The Value and Cost of Restaurant Calorie Labels: Results from a Field Experiment

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Abstract

Using field experiment data, we estimate a structural model of consumer demand to determine the value of information for restaurant menu labels. Our experimental design allows us to compare the effectiveness of calorie labels to a “fat tax” at reducing caloric intake. Results show numeric labels did not influence demand, but symbolic traffic light labels reduced the marginal utility of caloric intake. Our model projects both labels would reduce intake more than high-calorie taxes or low-calorie subsidies. Ultimately, traffic light calorie labels led to the largest reduction in caloric intake but also one of the largest reductions in restaurant net returns.

Key Words: menu labeling, full-service restaurant, calorie taxes/subsidies, restaurant net returns

JEL Codes: I18, D04

I. Introduction

In 2009, Americans spent 42% of their food dollars on meals away from home (Morrison, Mancino, and Variyam, 2011). Consumers choose to eat outside the home for a variety of reasons including convenience, but there is mounting concern that this spending pattern will have a detrimental effect on Americans' diet and overall health. Todd, Mancino, and Lin (2010) estimated that for each additional meal eaten away from home, consumers ate an additional 134 calories. By their estimation, the average person will gain two pounds each year just by eating out one meal a week. Not only does food away from home tend to be higher in calories, its nutrient quality pales in comparison to meals prepared in the home (Todd, Mancino, and Lin, 2010).

The combined increases in eating away from home and U.S. obesity/overweight rates have caught the attention of policymakers. In an effort to help promote healthier food choices, several cities, counties, and states have passed or are considering legislation which would require nutrition labeling on restaurant menus (CSPI, 2010). With the passage of the 2010 health care bill, a standardized menu labeling system will soon be required in restaurants across the country. The labeling guidelines currently being set by the Food and Drug Administration (FDA) will take precedence over local labeling laws. Although the specific guidelines have not been released (they are expected to be released by the end of 2011), it is probable that restaurants with 20 or more outlets will be required to provide: (1) calorie information for all menu items on all menus, menu boards, food tags, and drive-throughs, (2) additional nutrition information for all menu items available upon request, and (3) a statement of the recommended daily caloric intake (2,000 calories/day) for the average individual (FDA, 2011).

While the literature on menu labeling in restaurants is expanding, large gaps in knowledge remain. This research was designed to fill many of these gaps by explicitly calculating the value of information present in two types of calorie labels using data collected from a field experiment in which restaurant diners were unaware of the ongoing study. The innovativeness of our approach can be seen by briefly surveying the existing literature on the topic.

Past research on the effectiveness of menu labeling has been remarkably inconclusive. Some studies conclude providing nutritional information on menus lowers caloric intake (e.g., Milich, Anderson, and Mills, 1976; Wisdom, Downs, and Loewenstein, 2010). Yet, other studies find the information has no effect (e.g., Mayer et al., 1987; Harnack et al., 2008). Even among studies finding an effect, the size of the effect tends to be small. For example, Balfour et al. (1996) and Yamamoto et al. (2005) found that only a small proportion of consumers (16% and 29%, respectively) changed their menu item selection when presented with nutrition information. Importantly, none of these previous studies have provided an estimate of the economic value of nutritional information on restaurant menus that could be used in a cost-benefit analysis.

One of the primary weaknesses of previous research relates to issues concerning external validity. In particular, many of the previous studies have been conducted in artificial settings in which participants were aware of the on-going research. The earliest studies on restaurant menu labeling were not actually conducted in restaurants but in laboratory or cafeteria settings (Milich, Anderson, and Mills, 1976; Cinciripini, 1984; Mayer et al., 1987; Balfour et al., 1996; Yamamoto et al., 2005; Harnack et al., 2008). There is ample evidence that people often behave differently when they are aware that their behavior is scrutinized, suggesting the need for research in a more natural setting (Harrison and List, 2004; Levitt and List, 2007). More recent studies have been conducted in fast-food restaurants (Chandon and Wansink, 2007; Wisdom, Downs, and Loewenstein, 2010), but to our knowledge only one study has been conducted in a full service, sit-down restaurant (Pulos and Leng, 2010). This setting is of particular interest because diners actually have time to thoughtfully consider nutrition information presented on menus, which is often not the case in fast-food outlets. Moreover, the sample of consumers self-selecting into fast-food restaurants is likely to respond differently to menu labels than consumers selecting full service restaurants.

Another weakness of previous research relates to the type of nutritional information provided. Past research has solely focused on providing calorie information in a numeric format (i.e., the number of calories beside each menu item). Although this is a straightforward way to present information to diners, research has shown people are unfamiliar with calories, often grossly mis-estimate caloric intake, and are unaware of how many calories they should consume on a daily basis (Burton et al., 2006; Krukowski et al., 2006; Blumenthal and Volpp, 2010). Given these difficulties, one might question whether numeric calorie labeling will substantively influence consumer choice. As the research in behavioral economics shows, *how* information is provided can be just as (if not more) important as *which* information is provided (Thaler and Sunstein, 2008). Based on the information processing literature (Scammon, 1977; Russo et al., 1986), we hypothesize that symbolic presentation of nutrition information will have a larger effect than numeric calorie information. Symbols are easier to process for the consumer, and serve as a quick guide or normative suggestion to choose lower-calorie menu items.

Federal legislative efforts have primarily focused on food information policies, but these are not the only policy instruments which could be used to encourage healthier eating. Indeed, many have argued for pricing policies such as “fat taxes” and “thin subsidies” to direct consumers toward lower-calorie items. French (2003) found that imposing a “thin subsidy” for low-fat items in vending machines (50% price reduction) can dramatically increase sales on those items (93% increase); nevertheless, price changes of this magnitude are politically infeasible. Most studies on “fat taxes” have concluded they will have very little effect on caloric intake (e.g., see Kuchler, Tegene, and Harris, 2005; Dharmasena and Capps, 2011; Schroeter, Lusk, and Tyner, 2008) or obesity rates as these taxes will likely cause consumers to change where they eat rather than how much they eat (Anderson and Matsa, 2011). Regrettably, few studies have attempted to compare the relative effectiveness of different policy options (i.e., information or labeling policies versus pricing policies) under an over-arching experimental design. One exception is the study by Horgen and Brownell (2002) who studied labeling and pricing interventions in a restaurant setting. However, in their study, labels were not provided for all menu items and advertising was used to draw diners’ attention to the healthier and lower-priced items. Our research aims to compare policy options in a natural environment more similar to the world in which the policies would be implemented.

