The Impact of Restaurant Menu Labeling on the Cost of the Selected Meals

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Abstract

In response to the Food and Drug Administration (FDA) proposed rules for national menu labeling, several studies have examined the effect of restaurant menu labeling on consumers food choices and total calorie intake. However, outcomes other than nutritional and health concerns were not given enough attention. An important component that can be affected by menu labeling is the total cost/price paid by consumer for a selected meal. In this study, samples of 242 participants with diverse demographic characteristics were presented with two different restaurant menus. For each menu, we construct different experimental treatments associated with calorie information display formats (total calories, percentage daily intake and traffic lights) and we ask participants to make their meal choice(s). Data on price and calorie information for chosen food items is then recorded. Therefore, we examine how prices paid by consumers are affected by a change of calorie labeling formats for each menu. Results of this analysis are critical to restaurants owners and may have a significant impact on their pricing decisions.

Obesity within the U.S. has become an epidemic with food away-from-home (AFH) availability a major contributor due to people often unconsciously underestimating the caloric intake of meals AFH. To combat this issue, the Food and Drug Administration is releasing rules on new menu-labeling standards at chain restaurants. These rules will require chain restaurants with 20 plus locations to disclose calorie information on menus. In this context, several studies have examined restaurant menu labeling and have reported mixed results. These studies range from survey, laboratory, to field based experiments. On one hand, it appears that, for some consumers, there are no statistically significant differences in calories purchased before and after labeling is implemented because these consumers consider other factors, such as taste, more relevant during their meal selection process. For example, Liu et.al. (2012) tested the effect of calorie information presented in different formats on calories ordered and perceived restaurant healthfulness using real restaurant menus. They found no significant difference between the calorie and no calorie groups. However, participants in each calorie label condition were significantly more accurate in estimating calories ordered compared to the no calorie group.

On the other hand, research has shown that nutrition labeling of restaurant menus can effectively impact consumer choice. Avcibasioglu et al. (2011) conducted a survey to determine the possible impact of the pending California menu labeling law. 62% of the participants indicated a change in their meal selection, with a high level of intention to order lower-calorie alternatives or eliminate some items.

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consumer for a selected meal. In this study, samples of 242 participants with diverse demographic characteristics were presented with two different restaurant menus. For each menu, we construct different experimental treatments associated with calorie information display formats (total calories, percentage daily intake and traffic lights) and we ask participants to make their meal choice(s). Data on price and calorie information for chosen food items is then recorded

Data/Experiment Design

A sample of 242 college students with diverse demographic characteristics were presented with two different restaurant menus: a sit-down restaurant menu (Olive Garden) and a fast food restaurant menu (McDonalds). These two restaurants were chosen among others because they are well known franchises throughout the U.S (more than 800 locations for Olive Garden and more than 14,267 locations for McDonald's) and they both possess considerable food variety offerings, with diverse nutritional profiles. Furthermore, the menus are broken down into the following categories: entrees, appetizers[1], desserts and drinks. Participants were randomly assigned to one of six treatment groups:

1) Menu items with prices only, no nutrition information (control group).
2) Menu items with prices plus calories for each item, similar to the FDA proposed guidelines.
3) Menu items with prices, calories, and percent daily intake (% DI) of calories based on a 2,000 calorie diet.
4) Menu items with prices, calories, and traffic light menu labeling. A green symbol represents low calories (<750 calories for entrees, <250 calories for appetizers, sides, or

[1] Appetizers appear only in Olive Garden's menu. No appetizers are defined for McDonalds restaurant

desserts; 0 calories for beverages.) and a red symbol represents high calories (>750 calories for entrée, >250 calories for appetizers, sides, or desserts; >0 calories for beverages). This is similar to traffic light signals used in school systems throughout the nation.

5) Menu items with prices, calories, traffic light, and % DI of calories.
6) Menu items with prices and only green traffic lights to indicate low calorie food.

Respondents were asked to view a McDonalds and Olive Garden menu that had the prescribed nutritional information associated with the treatment group they were assigned. Each menu was presented on a computer screen to allow for ETT measurements. Respondents were asked to select the food item(s), if any, which they would like to order for dinner from each menu. After making their selection from the first menu, the respondent was asked to choose items from the second menu. The order of menu presentation was random as was the assignment of treatment group. At the end of the experiment, participants were presented with a questionnaire regarding their dinning habits, their restaurant purchasing habits, health information (e.g. on a diet, height, weight, etc.), and demographics. Table 1 describes the sample characteristics.

