: Optimal eating in all-you-can-eat buffet

Physicians and dieticians recommend that eating should stop before reaching fullness. Proposition 2 states that at the a-la-carte dinner this stopping rule is also rationally optimal. This is so because the utility derived from consuming the last unit of food that leads to fullness is zero, whereas the price of that unit is positive. Hence it is rationally optimal to cease eating earlier, at the point where the marginal utility from eating equates the marginal utility from the consumption of other goods that can be purchased with the unit price of food. It thus follows that the individual eats at dinner less than he or she eats at brunch, irrespective of whether or not the behavioral constraint is binding.[2]

3 Price effects

Applying their model to examine the effect on eating of an increase in the buffet entry price, J-W conclude that the higher the price, the more (beyond the point of fullness) the individual will eat. The present model, however, gives rise to quite a different result, unveiling as well the connection between buffet eating and the a-la-carte unit price, as summarized in the following propositions.

Proposition 3 *When the behavioral constraint is binding, the higher the buffet entry price or the lower the a-la-carte unit price, the more the individual will eat at brunch. However, when the behavioral constraint is not binding, an increase in either the buffet price or the a-la-carte unit price will not affect eating.*

Proof: When the behavioral constraint is binding, $q_b = \tilde{p}$. Differentiation yields

$$\frac{dq_b}{dp_b} = \frac{1}{p_c} > 0 \tag{6}$$

$$\frac{dq_b}{dp_c} = -\frac{p_b}{p_c^2} < 0\,. \tag{7}$$

Hence, the quantity consumed at brunch is positively related to the buffet entry price and negatively related to the a-la-carte unit price. However, when the behavioral constraint is not binding, $q_b = \tilde{q}$. Consequently

$$\frac{dq_b}{dp_b} = \frac{dq_b}{dp_c} = 0\,, \tag{8}$$

implying that the quantity consumed is not responsive to price changes. Q.E.D.

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[2] We assume, of course, that at dinner the individual may select a continuously varying quantity at a corresponding continuously varying price. Evidently, this is an approximation of practical a-la-carte meals, where *discrete* quantities of food are offered for fixed prices. In practice, people often end up an a-la-carte meal at a state of fullness or beyond because they are unable to order smaller quantities (at corresponding lower prices) and have already paid for an entrée which they feel compelled to finish. Given this rigidity in quantity choice, a-la-carte meals may reflect features of all-you-can-eat buffets.

Evidently, a higher entry price increases the average price per unit for a given amount of eating. Therefore, when the behavioral constraint is binding, an increase in the buffet price requires more eating to push the average price back down. However, Proposition 3 differs from J-W's result in allowing for the possibility that eating will *not* be affected by an increase in the buffet price. Furthermore, it introduces the competing a-la-carte unit price as a factor that plays a crucial role in determining the amount of eating in an all-you-can-eat buffet.

Proposition 4 *The higher the buffet entry price, the less the individual will eat at dinner, irrespective of whether the behavioral constraint is binding or not. However, the higher the a-la-carte unit price, the less the individual will eat at dinner if the behavioral constraint is not binding, yet the more he or she may eat if the behavioral constraint is binding.*

Proof: Totally differentiating condition (4) and substituting, respectively, equations (8) and (6), yields

$$\frac{dq_c}{dp_b} = -\frac{p_c V''}{p_c^2 V'' + U_{q_c q_c}} < 0 \tag{9}$$

$$\frac{dq_c}{dp_b} = -\frac{p_c^2 V'' + U_{q_c q_b}}{p_c [p_c^2 V'' + U_{q_c q_c}]} < 0. \tag{10}$$

Hence, the quantity consumed at dinner will fall with an increase in the buffet entry price, exhibiting, however, a greater negative response when the constraint is binding. Similarly, differentiating condition (4) and substituting, respectively, equations (8) and (7), yields

$$\frac{dq_c}{dp_c} = \frac{V' - p_c q_c V''}{p_c^2 V'' + U_{q_c q_c}} < 0 \tag{11}$$

$$\frac{dq_c}{dp_c} = \frac{p_c^2 (V' - p_c q_c V'') + p_b U_{q_c q_b}}{p_c^2 [p_c^2 V'' + U_{q_c q_c}]}. \tag{12}$$

While equation (11) implies that the quantity consumed at dinner will fall with an increase in the a-la-carte unit price, the sign of equation (12) is ambiguous, allowing for the possibility that eating at dinner may also rise with price. Q.E.D.