Finally, previous research has failed to determine how menu labeling will affect parties other than the consumer. Although there are costs associated with item reformulation and menu redesigns, there has been little accounting of how consumers’ new choices might affect restaurant profitability. In fact, only one study to our knowledge considers the effect of calorie labels on restaurant revenue (Bollinger, Leslie, and Sorensen, 2011). Thorough economic analysis, however, should compare the benefit of providing caloric information to diners (via diners’ value of information) to the cost of information provision (change in restaurant net returns over food and preparation costs due to menu label). Additionally, accounting for changes in net returns (over food and preparation costs) is needed to quantify the trade-offs for each policy option (e.g., Policy A will decrease caloric intake by X calories but will reduce restaurant net returns by Z dollars). Our study is designed to provide information on such tradeoffs.

The overall purpose of this research is to perform an in-depth examination of menu labeling and pricing policies in a full service, sit-down restaurant. Specifically, this research determines: (1) whether caloric labels in a full service restaurant influence food choice, (2) whether symbolic calorie labels are more/less influential than numeric calorie labels, (3) how effective menu labels are relative to “fat taxes” and “thin subsidies” at reducing caloric intake, (4) how menu labeling and “fat taxes/thin subsidies” affect restaurant net returns (over food and preparation costs), and (5) the economic value of menu labels.

II. Data and Experimental Design

From August to November 2010, daily lunch receipts were collected from The Rancher’s Club, a full service, sit-down restaurant in Stillwater, Oklahoma. The Rancher’s Club is upscale relative to other restaurants in town, with diners in our sample spending more than $14 on average for lunch including drinks and deserts. The restaurant is located on the Oklahoma State University campus but is open to (and frequented by) residents without affiliation with the University. Importantly, the restaurant had never previously been used for research purposes, making it unlikely diners would have any expectation of being part of a research study.

The restaurant was divided into three sections, each of which was assigned to a particular menu treatment. The authors informed restaurant staff of the general purpose of the study and stressed the need to maintain consistency over the course of the experiment (i.e., ensure diners were presented with the correct menu). Hosts and servers were also trained on how to address diners’ questions on the new menus, with an emphasis on factually answering the question rather than offering opinions on diet and nutrition. Restaurant patrons were unaware of the ongoing study, and in an effort to minimize response bias, wait staff were instructed to refrain from telling diners about the study.

The restaurant offered a total of 51 menu options, including items such as soups and salads, burgers, pasta, and even prime steaks. This menu offering allowed for a wide range of caloric values and prices ranging from a low of $3 for a cup of soup to a high of $58 for the prime steak. Caloric contents were obtained for each item using The Food Processor nutrition analysis software.[1] The head chef entered recipes for each menu item to obtain the most accurate calorie counts. Although complete nutrition profiles were available for each item, we only provided calorie information on menus in an effort to mirror what is likely to be mandated by the FDA.

Upon entering the restaurant, a lunch-party was randomly assigned to one of three menu treatments. All menu versions included descriptions and prices of each menu item, but the level of caloric information provided varied. The control used the restaurant's conventional menu that was in existence prior to the experiment. The control menu did not provide any information on an item's caloric content. The menu contained a brief description of each item and had the item's price. In the first manipulation, which we call the calorie only menu treatment, diners were given menus that had caloric information in parentheses immediately preceding each item's price. Other than this change, the menu was exactly the same as the control menu. In the second manipulation, which we refer to as the symbolic or calorie+traffic light menu treatment, diners were given menus with caloric information in parentheses immediately preceding each item's price plus a "traffic light" symbol that was red for items with more than 800 calories, yellow for items between 401 and 800 calories, and green for items with 400 calories or less. Caloric category cutoff points were selected so that each color was well represented on the menu. Aside

[1]More information on the software is available at http://www.esha.com/foodprosql

from the addition of the traffic light symbols, the menu was identical to the one used in the calorie only treatment.

To be clear, all diners at a table had the same menu. However, each table was assigned to a menu treatment, and parties were randomly assigned to a table upon entering the restaurant. Thus, at any given time all three menus were in use in the restaurant. The strength of this experimental design strategy is that differences in ordering patterns across menu treatments cannot be attributed to changes in menu preferences over time (such as changes across seasons from Summer to Winter or from changes from Monday to Friday). A potential weakness of the design is that repeat customers to the restaurant may be assigned to a different menu treatment on a subsequent visit. A diner previously assigned to the traffic light menu may remember the information and utilize it if later assigned to the control menu. Such an effect would cause differences across treatments to diminish over time. This is an issue we control for in the data analysis.

The experiment ran a total of 19 weeks. After the 12th week, we manipulated the prices of selected menu items on all three menus. Items were selected based on how frequently they were ordered; those which were ordered most regularly were ideal candidates for the price manipulation. Table 1 outlines the specific menu items chosen for the price manipulation, their caloric contents, and the magnitude of their price changes. As shown in table 1, we see a “fat tax” was imposed on four high-calorie (red light) menu items, while a “thin subsidy” was imposed on three lower-calorie (green or yellow light) menu items. Most price changes ranged from 10-13% of the item’s initial price; a constant percentage increase/decrease was not utilized in an effort to maintain the restaurant’s pricing format (whole or half dollar pricing). Two high-calorie items (the West Coast Cheese Burger and the Cowboy Combo), however, were assigned much larger price changes (17% and 23% price increases, respectively) relative to the other options. These items were especially high in calories; thus, they were taxed more heavily.

The purpose of the price manipulation was twofold. First, we wanted to directly compare how caloric intake changed as a result of menu labels as compared to a calorie tax/subsidy. Secondly, in the structural demand model described in the next section, we wanted to ensure that the marginal utility of price could be clearly identified and as we describe momentarily, the price manipulation helps ensure the price effect is not confounded with unobserved quality effects.

IV. Model and Data Analysis

Our analysis is based on a random utility model constructed to explain the choice of main entrée. Diner *i*'s utility from menu option *j* at time *t* is assumed to depend on the attributes of the menu choice option (e.g., price, caloric content) and a stochastic error term representing individual idiosyncrasies unobservable to the analyst. For an individual randomly assigned to menu type *m* (*m* = no label, calorie only label, calorie+traffic light label), the random utility function is:

(1) $$U_{itj}^{m} = V_{itj}^{m} + \varepsilon_{itj}^{m}$$

For the basic model we consider, the systematic portion of the utility function is:

(2) $$V_{itj}^{m} = \alpha Price_{itj} + \beta_1^m cal_j + \beta_2^m salad_j + \beta_3^m burger_j + \beta_4^m combo_j + \beta_5^m pasta_j + \beta_6^m veggie_j + \beta_7^m steakprime_j + \beta_8^m steakchoice_j,$$

where $Price_{itj}$ is the price of menu item *j* faced by individual *i* at time *t*, cal_j is the number of calories in menu item *j*, and the remaining variables are self-explanatory dummy variables describing *j*'s food type. The food-type dummy variables coincide with the major section headings on the menu. The marginal (dis)utility of price, α, does not have a menu superscript, m. This is an economic restriction we impose on the analysis which permits the calculation of welfare effects resulting from changes in menu label format. Without this restriction, one cannot calculate the monetary tradeoff needed to equate utility in two different menu treatments.