Methodology

The effect of different menu labeling formats on the cost of meal is estimated. In this case, we use food item prices on the menu to determine the total price for each food category (e.g. if one person selected two appetizers, their corresponding prices were added to represent total price of the appetizer category) and the total price for the total meal ordered. Using equation 1 we can capture the impact of each labeling format on prices of the selected meals

$$Price_{ij} = f\left(TR, D_i, PB_i\ Menu_j, FC\_Number_{ij}, Time_i\right) \quad i = 1, \dots, 242\ and\ \ j = 1, \dots, 4 \quad \textbf{(1)}$$

Whereby, the outcome variable $Price_{ij}$ represents the corresponding price of food category j ordered by person i, TR is a set of dummy variables indicating which treatment was used. Di and PB_i are demographic and purchasing behavior characteristics of each participant i. $Menu_j$ is a binary variable that indicates which menu a food category j belongs to. FC_number_{ij} counts how many items were ordered by each individual i in each food category j. $Time_i$ refers to what time of the day an individual i participated in the experiment. See Table 2 for a list of outcome and explanatory variables.

An important characteristic of our data sample is that the dependent variable contains zero observations. This is mainly because some participants did not select all food categories subject to the study. For example, a participant who only chose to have an entrée, an appetizer and a drink, will have zero dollars for the dessert category.

To minimize the impact of this problem we used a Tobit model (proposed by Tobin in 1958). The Tobit model is expressed in terms of a latent variable y_i given by

$$y_i^* = \begin{cases} X_i\beta + \varepsilon_i, & X_i\beta + \varepsilon_i > 0 \\ 0, & X_i\beta + \varepsilon_i \leq 0 \end{cases} \quad \textbf{(2)}$$

Where i= 1, 2, 3 …242 is the number of participants, y_i is the censored dependent variable, X_i is the vector of explanatory variables, β is a vector of parameter estimates and $\varepsilon_i \sim N(0, \sigma^2)$. Let $z = X\beta/\sigma$, $f(z)$ be the standard normal density and F (z) be the cumulative normal distribution function, then,

$$E(y^*) = X\beta F(z) + \sigma f(z) \quad \textbf{(3)}$$

$$E(y^*|y^* > 0) = X\beta + \sigma f(z)/F(z) \quad \textbf{(4)}$$

Equations 3 and 4 represent the unconditional and conditional expected value of y_i respectively. The corresponding unconditional and conditional marginal effects are respectively given by

$$\frac{\partial E(y^*)}{\partial x_j} = F(z)\beta_j \quad \textbf{(5)}$$

$$\frac{\partial E(y^*|y^*>0)}{\partial x_j} = \beta_j[1 - \frac{zf(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}] \textbf{ (6)}$$

These effects are combined in equation 7 following McDonald and Moffitt (1980) decomposition.

$$\frac{\partial E(y^*)}{\partial x_j} = F(z)\left(\frac{\partial E(y^*)}{\partial x_j}\right) + E(y^*)(\frac{\partial F(z)}{\partial x_j}) \textbf{ (7)}$$

Therefore, the total change in the unconditional expected value of y* can be decomposed into two parts: 1) the change in the expected value of y being above zero weighted by the probability of being above zero and 2) the change in the probability of being above zero weighted by the conditional expected value of y*.

Table 3 presents the average price chosen by the respondents for each food category, treatment, and restaurant type.

Results

Tables 4 presents the effect of different labeling formats on the price using Tobit regression. In this table we do not see any significant effect of menu labeling on the total price of the meal or on the price paid for entrée items. However, we do observe a negative effect of some labeling treatments on the other food categories. For example, the overall expenditures for dessert were less in treatments 3, 4 and 6. In addition, consumers tend to spend less for the appetizer when calories and traffic lights were combined (Treatment 4), and they spent less for drinks when they are exposed to green traffic lights only (Treatment 6). The menu indicator and the number of items variables are found to be highly significant. Given that in all food categories, participants are likely to spend less money at McDonald's restaurant and more money when they order more items within each food category and for the total price of the meal.

None of the demographic variables we employed and neither the time of the day variable had a significant impact on expenditure for all food categories.

Table 5 presents the corresponding marginal effects. According to table 5, participants were price sensitive in treatments 3, 4 and 6. For instance, the conditional marginal effects produced in these treatments show that, on average, respondents would spend, approximately, $0.2 less for dessert when exposed to dessert calorie and their percentage daily intake labeling (treatment 3). Further, the average respondent could be expected to spend $0.9 less for appetizers when exposed to appetizer calories and their corresponding traffic light symbols (Treatment 4). Treatment 6 where only green traffic lights are used is found to impact expenditure on drink and dessert categories. On average, participants would spend $0.3 less on drink and $0.2 less on dessert. These reductions do not sound large, but in the context of a restaurant where thousands of meals are served the dollar value could be substantial. However, we do not see any impact on total meal expenditures.