The explanation for these results is straightforward. An increase in the buffet price reduces money left for other consumption. Being a normal good (it can easily be shown that $dq_c/dI > 0$), the amount of eating at dinner falls [equation (9)]. Because the behavioral constraint is not binding, the amount of eating at brunch remains at the point of fullness and there is no cross effect on eating at dinner. However, when the behavioral constraint is binding, an increase in the buffet price increases eating at brunch and reduces the marginal utility of eating at dinner. Consequently, both the income and cross effects act to discourage eating [equation (10)]. An increase in the a-la-carte unit price generates same-direction income and substitution effects to reduce eating at dinner when the constraint is not binding [equation (11)]. However, when the constraint is binding, an increase in the a-la-carte unit price reduces eating at brunch and increases the marginal utility of eating at dinner. If the opposite-direction cross effect is sufficiently strong, eating at dinner will increase [equation (12)].

Finally, consider how changes in the buffet entry price or the a-la-carte unit price affect Sunday eating. This is given by the total amount of food consumed in both meals, $Q = q_b + q_c$. When the behavioral constraint is not binding, equations (8), (9) and (11) immediately imply that Q will fall with an increase in either price, since q_b does not change whereas q_c declines. The following propositions summarize the results for the case where the behavioral constraint is binding.

Proposition 5 *When the behavioral constraint is binding, the higher the buffet entry price, the more the individual will eat on Sunday if* $|U_{q_c q_c}| > |U_{q_c q_b}|$, *yet the less he or she will eat on Sunday if* $|U_{q_c q_c}| < |U_{q_c q_b}|$.

Proof: Adding up equations (6) and (10) yields

$$\frac{dQ}{dp_b} = \frac{1}{p_c} - \frac{p_c^2 V'' + U_{q_c q_b}}{p_c[p_c^2 V'' + U_{q_c q_c}]} = \frac{U_{q_c q_c} - U_{q_c q_b}}{p_c[p_c^2 V'' + U_{q_c q_c}]}\,. \qquad (13)$$

Hence, the sign of equation (13) is positive if $-U_{q_c q_c} > -U_{q_c q_b}$ and negative otherwise. Q.E.D.

Proposition 6 *When the behavioral constraint is binding, the higher the a-la-carte unit price, the less the individual will eat on Sunday if* $|U_{q_c q_c}| \geq |U_{q_c q_b}|$. *Otherwise, if* $|U_{q_c q_c}| < |U_{q_c q_b}|$, *the effect on Sunday eating is ambiguous.*

Proof: Adding up equations (7) and (12) yields

$$\frac{dQ}{dp_b} = -\frac{p_b}{p_c^{\,2}} + \frac{p_c^{\,2}(V' - p_c q_c V'') + p_b U_{q_c q_b}}{p_c^{\,2}[p_c^{\,2} V'' + U_{q_c q_c}]} =$$

$$= \frac{p_c^{\,2}[V' - V''(p_b + p_c q_c)] - p_b(U_{q_c q_c} - U_{q_c q_b})}{p_c^{\,2}[p_c^{\,2} V'' + U_{q_c q_c}]}. \tag{14}$$

Hence, the sign of equation (14) is negative if $-U_{q_c q_c} \geq -U_{q_c q_b}$ and ambiguous otherwise. Q.E.D.

