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The Effect of Nutrition Labelling on Fast-Food Nutritional Content

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The Effect of Nutrition Labelling on Fast-Food Nutritional Content

A Thesis Presented

By

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ABSTRACT

THE EFFECT OF NUTRITION LABELLING ON FAST-FOOD NUTRITIONAL CONTENT

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Abstract: The United States has implemented many policies to target obesity. Recently, the U.S. Food and Drug Administration has mandated that restaurants must label the calorie content of the food they provide on menus and menu boards. Previous literature suggests that this policy will cause a small subset of consumers to improve the nutritional quality of the food they consume. Restaurants' responses to the policy are not as well studied but existing literature suggests that menu items become slightly healthier after the introduction of various local policies. This paper seeks to assess the impact of a nationally-instituted nutrition labelling policy on fast-food nutritional content. We find evidence that restaurants both improve the healthfulness of pre-existing food items and introduce new food items of substantially lower nutritional quality.

Disclaimer: Part of this thesis was written in collaboration with my advisors, Dr. Nathalie Lavoie, and Dr. Emily Wang, in the context of a grant proposal. The data collection process was done in large part by Dr. Qihong Liu.

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CHAPTER I

INTRODUCTION

Obesity is now widely acknowledged as a leading public health crisis affecting the United States and much of the developed world. It is estimated that obesity imposes a social cost of $117 billion in the United States alone (Komesaroff and Thomas, 2007). The U.S. Department of Health and Human Services found a prevalence of obesity of about 40 percent in adults and 19 percent in youths, and this prevalence has been steadily increasing (Hales et al, 2017). Poor diets are a key contributing factor to obesity (Lin and Guthrie, 2012), which in turn is linked to mortality from heart disease, stroke, and type 2 diabetes (Micha et al., 2017). Broadly separating individual’s diet into two components, food-at-home and food-away-from-home, our proposed research focuses on effect of policies intended to decrease obesity on the latter with this paper focusing specifically on fast-food.

Food-away-from-home (FAFH) has taken increasing importance in our diet. Spending on FAFH first surpassed spending on food at home in 2010 (Saksena et al., 2018) and in 2019, the industry took in an unprecedented $863 billion in revenue (Nation’s Restaurant News). This figure out competes the total revenue in grocery sales, $674 billion, by nearly $200 billion, speaking to the importance of food-away-from-home. The increasing importance of FAFH is magnified by its nutritional profile, i.e., poorer quality and more caloric than food at home. It contains more saturated fats and sodium, and less calcium, iron, and fiber than food at home (Saksena et al., 2018).

As consumer preferences shift, restaurants are coming under increasing examination regarding the nutritional quality of the products they offer. Between 1977 and 2008, Americans increased their away-from-home caloric intake from 18 percent to 32 percent (Lin and Guthrie, 2012). Restaurants have increased in importance to American diets and this trend is likely to continue. Given this, the role of FAFH in obesity is important to consider.

This thesis assesses fast-food restaurants' strategic responses to policy that requires overt disclosure of nutritional content of their menu items. Specifically, when they are required to label calories next to menu items on menus and menu boards. We find evidence that firms reformulate items to be more healthful and introduce new items which are less healthful. One potential explanation for this pattern is that firms want to appeal to both health-conscious consumers and to consumers who prefer taste over nutritional quality.

CHAPTER II

BACKGROUND

One potential remedy to the obesity and general poor diet crisis facing the United States is labelling nutritional information to inform consumers about their dietary choices. Pre-packaged foods sold in grocery stores have held a nutrition labelling requirement since the passage of the Nutrition Labelling and Education Act of 1989-90 (H.R.3562). A retrospective FDA (2018a) review of this policy found that benefits, in the form of gains to consumer welfare, have exceeded costs, in the form of regulatory impositions. Recently, a similar policy of nutrition labelling was enacted for restaurants.

On May 7th, 2018, a policy of nutrition labelling on menus and menu boards in restaurants was enacted nationally (FDA, 2018b). This paper seeks to assess the impact of the nationally instituted nutrition labelling policy on the nutritional quality of food offered in U.S. restaurants.