In terms of the demographic variables and the time of the day variable, no significant effect was found to impact participant's expenditure on all food categories and also on the total price of the meal.

Conclusion

The objective of this study was to assess the impact of calorie information presented in different formats on food cost. In this case, a sample of 242 participants with diverse demographic characteristics were presented with two different restaurant menus: a sit-down restaurant menu (Olive Garden) and a fast food restaurant menu (McDonalds).

Results revealed that calorie labeling on a restaurant menu had a little impact on prices paid by consumers for each food category and also for the price paid for the total meal. This suggests that, for restaurants, providing nutrition information does not hurt their profit, and therefore this

may be another incentive for restaurants to comply with FDA regulations on displaying calorie information on their menus.

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Table 1. Demographic Profile of Participants by Treatment

	Tr1	Tr2	Tr3	Tr4	Tr5	Tr6
Male	52%	43%	53%	28%	50%	31%
Age	21.5	21.5	21.8	21.8	21.5	22
White/Caucasian	68%	75%	68%	68%	65%	50%
African American	-	1%	-	5%	5%	17%
Hispanic	13%	3%	5%	-	8%	4%
Asian	18%	13%	25%	27%	22%	21%
Other	3%	-	2%	-	-	7%
On diet	18%	15%	23%	13%	23%	12%

Table 2. Description of the Dependent and Independent Variables Used in the Analysis

Independent Variables	**Explanation**
Male	=1 for male and =0 for female
On diet	=1 if the person is on diet and =0 otherwise
White	=1 if white (Base outcome is other ethnicity)
African-American	=1 if African American
Hispanic	=1 if Hispanic
Asian	=1 if Asian
Tr2	Treatment 2: Item price + calories (Base outcome is Tr1: price only)
Tr3	Treatment 3: Item price + calories +% daily intake value
Tr4	Treatment 4: Item price + calories + traffic light symbols
Tr5	Treatment 5: Item price + calories +% daily intake value + traffic light symbols
Tr6	Treatment 6: Item price + green traffic lights *only*
Menu Indicator	=1 for MacDonald's and 0 for Olive Garden
Noon	=1 if the time of the day is between 12:00 – 2:00pm (Base outcome is morning)
Afternoon	=1 if the time of the day is after 2:00pm
Items Number	Number of items within each food category
Dependent Variables	Explanation
Price_entree	Total price of all entrée items
Price _drink	Total price of all drink items
Price _dessert	Total price of all dessert items
Price _appetizer	Total price of all appetizer items
Total_ price	Total price of the meal selected

Table 3. Price Averages by Treatment, Restaurant Type and Food Category

Restaurant	Food Category	Tr1	Tr2	Tr3	Tr4	Tr5
McDonald's [a]	Price_entree	6.53	6.13	5.94	5.46	5.82
	Price_dessert	0.71	0.52	0.51	0.87	0.48
	Price_drink	1.69	1.93	1.67	1.48	1.96
	Total_price	8.92	8.58	8.12	7.81	8.26
Olive Garden	Price_entree	14.85	13.45	14.33	15.91	17.22
	Price_appetizer	3.58	4.18	5.71	5.35	4.16
	Price_dessert	2.27	0.87	2.23	2.37	1.93
	Price_drink	2.16	2.19	2.34	2.19	2.05
	Total_price	22.85	20.69	24.61	25.82	25.36

[a] There are no "appetizers" at McDonald's so the menu indicator variable was not included in the model.