4 The experiment

We now report an experiment destined to test Proposition 3, which is the major result of the paper. Contrary to J-W, it suggests that an increase in the all-you-can-eat buffet price will increase eating only if the behavioral constraint on the amount to be eaten is binding, but will not affect eating when the behavioral constraint is not binding.

4.1 The setting

The experiment was carried out in collaboration with *River Express*, an Asian restaurant located in the food court of the College of Management Academic Studies (COMAS) campus in the city of Rishon LeZion, Israel. Normally, the restaurant offers a-la-carte meals only at the average price of NIS 2 per unit. In the experiment, we offered students an all-you-can-eat sushi buffet on Sunday lunch time (December 11th, 2011) during four hours (12:00 - 16:00) for the pre-advertised price of NIS 45. However, upon arriving for the buffet, predetermined to eat at the advertised price, a randomly selected two-thirds of the students were surprised to hear that they would actually be charged lower prices, NIS 30 and NIS 20. During the experiment, the restaurant offered sushi to our participants only (non-participants could order other foods). The difference between the cost of the food actually eaten and the reduced amount paid by the participants was covered by the research budget of the School of Economics.

A week prior to the experiment, posters were put up around campus which advertised the NIS 45 all-you-can-eat offer. The poster stated that the meal would include two types of sushi: spicy tuna maki (tuna with cucumber and green onion wrapped in avocado) and avocado and salmon maki (inside-out roll with avocado wrapped in salmon),[3] as well as a free drink. Since the experiment required a designated space in the food court, observance of the amounts eaten and filling out of questionnaires, there was no choice but to mention on the poster that this was part of an experiment. However, the real goal of the experiment was camouflaged: the poster stated that the experiment was being done as part of an international comparative research project which investigates the profitability to restaurants of alternative dining systems.

The location of the experiment was divided into three areas and cordoned off with rope, apart from openings for entrance and exit. Each area, designated for a separate price group, contained eight tables, each with four seats, a station for filling out the questionnaire (next to the exit) and a corner buffet table, on which were placed transparent plastic containers with six pieces of maki each. Each container contained one type of maki only. About 20 containers of fresh sushi, which had been prepared a few minutes earlier, were placed on each buffet table at the start of the experiment. During the experiment, the restaurant saw to it that there was a constant supply of fresh sushi on the buffet tables.

Students who wished to participate in the experiment were directed by a research assistant to one of the three areas alternately, according to their order of arrival (those arriving in groups where directed to the same area). Each participant was handed a coupon which stated the price he or she was due to pay at the end of the meal. Another assistant assigned the participant a number. The number was written on a large sticker that was adhered to the participant’s shirt. The participant was then directed to the buffet table where another assistant offered him or her a free can of drink and suggested that he or she choose a container with six pieces of maki from one of the two types. The assistant registered on a sheet of paper the number assigned to the participant and the fact that he or she took one container from the table. The participant then chose a place to sit and began eating. Every time the participant returned to the buffet table, he or she was allowed to take one container only, which was added to the count kept by the assistant. Two other assistants observed the participants, each covering four tables. Once a participant had finished his or her meal and was getting up to leave, he or she was asked to fill out a short questionnaire which included questions on gender, age, height, weight, quality of food, number of persons he or she was dining with and frequency of eating out. After doing so, he or she submitted the questionnaire to one of the two assistants who recorded on it the participant's assigned number. The assistant also recorded how many pieces of maki (if any) were left on the table uneaten. Another assistant escorted the participant to the restaurant's cashier to pay for the meal.

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[3] The restaurant assured us that the two types of maki have similar weights and caloric values.

4.2 Method and results

Dividing the buffet price by the competing a-la-carte unit price, the model implies that participants will get their money's worth after 22.5, 15 and 10 units of sushi in the NIS 45, NIS 30 and NIS 20 group, respectively. Assessing that fullness is reached, on average, somewhere between 15 and 20 units,[4] we expected participants to overeat in the highest price group, but to cease eating upon reaching fullness in the other two groups. Consequently, we hypothesized that the average amount consumed would be greater in the highest price group than in the middle price one but would be, more or less, the same in the latter and the lowest price groups.