Equation (2) posits that consumers' utility for a menu item is affected by the item's calories. Colby, Elder, and Peterson (1987) found that consumers overwhelmingly consider a menu item's taste to be its most important attribute. Additionally, Horgen and Brownell (2002) suggest consumers may believe "healthy" menu items sacrifice taste, and thus, may choose less "healthy" options. For these reasons, we hypothesize that without any nutritional information, utility will be increasing with calories (i.e., $\beta_1^{no\ info} > 0$).

When calorie information is present, the marginal utility of calories may change. Numerous studies in the nutrition literature have shown people tend to underestimate the number of calories in the foods they consume (see Burton et al., 2006; Chandon and Wansink, 2007), so when consumers learn (via nutritional information) they are eating more calories than they believed, feelings of guilt or disappointment may arise from overeating, and their utility from that food choice may fall. Alternatively, the provision of nutrition information may reduce the bias in estimates of caloric intake, so simply being more aware of the nutritional content of one's food could also decrease utility. Whatever the reason, we expect the marginal utility of caloric intake will fall in the calorie only and calorie+traffic light treatments relative to the control.

If the error terms in equation (1) are distributed iid type I extreme value, McFadden (1974) shows that out of a set of *J* alternatives, the probability of alternative *j* being chosen is the familiar multinomial logit model:

$$(3) \qquad P_{itj}^{m} = \text{Prob(option } j \text{ is chosen)} = \frac{e^{V_{itj}^{m}}}{\sum_{k=1}^{J} e^{V_{itk}^{m}}}$$

Despite allowing all the non-price parameters to vary by menu treatment, equation (2) is a rather simplistic utility specification. Several alternative specifications were considered but none proved to significantly improve model fit. For example, because the experiment ran 19 weeks, it is possible that some diners were returning guests who might have become desensitized to the new menu labels. If this were the case, one would expect the effect of menu labeling to dissipate over time. However, when equation (2) is modified to include a time trend variable interacted with the attributes, none of the time-attribute interactions were statistically significant, and as a result we omitted them from the model.

Another potentially restrictive assumption of the multinomial logit is that the error term, ε_{itj}^{m}, is assumed independently and identically distributed across individuals and alternatives. However, some menu alternatives (or people) might share unobserved similarities which cause their errors to be correlated. To address this issue, we estimated error-component models. In this model, alternative-specific random effects were added in which it was assumed that items in the same sub-section of the menu shared a common error component. In such specifications, however, the estimated standard deviation of the random effects were not statistically different that zero, and this was true for specifications in which we assumed a menu-day random effect, day-only random effect, or no panel structure at all. A similarly motivated nested-logit specification, which assumes menu items within a nest (but not across nests) exhibit similar substitution patterns, did not significantly improve model fit either. As a result, the ultimate analysis rests on the conventional multinomial logit specification. We also tested for differences in error variance across menu treatments following Swait and Louviere (1993), but found no evidence of heteroskedasticity. Finally, likelihood ratio tests could not reject the null hypothesis that $\beta_k^{no\ label} = \beta_k^{calorie\ only} = \beta_k^{traffic\ light}$ for all $k > 1$, meaning that the calorie labels only influenced the marginal utility of calories but not the marginal utilities associated with food-type.

One final model specification issue which had a substantive impact on results relates to the potential for unobserved, alternative-specific quality attributes to correlate with the alternative's price leading to a biased estimate α (see Berry, Levinsohn, and Pakes, 1995 and Nevo, 2001). Petrin and Train (2010) suggested a relatively straightforward method to account for this type of endogeneity problem assuming one is in possession of a good instrument for price. A good instrument should be highly correlated with price but uncorrelated with the unobserved quality of the menu item. Fortunately, our experimental design was constructed to yield precisely such an instrument.

Let d_{1j} be a dummy variable indicating items for which we increased prices (and d_{2j} those for which we decreased prices) after the experimental price manipulation, and let t be a dummy variable indicating those observations obtained after the experimental price manipulation. The interaction between these variables, $d_{1j}*t$ and $d_{2j}*t$, are valid instruments for $Price_{itj}$ because they are clearly correlated with price but, by construction, they are not are not characteristics of the choice alternatives. The choice alternatives did not change over time, and so assuming that the marginal utilities of product characteristics (both observed and unobserved) do not change over time, the instrument is orthogonal to the error term.

Following Petrin and Train (2010), we regressed $Price_{itj}$ against the two instruments, $d_{1j}*t$, $d_{2j}*t$, the dummy variables d_{1j} and d_{2j}, and all the non-price attributes in equation (2). Letting e_{itj} be the error term from this regression, Petrin and Train (2010) show that an unbiased estimate of the price effect can be obtained by replacing equation (2) with:

$$(4) \qquad \tilde{V}_{itj}^{m} = \tilde{\alpha} Price_{itj} + \tilde{\beta}_1^{m} cal_j + \tilde{\beta}_2\ salad_j + \tilde{\beta}_3\ burger_j + \tilde{\beta}_4\ combo_j + \tilde{\beta}_5\ pasta_j + \tilde{\beta}_6\ veggie_j + \tilde{\beta}_7\ steakprime_j + \tilde{\beta}_8\ steakchoice_j + \lambda e_{itj}$$

This so-called control function approach produces unbiased estimates, but the conventional standard errors are incorrect. As a result, we used bootstrapping to obtain the standard errors.

Once the parameter estimates are obtained, expected caloric intake and restaurant net returns over food and preparation costs for menu type *m* can be calculated as:

(5) $E[calories]^m = \sum_{j=1}^{J} \tilde{P}_j^m \, cal_j$

and

(6) $E[net\ returns]^m = \sum_{j=1}^{J} \tilde{P}_j^m \, Markup_j,$

where $\tilde{P}_j^m$ is the probability of choosing menu item *j* given menu type *m*, which is obtained by substituting the utility specification in equation (4) into equation (3). $Markup_j$ represents the mark-up, or margin, for each menu item *j*, which provides the net returns for each menu item above its food and preparation costs. In addition to studying the calorie and net return impacts of different menus, the effects of a "fat tax" or "thin subsidy" on caloric intake and net returns can also be simulated by changing the prices of certain menu items and re-calculating (5) and (6) at the altered probabilities of choice. For this application, we considered a "fat tax" in which the prices of all items more than 800 calories (i.e., the "red" items on the traffic light menu) were increased 10%, and also a "thin subsidy" in which the prices of all items less than 400 calories (i.e., the "green" items on the traffic light menu) were decreased 10%.