The Patient Protection and Affordable Care Act signed into law on March 23rd, 2010, mandated nutrition labelling in restaurants as a national policy (42 U.S.C. § 18001). Of interest to this paper is section 6205 which, required the FDA to implement a rule for restaurants to:

1. Label calorie counts adjacent to the relevant item’s name on their menu.

2. Succinctly state the daily reference value (DRV) of calorie intake (2,000 calories) on their menu.

3. Provide consumers with more detailed nutritional information in written form at the restaurant and display availability of this information on their menu.

These rules apply to standard menu items at restaurants and similar retail food establishments; notably, restaurant chains with fewer than 20 locations are exempt from this regulation. Additionally, the rule does not apply to items not listed on the menu (e.g. condiments), daily specials, temporary menu items (appearing for less than 60 days per calendar year), custom orders, or items that are part of a customary market test (appearing for less than 90 days). However, self-service food items must be labeled at the point of service (42 U.S.C. § 18001, Sec. 4205).

Implementing this policy proved to be quite controversial and lobbyists managed to have it postponed twice (Bokamp, 2017). Critics claimed that the regulation is not flexible enough for restaurants that conduct most of their business through delivery and imposes unjustified costs (Bokamp, 2017). Advocates claimed it is vital and relatively simple for consumers to be informed of the nutritional content of their food (Bokamp, 2017). A lengthy review of the potential costs and benefits of the policy found substantial benefits for minimal costs (FDA, 2011). Eventually, it was instituted by the FDA on May 7th, 2018 (FDA, 2018b).

Fast-food is a major industry in the United States generating $273.2 billion in revenue in 2019, according to a report by IBIS World (Hyland, 2019). Over the past 5 years the industry has experienced substantial growth and is projected to continue growing but at a slower rate for the next 5 years. Fast-casual restaurants, such as 5 Guys and Chipotle, which offer higher quality food and a more attractive atmosphere have steadily been gaining market share. Nevertheless, the market is still dominated by large traditional restaurant chain franchisors: The McDonald’s Corporation, The Wendy’s Company, Yum!

Brands Inc. (KFC, Taco Bell, and Pizza Hut), Restaurant Brands Inc. (Burger King and Popeyes), Domino's Pizza Inc., and Chick fil-A (Hyland, 2019).

Fast food restaurants are generally divided into six subtypes: Burger (34.3 percent of fast food restaurants), Sandwiches (11.3 percent), Chicken (10.3 percent), Ethnic (9.1 percent), Pizza and Pasta (8.8 percent) and Other (26 percent) (Hyland, 2019). These categorizations are consistent with those used by *Nations Restaurant News* magazine (2019), a well-known industry publication and a useful source for categorizing individual restaurants.

Individual fast-food restaurants are mostly financed and managed by small-business franchisees, 94.2 percent of establishments have fewer than 50 employees (Hyland, 2019). Despite the decentralized nature of fast food restaurant ownership, the franchisors of large restaurant chains exercise almost complete control over the food offered in their restaurants (Miles, 2018). Large restaurant chains usually have national supply arrangements for all their inputs and franchisees are often prohibited from purchasing any inputs by other means (Miles, 2018). The nature of franchise agreements allows franchisors a high degree of flexibility to change menus and have those changes implemented across franchises.

A study conducted by the U.S. Department of Agriculture (USDA) found that fast-food has continually increased in importance to American diets (Lin and Guthrie, 2012). Americans consume 13 percent of their calories at fast-food restaurants, the largest subset of food away from home, increasing from 3 percent in 1977-78. Additionally, food prepared away from home has been found to have significantly lower nutritional quality than food prepared at home. The authors discuss nutrition labelling in restaurants as a feasible remedy to the poor nutritional quality of food prepared away from home. They note that nutritional labelling may incentivize consumers to choose healthier options and restaurants to offer them. However, people's food choices may not be entirely rational, based more on hunger and sensual pleasure than nutrition (Lin and Guthrie, 2012). It is evident that any policy which seeks to address the growing issue of poor nutrition and obesity in the United States must focus on food away from home and, specifically, fast food. What is less clear is whether nutrition labelling is an effective policy to combat this issue.