Table *4*. Tobit Results of Price Regressions

Variables	Price_entree	Price_dessert	Price_drink	Price_appetizer	Total_price
Age	-0.00475	-0.00378	0.000198	0.00406	-0.00389
	(0.00445)	(0.00806)	(0.00119)	(0.00426)	(0.00462)
Male	-0.182	0.231	-0.201	0.448	0.538
	(0.484)	(0.333)	(0.132)	(0.551)	(0.497)
On diet	0.110	-0.0263	-0.219	-0.134	-0.462
	(0.636)	(0.411)	(0.176)	(0.772)	(0.647)
White	-0.115	0.0989	-0.410	-1.092	-2.502
	(1.677)	(1.517)	(0.465)	(1.660)	(1.730)
African-American	0.0571	-0.220	0.612	-0.107	-0.163
	(1.885)	(1.628)	(0.524)	(1.865)	(1.954)
Hispanic	0.634	0.626	-0.672	-1.897	-1.828
	(1.926)	(1.628)	(0.536)	(2.047)	(1.983)
Asian	0.0158	0.202	-0.434	-1.333	-1.943
	(1.717)	(1.537)	(0.478)	(1.723)	(1.772)
Tr2	-0.963	-0.684	-0.289	-0.465	-1.086
	(0.838)	(0.571)	(0.234)	(0.989)	(0.866)
Tr3	-0.356	-1.039*	-0.0798	-0.587	0.0349
	(0.813)	(0.553)	(0.227)	(0.956)	(0.842)
Tr4	0.261	-0.954*	-0.273	-1.912*	0.292
	(0.812)	(0.539)	(0.227)	(0.978)	(0.841)
Tr5	-0.0758	-0.277	-0.260	-1.492	-0.270
	(0.809)	(0.521)	(0.226)	(1.004)	(0.840)
Tr6	0.530	-1.205**	-0.409*	-1.087	0.109
	(0.817)	(0.558)	(0.232)	(0.981)	(0.842)
Menu indicator [a]	-14.33***	-4.625***	-0.747***	--	-17.99***
	(0.536)	(0.385)	(0.128)		(0.483)
Noon	0.515	-0.452	-0.177	0.838	0.238
	(0.726)	(0.507)	(0.207)	(0.881)	(0.750)
Afternoon	0.430	-0.00977	0.123	0.736	0.469
	(0.614)	(0.402)	(0.175)	(0.750)	(0.634)
Items Number	5.509***	6.789***	2.775***	10.99***	3.808***
	(0.323)	(0.343)	(0.144)	(0.527)	(0.217)
_se	4.906***	2.236***	1.314***	3.273***	5.099***
	(0.166)	(0.142)	(0.0509)	(0.221)	(0.164)
Constant	8.690***	-1.464	0.0246	-2.745	14.83***
	(1.926)	(1.641)	(0.530)	(1.975)	(2.021)
Observations	484	484	484	242	484

[a] There are no “appetizers” at McDonald’s so the menu indicator variable was not included in the model.
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Tobit Marginal Effects

Variables	Price_entree	Price_appetizer	Price_drink	Price_dessert	Total_price
Age	-0.00433	0.00217	0.000142	-0.000779	-0.00386
	(0.0040)	(0.0022)	(0.00085)	(0.00166)	(0.00459)
Male	-0.166	0.240	-0.144	0.0478	0.534
	(0.441)	(0.294)	(0.0951)	(0.0686)	(0.493)
On diet	0.101	-0.0710	-0.154	-0.00541	-0.458
	(0.580)	(0.412)	(0.127)	(0.0849)	(0.642)
White	-0.105	-0.599	-0.300	0.0203	-2.485
	(1.529)	(0.885)	(0.334)	(0.313)	(1.716)
African-American	0.0521	-0.0566	0.473	-0.0443	-0.162
	(1.719)	(0.994)	(0.377)	(0.336)	(1.938)
Hispanic	0.584	-0.880	-0.438	0.139	-1.804
	(1.757)	(1.091)	(0.385)	(0.336)	(1.967)
Asian	0.0144	-0.668	-0.300	0.0422	-1.921
	(1.566)	(0.919)	(0.343)	(0.317)	(1.758)
Tr2	-0.868	-0.242	-0.201	-0.133	-1.075
	(0.764)	(0.528)	(0.168)	(0.118)	(0.859)
Tr3	-0.323	-0.303	-0.0569	-0.196*	0.0346
	(0.742)	(0.510)	(0.163)	(0.114)	(0.835)
Tr4	0.239	-0.918*	-0.191	-0.181	0.290
	(0.741)	(0.521)	(0.163)	(0.111)	(0.835)
Tr5	-0.0690	-0.733	-0.182	-0.0558	-0.268
	(0.738)	(0.535)	(0.163)	(0.107)	(0.833)
Tr6	0.487	-0.547	-0.282*	-0.225*	0.109
	(0.745)	(0.523)	(0.167)	(0.115)	(0.836)
Menu indicator [a]	-12.29***	--	-0.536***	-1.022***	-17.18***
	(0.489)		(0.0923)	(0.0794)	(0.479)
Noon	0.472	0.463	-0.125	-0.0903	0.236
	(0.662)	(0.470)	(0.149)	(0.105)	(0.744)
Afternoon	0.392	0.390	0.0882	-0.00202	0.465
	(0.560)	(0.400)	(0.126)	(0.0829)	(0.629)
Items Number	5.024***	5.858***	1.994***	1.400***	3.778***
	(0.294)	(0.281)	(0.104)	(0.0707)	(0.215)
Constant	7.926***	-1.464	0.0177	-0.302	14.71***

	(1.757)	(1.053)	(0.381)	(0.339)	(2.005)
Observations	484	242	484	484	484