Table 1 presents descriptive statistics for the uncontrolled amount of sushi consumed, by all participants and by gender, under the alternative buffet prices. The table reveals that average consumption among all participants declined from 24.50 units, consumed by those who paid the advertised price of NIS 45, to 18.56 and 18.33 units, consumed by those who paid the lower prices of NIS 30 and NIS 20, respectively. Among females (49 percent of the participants), consumption declined from 23.12 units in the first group to 15.05 in the second while rising a bit to 15.25 units in the third, and among males it declined from 25.79 units to 20.79 units and rose a bit to 22.82 units, respectively. Still, consumption may vary across groups not only because of differences in the buffet entry price and gender, but also because of differences in participants' age and Body Mass Index (BMI),[5] which may affect the point of fullness, or because of differences in the quality of food served, companion of dining with and frequency of dining out. Table 2 provides descriptive statistics for all explanatory variables based on the data collected from participants' questionnaires.

Table 1: Descriptive statistics for the average quantity of sushi consumed

	All	**Buffet Price**		
		NIS 45	NIS 30	NIS 20
	I	II	III	IV
All	20.46 (7.57)	24.50 (7.96)	18.56 (6.69)	18.33 (6.39)
Male	23.01 (7.09)	25.79 (7.96)	20.79 (6.29)	22.82 (6.08)
Female	17.78 (7.14)	23.12 (7.87)	15.05 (5.84)	15.25 (4.57)

Note: Standard deviations appear in parentheses.

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[4] The restaurant's largest a-la-carte serving of 12 units often left us a bit hungry. Presumably, this is also the case with our eating population, which is younger and hungrier.

[5] The BMI is defined as the ratio of one's weight in kilograms to one's squared height in meters. A BMI between 20 and 25 is considered normal weight. An individual is classified as overweight if his or her BMI is between 25 and 30, and as obese if the BMI exceeds 30.

Table 2: Descriptive statistics for the explanatory variables

	All	**Buffet Price**		
		NIS 45	NIS 30	NIS 20
	I	II	III	IV
BMI	23.43 (3.79)	23.16 (3.57)	24.02 (3.94)	23.11 (3.86)
GENDER	0.49 (0.50)	0.48 (0.50)	0.39 (0.49)	0.59 (0.49)
AGE	28.28 (8.32)	25.15 (4.03)	28.59 (8.86)	31.11 (9.85)
QUALITY	0.27 (0.45)	0.44 (0.51)	0.22 (0.42)	0.15 (0.36)
COMPANION	1.57 (0.98)	1.35 (0.93)	1.56 (0.82)	1.79 (1.14)
FREQUENCY	1.71 (0.68)	1.59 (0.57)	1.65 (0.59)	1.89 (0.82)
N	162	54	54	54

Note: Standard deviations appear in parentheses.

In order to estimate the effects of the explanatory variables on the quantity of sushi consumed, we run an OLS regression, selecting the price of NIS 30 as a reference (omitted) category. The remaining independent variables were defined as follows:

1. ***PRICE*(*45*)** – 1 if NIS 45; 0 if NIS 20
2. ***PRICE*(*20*)** – 1 if NIS 20; 0 if NIS 45
3. ***GENDER*** – 1 if female; 0 if male
4. ***AGE*** – Number of years since birth
5. ***BMI*** – Weight in kilograms divided by squared height in meters
6. ***QUALITY*** (of food) – 1 if "delicious"; 0 if "average"
7. ***COMPANION*** – Number of people dining with (maximum 3: there were four chairs at each table)
8. ***FREQUENCY*** (of dining out at a restaurant) – 1 if "almost every day"; 2 if "once a week"; 3 if "once a month or less"