In addition to these calorie and net return changes, it is also useful to consider individuals' willingness-to-pay for different menu items. The utility coefficients given in equation (4) can readily be used in this regard. For example, an individual's willingness-to-pay for a prime steak instead of a salad is just the price difference between the two options that would generate the same level of utility: $[(\tilde{\beta}_7 + \tilde{\beta}_1^m cal_{prime\ steak}) - (\tilde{\beta}_2 + \tilde{\beta}_1^m cal_{salad})]/-\alpha.$

A calculation more relevant to the policy debate, however, is the value of information or the welfare change resulting from a move from the conventional menus to the menus containing caloric information. One challenge with such a calculation is that the mandatory labeling policy does not actually change the underlying quality of the product. The labels simply serve to provide information to diners about the choices they actually face. Foster and Just (1998) introduced a method to measure welfare changes in situations such as this; an approach that was extended to random utility models by Leggett (2002).

In this framework, consumers are assumed to make choices based on their (potentially incorrect) *perceptions* of quality, but the utility they ultimately experience is determined by *actual* quality. Foster and Just (1998) argue that a "cost of ignorance" can be determined by calculating the welfare loss that would result if consumers gained new information (making perceived quality equal actual quality) but were constrained to make the same choices as they did before information. The value of information is negative one times the cost of ignorance.

In the discrete choice framework, Leggett (2002) showed that the appropriate welfare measure in this framework is:

$$(7) \qquad \left[\frac{\ln\left(\sum_{j=1}^{J} e^{\tilde{V}_{ij}^{calorie\ label}}\right)-\ln\left(\sum_{j=1}^{J} e^{\tilde{V}_{ij}^{no\ label}}\right)}{-\alpha}\right]-\left[\frac{\sum_{j=1}^{J} \tilde{P}_{k}^{no\ label}(\tilde{V}_{ij}^{calorie\ label}-\tilde{V}_{ij}^{no\ label})}{-\alpha}\right].$$

The first term in brackets is the conventional welfare calculation except that the utility in the no label world, $\tilde{V}_{ij}^{no\ label}$, is based on consumers' *perceptions* of caloric intake. This is the value Leggett (2002) refers to as the anticipated utility change. In our case, this change might very well be negative if consumers tend to under-estimate the number of calories consumed prior to labels (Chandon and Wansink, 2007). This anticipated change, however, is based on incorrect perceptions of quality in the pre-label environment. The second term in brackets captures the value of the adjustment in perceptions as they approach true quality in the post-label environment. It captures the cost of ignorance resulting from diners making a different set of choices than they would have with better information. The standard errors associated with the welfare effects of the label change are determined using the aforementioned bootstrapped utility parameters.

V. Results

Daily lunch receipts collected over a 19-week period yielded 1,532 usable observations. The focal unit of analysis for each observation was the main entrée choice. Recall restaurant patrons received one of three menus upon being seated: a menu with no nutritional information, a menu with calorie information only (numeric calorie label) for each item, or a menu with calorie information plus a traffic light symbol (symbolic calorie label) for each item.

Using the raw data, we compared how frequently each item was ordered under each menu treatment to determine whether calorie labels influence food choice. For illustrative purposes, figure 1 shows how often three menu items were ordered. The three items were chosen to represent a low, medium, or high-calorie menu option. Per the figure, we see that the Signature Cheese Burger (a high-calorie, red light, item) made up the greatest proportion of meals ordered, 5.1%, under the control menu where no calorie label was provided. Conversely, this item only composed 3.6% of total items ordered when diners had the symbolic calorie (calorie+traffic light) menu. The six ounce sirloin (a low-calorie, green light item), on the other hand, was especially popular in the symbolic calorie label treatment, comprising 5.3% of total meals ordered. In the case of the West Coast Rancher (a medium-calorie, yellow light item), it was frequently ordered in all three menu treatments, but accounted for the largest share of total meals ordered (10.2%) when the numeric calorie label was present.

Looking at the order frequency of individual menu items across treatments offers some insight on whether calorie labels influence food choice. However, with 51 menu items to choose from, we recognize some items will be ordered far more often than others, and some items may not be ordered at all (i.e., a $50 steak). Thus, figure 2 reports how frequently low, medium, and high-calorie items were ordered across menu treatments. From figure 2, it can be seen that low-calorie items, those with 400 calories or less, were ordered most often in the symbolic calorie label treatment (38.8% of all meals ordered) and least often in the no calorie label treatment (29.9% of all meals ordered). High-calorie items, those with more than 800 calories, were just the opposite. These items were selected most when no calorie label was present and least when the symbolic calorie label was present, representing 34.5% and 28.1% of all meals ordered, respectively. Medium-calorie items, those with 401-800 calories, were chosen at least one-third of the time in each of the menu treatments, and were most popular in the numeric calorie label treatment, accounting for 38.4% of all meals ordered. From figure 2, we can conclude that calorie labels resulted in significantly more low and medium-calorie items ordered compared to high-calorie items (p-value=0.01). The presence of either a numeric or symbolic calorie label reduced the proportion of high-calorie items chosen by 4.4% or 6.4%, respectively.

Structural Demand Estimates

While many previous studies have solely focused on analyzing the number of calories ordered/consumed, we estimated a structural demand model which allows us to estimate the welfare effects resulting from menu labeling changes and to simulate outcomes in alternative policy scenarios. Table 2 presents two sets of multinomial logit (MNL) estimates: the conventional model and the model corrected using the control function approach (Petrin and Train 2010) to resolve the potential price endogeneity issues.

The most notable difference between the two sets of estimates is the magnitude of the price coefficient. Under the conventional model, a one dollar increase in an item's price is projected to decrease utility by 0.0285 units; however, in the corrected model, a one dollar price increase results in a 0.1286 unit decrease in utility. Further, the control function approach yielded a more reasonable and intuitive coefficients for other attributes. Consider the estimates for prime and choice steaks. Under the conventional MNL estimates, the marginal utility of a prime (choice) steak was negative (positive) relative to the utility derived from the daily special. Holding all else constant, these estimates suggest individuals would be happier with a choice steak rather than a prime steak, a result which is inconsistent with the fact that prime steaks are of higher quality and are almost universally higher priced. The corrected MNL estimates depict a more likely story, as both the prime and choice steak coefficients were positive, and the prime steak coefficient was greater than that of the choice steak, meaning people would, holding all else constant, choose a prime over a choice steak.

Focusing on the corrected MNL estimates, we see that restaurant patrons had a positive marginal utility of calories, such that for every additional calorie a menu item has, an individual's utility increases by 0.0005 units. Based on previous research, this result is expected as people often link calories to taste, implying the more calories an item has, the better it tastes and the happier the consumer (Horgen and Brownell 2002).

When calories were interacted with menu type, however, we found the marginal utility of calories fell. More specifically, the interactions between calories and the calorie-only (numeric calorie label) and the calorie+traffic light (symbolic calorie label) menus show that the marginal utility of calories fell 0.0003 and 0.0006, respectively, relative to the control menu. Only the later effect, however, was statistically significant. That is, the numeric presentation of calorie information only (as mandated by the forthcoming law) was not significantly different from the control menu. Symbolic presentation of calorie information significantly lowered the marginal utility of information.

Because the model was estimated by interacting the treatment dummy variables with the calorie effect, the reported calorie effect shows the marginal utility of calories in the control menu and the coefficients on the interactions show the additional effects over and above the control. Thus, the marginal utility of calories was: 0.0005 for the control menu with no calorie label, 0.0005-0.003=0.0002 for the menu with the numeric calorie label, and 0.005-0.0006= -0.0001 for the menu with the symbolic calorie label.

The estimates also indicate that some menu categories are more preferred than others. For instance, the coefficients for salads, pasta, and vegetarian items were all significantly negative, implying diners would be happier eating the daily special over items from these categories holding all else constant. Of these categories, diners least preferred to order salads as this category had a marginal utility of -2.0356. Burgers, combo meals, and prime and choice steaks, conversely, were preferred to the daily special.

A key advantage of estimating a structural choice model over analyzing raw data is the ability to quantify how much people are willing to pay for certain menu items. For instance, an individual's willingness-to-pay for a prime steak with 1,000 calories over a salad with 300 calories is calculated as: $\left[\left(\tilde{\beta}_7 + \tilde{\beta}_1^m cal_{prime\ steak}\right) - \left(\tilde{\beta}_2 + \tilde{\beta}_1^m cal_{salad}\right)\right] / -\alpha$. Inserting the appropriate estimates, we find that, when no calorie label is present, an individual was willing to pay $\frac{[(2.2362+0.0005*1000)-(-2.0356+0.0005*300)]}{--0.1286}$ = \$35.94 for the prime steak over the salad—an estimate that is well within the price variation present on the menu. Figure 3 illustrates this willingness-to-pay difference between steaks and salads for the three menu treatments. Notice the willingness-to-pay decreased by \$1.62 and \$3.26 for the numeric and symbolic calorie labels, respectively, relative to the control. This can be attributed to the fact that the marginal utility of calories falls in the calorie only and symbolic treatments.

Similarly, we can calculate a person's willingness-to-pay for an item as its caloric content changes. Figure 4 displays how the willingness-to-pay for a hypothetical burger over the daily special changes as the number of calories in the hypothetical burger increases. When no calorie label was present, willingness-to-pay increases as the calorie content of the burger increases. We observed a similar relationship with the numeric calorie label, except that willingness-to-pay increased at a much slower rate. On the contrary, when the symbolic calorie label was present, a negative relationship existed between willingness-to-pay and calories. In fact, at some point, a burger could have so many calories that the burger would have to be sold at a discount relative to the daily special to induce customers to order it.

Simulated Impacts on Calories and Net Returns

Federal legislative efforts have focused on information or labeling policies to combat rising obesity rates, yet other policy instruments such as pricing policies (i.e., "fat taxes" or "thin subsidies") may be effective at achieving the same desired outcome.

Using the estimated model, we calculated the expected caloric intake and restaurant net returns (over food and preparation costs) per diner for four possible policy options: a numeric calorie label, a symbolic calorie label, a "fat tax," and a "thin subsidy" based on equations (5) and (6). Recall for the “fat tax” that items with more than 800 calories (high-calorie or red light items) received a 10% price increase. Likewise, for the “thin subsidy,” items with 400 calories or less (low-calorie or green light items) were subject to a 10% price reduction. We use the term “fat tax” loosely as the policy simulated taxes calories, not fat or fatness.

Table 3 reveals the expected caloric intake for each policy option. Notice the expected intake was 641.03 calories at the status quo (no calorie labels, no calorie taxes/subsidies). Comparing information and pricing policies, table 3 shows that the information policies outperformed either pricing policy in terms of reducing caloric intake, with the numeric and symbolic calorie labels reducing intake by 27.43 and 55.62 calories, respectively. Only the symbolic label reduction was significantly different from zero at the 5% level, however. The 10% “thin subsidy” and “fat tax “only decreased caloric intake by 11.51 and 21.98 calories, respectively, neither of which was statistically different from zero. Clearly the symbolic calorie label (calorie+traffic light symbol) produced the greatest decrease in caloric intake, indicating that adding traffic light symbols to menus could enhance the effectiveness of the numeric calorie label currently being proposed.

Symbolic calorie labels may outperform the other policy options considered here in terms of influencing consumers to make lower-calorie choices; however, it is also important to consider the effect on restaurant net returns above food and preparation costs. Table 4 provides the simulated net return impacts for each policy option. If no information or pricing policy were enacted, the expected restaurant net return (over food and preparation costs) was $6.94/person/meal. Mandating a numeric or symbolic calorie label would reduce the expected net returns by $0.14 or $0.27, respectively, yet only the symbolic label produced a statistically significant reduction in restaurant net returns. In the case of pricing policies, a “fat tax” would actually result in a $0.16 (statistically insignificant) increase in restaurant net returns, but a "thin subsidy" would cause the largest ($0.34) decrease in net returns, which was statistically different from zero.

Striking a balance between consumer health and restaurant profitability will likely be challenging. While policymakers may want to mandate symbolic calorie labels because they produce the largest intake reductions (55.62 calories/meal), restaurants are likely to oppose this particular label because it also leads to significant reductions in net returns over food and preparation costs ($0.27/meal). Restaurants might instead promote the use of a "fat tax" because it does not negatively impact their net returns, yet policymakers may not be willing to trade the additional 33.64 calorie reduction which could be achieved via symbolic calorie labels. Ultimately, legislators will be forced to make a tradeoff, and our results suggest restaurants are likely to be on the losing end. Making these tradeoffs is different when comparing different units: calories lost by consumers to dollars lost by restaurants. A cost benefit analysis is needed to translate the lost calories into a dollar-benefit; and this is the role provided by the value of information calculation.

Value of Information

Calculating the value of information for both the numeric and symbolic menus will allow us to translate the benefits of the policy measure from calories to dollars. Using equation (7), we found that the value of the numeric calorie labels was $0.03/diner/meal and the value of the symbolic calorie label was $0.13/diner/meal. Thus, if a consumer dined out 100 times in a year, the value of information present in the symbolic calorie label would be $13.00/person/year. However, table 5 shows that the value of information associated with both numeric and symbolic calorie labels was not statistically different from zero.

Economists often apply benefit-cost ratios to determine if a particular policy should be pursued. If the ratio is greater than one, the policy is a viable option. Here, for a symbolic calorie label, the benefit to consumers is worth $0.13 and the cost to restaurants (in lost net returns) is $0.27, yielding a benefit-cost ratio of 0.481. Numeric calorie labels share a similar result, with an even smaller benefit-cost ratio of 0.214. These ratios indicate the benefits of the information do not outweigh the costs to the restaurants, implying these policy instruments are not economically efficient.