Tables 3 and 4 present the estimation results, for all participants and by gender, respectively. Controlling for other explanatory variables to examine the effect of price alone, sushi consumption among all participants (Table 3, column IV) declines by 6.86 units from the NIS 45 group to the NIS 30 group, but varies only slightly (+1.0 units) between the lower price groups. While the fall in consumption from the highest to the middle price group is statistically significant, the minor variation between the lower price groups is not. Consumption by gender exhibits a similar pattern (Table 4, columns III and VI): among males, consumption significantly declines by 5.62 units from the highest to the middle price group and insignificantly changes (+2.16 units) between the lower price groups. Among females, consumption significantly declines by 8.25 units and insignificantly changes (+0.38 units), respectively. The results are thus consistent with our hypothesis that at relatively low prices, participants would already be getting their money's worth before reaching fullness (after consuming 15 and 10 units in the NIS 30 and NIS 20 groups, respectively), hence a fall in price, from the middle to the lowest price group, will not affect the quantity consumed, which is likely to be their bliss point.

Table 3: Estimation of the regression equation (all participants)

	All			
	I	II	III	IV
PRICE(45)	5.944* (1.356)	6.435* (1.266)	6.797* (1.205)	6.858* (1.267)
PRICE(20)	-0.222 (1.356)	0.856 (1.280)	1.068 (1.216)	1.018 (1.257)
GENDER	–	-5.294* (1.045)	-3.697* (1.061)	-3.732* (1.093)
BMI	–	–	0.594* (0.139)	0.595* (0.144)
AGE	–	–	–	0.005 (0.064)
QUALITY	–	–	–	-0.317 (1.177)
COMPANION	–	–	–	-0.244 (0.519)
FREQUENCY	–	–	–	0.336 (0.762)
N	162	162	162	162
R^2	0.143	0.263	0.340	0.342

** Statistically significant variables.*
Note: Standard errors appear in parentheses.

Finally, Table 3 reveals that aside from the variable ***PRICE(45)***, only two additional explanatory variables are statistically significant in determining the quantity of sushi consumed by all participants: ***GENDER*** and ***BMI***. Males eat more than females and more overweight persons eat more. Specifically, males eat

3.73 units more than females and a 1 point increase in BMI increases eating by 0.60 units. Table 4 indicates that the ***BMI*** variable is statistically significant by gender as well: the more overweight a male or a female is, the more he or she eats. Specifically, a 1 point increase in BMI increases male and female eating by 0.39 and 0.74 units, respectively.

Table 4: Estimation of the regression equation (by gender)

	Male			Female		
	I	II	III	IV	V	VI
***PRICE*(*45*)**	4.998* (1.760)	5.437* (1.768)	5.617* (1.863)	8.068* (1.806)	7.963* (1.613)	8.254* (1.750)
***PRICE*(*20*)**	2.030 (1.885)	2.106 (1.870)	2.159 (1.931)	0.202 (1.729)	0.429 (1.544)	0.379 (1.674)
BMI	–	0.357* (0.131)	0.387* (0.146)	–	0.739* (0.164)	0.744* (0.175)
AGE	–	–	0.066 (0.100)	–	–	-0.031 (0.084)
FREQUENCY	–	–	1.297 (1.380)	–	–	0.056 (0.966)
COMPANION	–	–	-0.058 (0.801)	–	–	-0.371 (0.682)
QUALITY	–	–	0.212 (1.845)	–	–	-1.435 (1.569)
N	83	83	83	79	79	79
***R*^{2}**	0.092	0.118	0.133	0.277	0.431	0.441