VI. Conclusion

With American obesity and overweight rates on the rise, policymakers have decided that consumers need to be re-educated on the foods they eat, especially the meals they eat away from home. With the passage of the 2010 health care bill, chain restaurants, defined as having 20 or more outlets, will be required to provide calorie information for each item as well as a statement of the recommended daily caloric intake on all menus. Complete nutrition profiles for each item must also be available on site (FDA 2011).

The proposed legislation mandates that calorie information must be provided in a numeric format (FDA 2011); yet, to our knowledge, no other information formats have been researched or tested. With any educational program, *how* the information is presented can be just as important as which information is presented. Moreover, information or labeling policies are only one potential solution; consumers may respond just as much to price changes on menus such as “fat taxes” or “thin subsidies.” The purpose of this research was to examine a wide array of potential policy instruments to determine which performs the best at encouraging lower-calorie choices. Additionally, this research reviewed each policy instrument from a restaurant's perspective, examining how each instrument affected restaurant net returns above food and preparation costs. Finally, our study calculated the value of information consumers receive from two different labeling systems (numeric and symbolic calorie label).

Results of this study revealed menu labeling can influence food choice. When no calorie label was present, we found a greater proportion of higher-calorie meals (more than 800 calories) ordered than when either a numeric or symbolic calorie label was utilized. Note, however, the symbolic calorie label led to greater calorie reductions (55.6 cal/meal) than the numeric calorie label (27.4 cal/meal) currently proposed by the Food and Drug Administration. Each of the labels also outperformed the pricing policies at reducing caloric intake. Still, one is left to question: Is 55 calories a substantial reduction? An individual could simply order water instead of a soft drink and decrease his/her intake by 150 calories, almost three times the reduction produced by the symbolic calorie label!

From a restaurant's point of view, the majority of policy instruments will damage its net returns (over food and preparation costs). Only a "fat tax" will not negatively affect net returns, but this option is an unlikely candidate for implementation because information policies led to greater decreases in calorie intake. Possibly even more frustrating for the restaurant community is that consumers only place a $0.13 ($0.03) per meal value on symbolic (numeric) calorie labels, yet these labels would reduce their net returns by $0.27 or $0.14 per meal, respectively. Either label leaves restaurants searching to make up for lost net returns, often accomplished by raising prices and thus, reducing consumer welfare.

Collectively, our results suggest neither information nor pricing policies are likely to produce the substantial reductions in caloric intake which policymakers would prefer to see. If an alternative is to be chosen, however, this study finds that a symbol should be required *in addition to* the number of calories on restaurant menus. For future research, a more effective course of action may be to more thoroughly examine all potential policy options (calorie labels, food taxes/subsidies, re-structuring of farm programs, etc.) in both fast-food and full-service restaurant settings. It could be the case that a symbolic calorie label works best in fast-food settings because people need to make decisions quickly, whereas another policy option may be best suited in full-service establishments where people have more time to thoughtfully consider all aspects (price, calories, and so on) of menu items. Undoubtedly, this could complicate legislation; nonetheless, a blanket policy for all restaurants may not be the most appropriate for achieving the government's goal of a healthier America.

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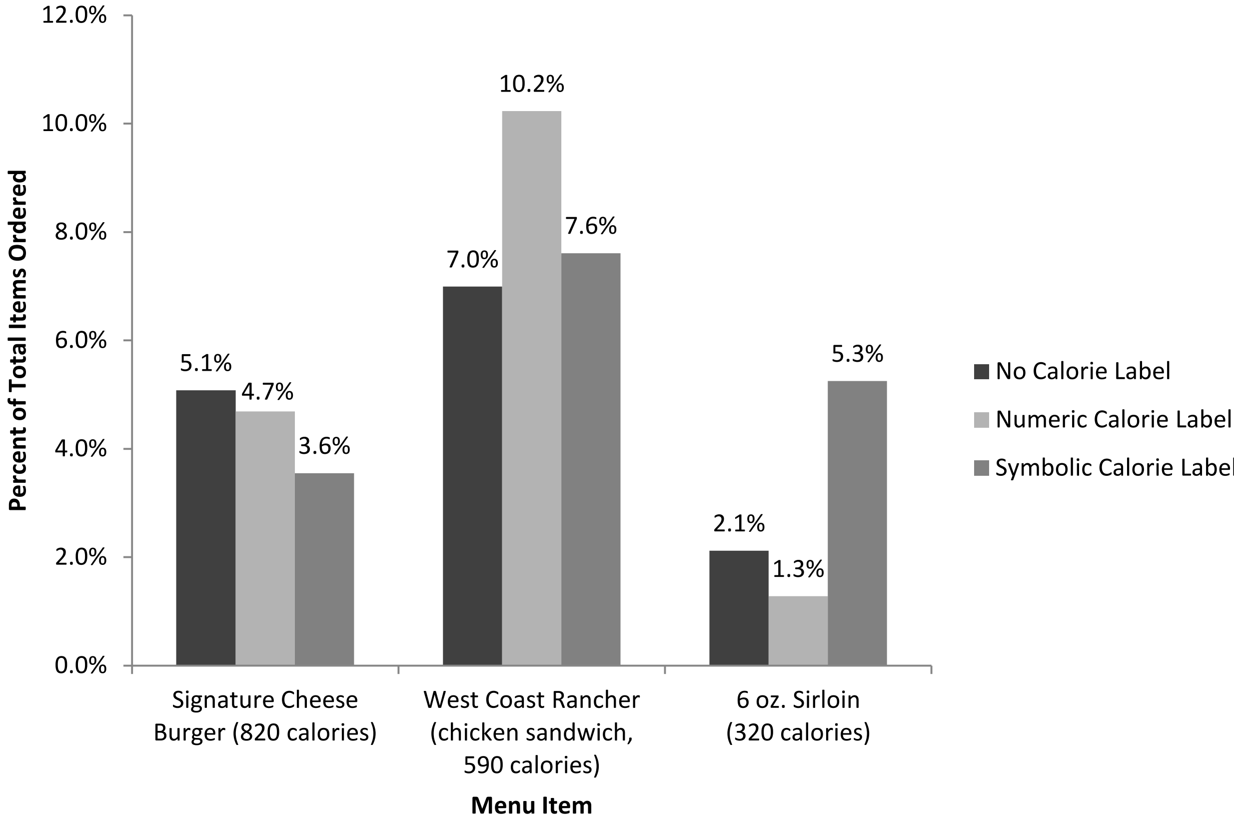

Figure 1. Percent of Total Meals Ordered Across Menu Types, Select Menu Items

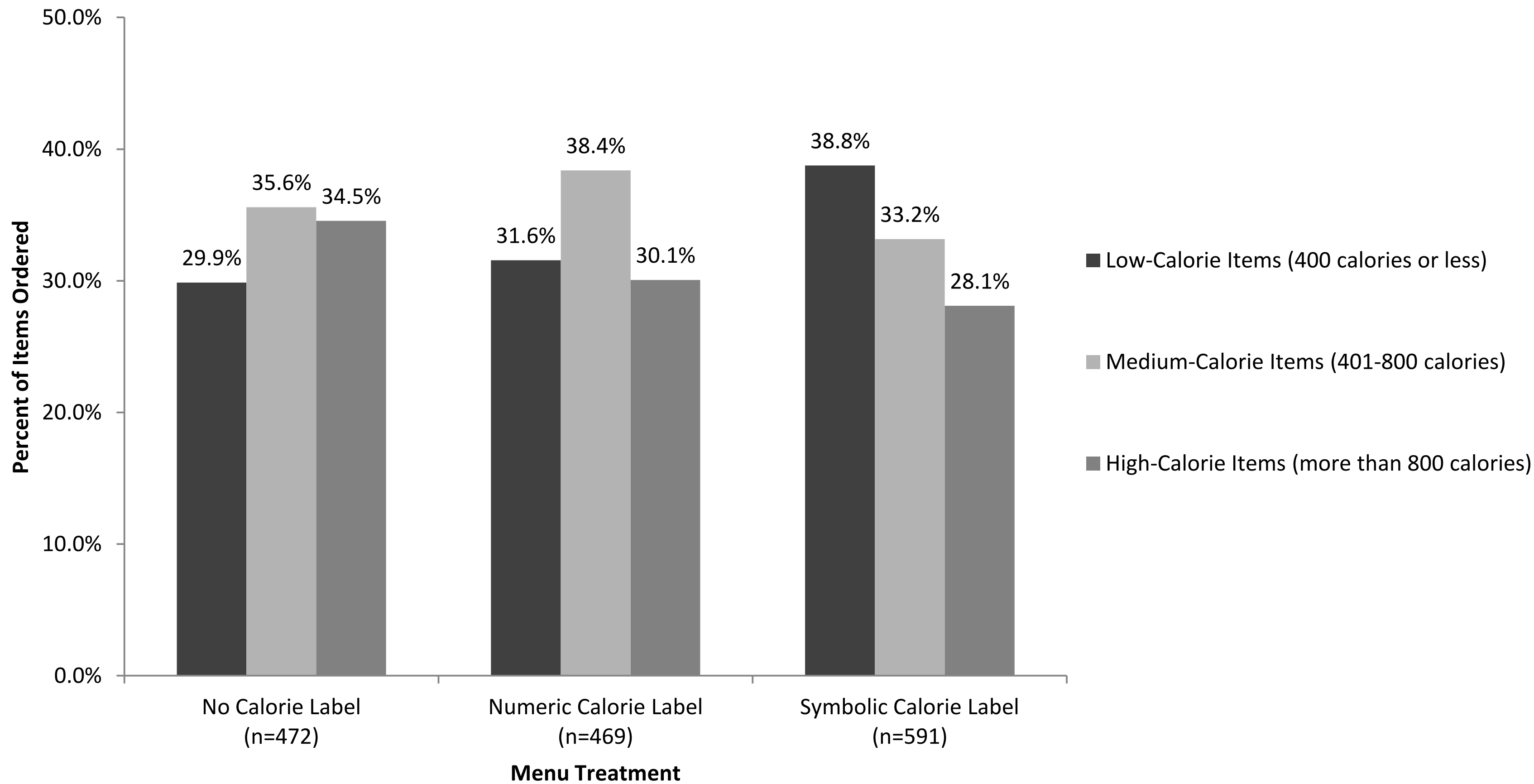

Figure 2. Percentage of Low, Medium, and High-Calorie Items Ordered by Menu Treatment

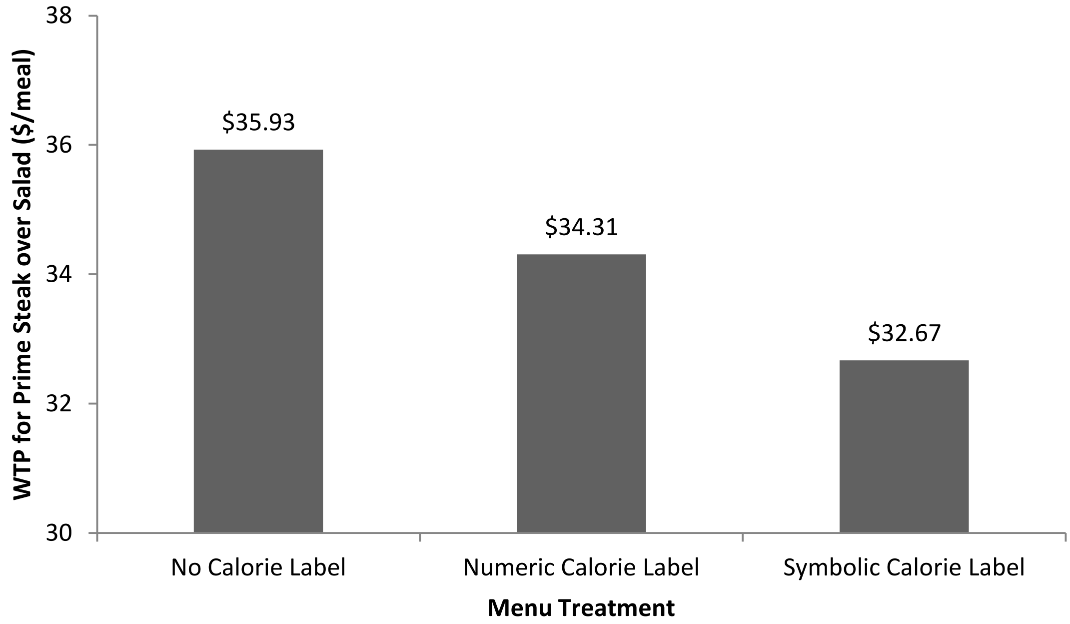

Figure 3. Willingness-to-pay for a Prime Steak (1,000 cal) over a Salad (300 cal) Across Menu Treatments