** Statistically significant variables.*
Note: Standard errors appear in parentheses.

5 Policy implications

As mentioned in the Introduction, economists have proposed instruments for combating the growing obesity epidemic, the most popular of which is the fat tax program, which aims at raising the relative price of calorie-dense foods so as to create an economic incentive for switching to low-calorie alternatives. Recently, however, Yaniv et al. (2009) challenged the effectiveness of the proposed program, developing a rational calorie-intake/calorie-use choice model to show that a fat tax may result in *increased* obesity. The reason for this is that a fat tax will generate substitution away from fast-food restaurant meals towards cooking more at home, leaving less time for physical activity. While calorie intake will fall, calorie burning may fall by more. Furthermore, Schroeter et al. (2008) demonstrated empirically that a tax imposed on a category of food away from home, often blamed for much of the rise in obesity, could lead to an increase in body weight. While such a tax decreases away-from-home consumption, it might reduce not just calorie intake but also some other necessary nutrients. Compensatory consumption at home might be energy-rich and well result in an increase in overall calorie intake and weight.

A question arises of whether the fat tax should be applied to all fatty foods or just to certain categories of food. Still, there seems to be a consensus among its proponents that it should be imposed on restaurant junk food. Analyzing eating behavior in all-you-can-eat buffets, J-W have recently shed doubt on the desirability of subjecting buffets to the fat tax program: while a higher entry price is likely to reduce the frequency of visiting buffets, it is bound to increase the amount of food consumed in a given visit beyond the point of fullness. Consequently, the imposition of a fat tax on buffet patrons might end up contributing to weight, exacerbating the problem the fat tax program aims to eliminate. The present model, however, yields more optimistic results. First, if the behavioral constraint on eating in the buffet is not binding, the individual will not continue eating beyond the point of fullness and the imposition of a fat tax will not increase the amount of food consumed. Second, since the fat tax is likely to be imposed not just on all-you-can-eat buffets but also, at the same percentage, on their counterpart a-la-carte items (e.g., on both pizza buffets and a-la-carte pizza slices), the behavioral constraint, represented by the buffet price relative to the a-la-carte unit price, will remain intact. Consequently, the amount consumed in an all-you-can-eat buffet will not increase even if the constraint is binding. Since the frequency of visiting buffets is likely to fall, the total amount of food consumed in buffets will fall as well. It thus follows that subjecting all-you-can-eat buffets to the fat tax need not be counter-effective. Third, even if the fat tax is imposed on buffets alone, and eating in the buffet increases because the behavioral constraint is binding, the cross effect on a subsequent a-la-carte meal the same day may be strong enough to reduce daily food consumption. Finally, even if the fat tax is imposed on a-la-carte meals alone, and eating in the buffet falls while eating in the a-la-carte meal increases, daily eating may fall as well.

6 Concluding remarks

We have incorporated the behavioral motivation of getting one's money's worth into a rational utility-maximization model to determine the individual's optimal eating in an all-you-can-eat buffet. Specifically, we have introduced this motivation as a constraint on the amount to be eaten, obtaining different results than those recently reported in the literature. However, browsing Internet blogs and forums on buffet experience suggests that the decision of how much to eat in an all-you-can-eat buffet may also be influenced by two additional motivations: coping with the challenge posed by the all-you-can-eat teaser and beating the system so that the restaurant ends up losing money. One blogger describes the first motivation as follows:

> ‘Ok eater,’ says the restaurant, ‘I dare you. Come here, and try to eat all you can eat. I bet you won't finish more than two plates.’ (Roberts, 2004).

Another blogger describes the second:

> Basically, my goal from the moment I walk into the buffet is to eat so much food that the restaurant loses money. I want to eat so much that when they see me come back the next time, they get scared. I want them to worry that if I eat at their buffet too often, they might have to close it down." (Brooks, 2007).

While the getting-one's-money's-worth motivation involves just the desire to end up with a good bargain, which if satisfied at quantities below the point of fullness need not affect the amount eaten, the other motivations seem to always lead to excess eating. In particular, an eater motivated by the desire to sink the business would surely recognize that there are other types of buffet eaters who are not driven by this motivation, thus he or she would be forced to eat to the point where the average value of food eaten across all types of eaters is high enough to sink the business. This requires different modeling which we leave for future research.

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