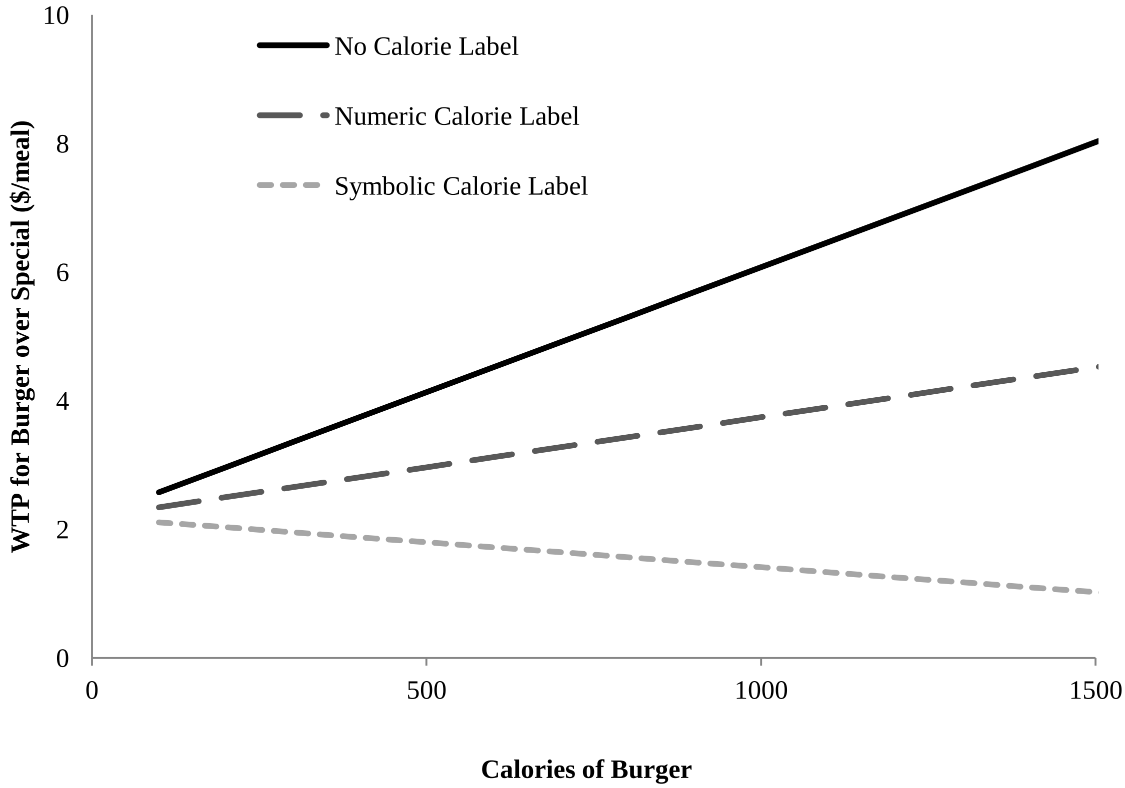

Figure 4. Willingness-to-pay for Burger over Daily Special across Menu Treatments

Table 1. Menu Items Selected for the Price Intervention

Menu Item	*Calories*	*Original Price*	*New Price*	*Percent Change*
Bacon Cheese Burger	920	8.5	9.5	+11.76%
Bleu Cheese Bacon Burger	920	8.5	9.5	+11.76%
West Coast Cheese Burger	970	8.5	10	+17.65%
West Coast Rancher Sandwich	590	9.5	8.5	-10.53%
Cowboy Combo	1185	13	16	+23.08%
Lentils	210	8	7	-12.50%
Pinchitos	280	8	7	-12.50%

Table 2. Multinomial Logit (MNL) Model of Menu Item Choice

Explanatory Variable	*Conventional MNL*	*Corrected MNL*[a]
Price	-0.0285***	-0.1286**
	(0.0106)[b]	(0.0627)
Calories	-0.00005	0.0005
	(0.0002)	(0.0004)
Calories*Calorie-Only Menu	-0.0003	-0.0003
	(0.0002)	(0.0002)
Calories*Calorie+Traffic Light Symbol Menu	-0.0006***	-0.0006***
	(0.0002)	(0.0002)
Salad[c]	-1.5012***	-2.0356***
	(0.1396)	(0.3567)
Burger[c]	0.7079***	0.2812
	(0.1087)	(0.3047)
Combo[c]	1.5734***	1.2504***
	(0.1106)	(0.2449)
Pasta[c]	-0.6848***	-0.9837***
	(0.1301)	(0.2452)
Veggie[c]	-0.5644***	-0.8851***
	(0.1511)	(0.2699)
Steak-Prime[c]	-0.7106**	2.2362
	(0.3371)	(1.8242)
Steak-Choice[c]	0.1588	0.8177**
	(0.1262)	(0.4086)
Residual for Menu Item Price		0.1086*
		(0.0648)
Log-likelihood	-5373	-5371
Number of Observations	1532	1532

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

[a] Corrected MNL estimates obtained using control function approach as discussed by Petrin and Train (2010).

[b] Standard errors are in parentheses. Standard errors for the corrected model were determined by bootstrapping.

[c] Effects of each menu category are relative to the daily special.

Table 3. Simulated Calorie Impacts

Policy Option	*E(Calories) Cal/Person/Meal*	*Change from Status Quo*
Status Quo	641.03	
	(15.11)[a]	
Numeric Calorie Label	613.6	-27.43
	(15.53)	(21.67)[a]
		[-70.24, 19.66][b]
Symbolic Calorie Label	585.41	-55.62
	(13.74)	(20.05)
		[-98.36, -20.15]
Fat Tax	619.05	-21.98
	(16.87)	(12.45)
		[-44.76, 3.22]
Thin Subsidy	629.52	-11.51
	(15.71)	(6.40)
		[-25.55, 1.34]

[a] Bootstrapped standard errors are in parentheses.

[b] 95% Confidence intervals are in brackets.

Table 4. Simulated Net Return (Over Food and Preparation Costs) Impacts

Policy Option	*E(Net Returns) $/Person/Meal*	*Change from Status Quo*
Status Quo	$6.94	
	($0.21)[a]	
Numeric Calorie Label	$6.80	-$0.14
	($0.19)	($0.12)[a]
		[-$0.47, $0.11][b]
Symbolic Calorie Label	$6.66	-$0.27
	($0.15)	($0.12)
		[-$0.59, -$0.11]
Fat Tax	$7.10	$0.16
	($0.23)	($0.23)
		[-$0.05, $0.50]
Thin Subsidy	$6.59	-$0.34
	($0.21)	($0.06)
		[-$0.48, -$0.24]

[a] Bootstrapped standard errors are in parentheses.

[b] 95% Confidence intervals are in brackets.

Table 5. Value of Information (VOI) for Calorie Labels

Calorie Label	*Mean VOI*
Symbolic Calorie Label vs. No Calorie Label	\$0.13 (\$0.53)[a] [-\$0.76, \$0.77][b]
Numeric Calorie Label vs. No Calorie Label	\$0.03 (\$1.03) [-\$0.20, \$0.33]

[a] Bootstrapped standard errors are in parentheses.

[b] 95% Confidence intervals are in brackets.