CHAPTER III

LITERATURE REVIEW

There are two potential actors who could change their actions in response to nutrition labelling in restaurants, the consumers, and the restaurants themselves. Most of the existing literature on this topic focuses on consumer responses to nutrition labelling. In general, it finds that consumers respond to the policy by slightly reducing their calorie intake and intake of other overconsumed nutrients.

Bollinger, Leslie, and Sorenson (2010) had access to detailed purchase data from Starbucks and used it to provide an important addition to the literature. The authors utilize a difference-in-difference design to assess the impact of a New York City (NYC) menu labelling regulation 3 months before and 11 months after its implementation. This NYC policy was similar to the now nationally mandated policy. They find that calories per transaction fall by approximately 6 percent in NYC relative to Philadelphia and Boston. However, calorie reductions are limited to food items, not beverages. Furthermore, although the reduction in calories is significant, it is small and would only translate to a small decrease in obesity. Additionally, there is a degree of heterogeneity of the effect of posting the calorie information; college educated people, women, and people with higher incomes were more likely to consume fewer calories (Bollinger, Leslie, and Sorenson, 2010). Overall, this study presents a clear example of calorie labelling decreasing calorie consumption by some consumers in a market setting.

Green, Brown, and Ohri-Vachaspati (2015) examine the socio-demographic disparities and the likelihood of customers using McDonald’s internally mandated calorie menu labels. The study found that more educated and higher income individuals were significantly more likely to report using calorie labels and reduce their calorie intake (Green, Brown, and Ohri-Vachaspati, 2015). Ebel et al. (2009) study the purchasing decisions of adults in low-income neighborhoods in New York City when presented with a locally instituted policy which is like the now nationally implemented policy. Many people reported that they noticed the menu labels and, as a result, reported purchasing fewer calories. However, their purchase decisions were not significantly different from those who did not notice the labels (Ebel et al. 2009). Yamamoto et al. (2004) conducted a similar experiment and find that when young subjects are presented with menus with and without calorie labels, they significantly reduced their calorie intake. While many consumers are not very well informed on how to use nutritional information to better their dietary choices, this misinformation is differentially distributed across demographics.

It has been firmly established by previous literature that nutrition labelling on menus and menu boards does cause some consumers to notice and respond to the labels by choosing healthier options. A meta-analysis of recent studies has affirmed this conclusion, finding reductions of 77.8 kcal consumed per consumer because of nutrition labelling policy (Littlewood et al., 2015). However, this effect is heterogenous across demographics. Furthermore, effects are not large enough to translate to a real change in obesity. What is not so well established is the firms' responses to changes in consumer preferences when they are mandated to display calorie content information. The few studies that have been done on locally implemented policies suggest a modest improvement in the nutritional quality of menu items after the policies went into effect.

Namba et al. (2013) is one such study that focused on fast food restaurant chains. They observe 5 treatment chains who operated in areas which required nutrition labelling, between 2005 and 2011, and 4 which did not. Menu labelling requirements began with the implementation of the NYC policy in 2008. They observed the proportion of food items that were “healthier” based on DRV for a 2,000-calorie diet, U.S. FDA guidelines, and the dietary guidelines for Americans from the USDA. The authors found that restaurants which were subject to the nutrition labelling policy began offering a significantly higher proportion of “healthier” menu items after being subject to the policy. (Namba et al. 2013).

Breummer, Krieger, Salens, and Chan (2012) utilized a sample of restaurants in King County, Washington which instituted a similar policy to the now national policy in 2009. The authors observed calorie counts of restaurant entrées before and after the policy went into effect. They found significant, but small, differences in the calorie content of fast-food menu items after the policy went into effect. Additionally, they observed saturated fat and sodium but did not find many significant differences. Overall, larger reductions were observed at sit-down than fast-food restaurants (Breummer, Krieger, Salens, and Chan, 2012). These studies observed calorie reductions from locally instituted nutrition labelling in restaurant mandates, it stands to reason that the national policy should have an even more substantial effect.

The limited literature on supply-side effects of nutrition labelling in restaurants has found small but significant improvements in the overall nutritional quality of menu items. However, further research is necessary to examine the effects of the policy more broadly and with respect to the recently implemented national policy.

While few articles have examined the supply-side effects of mandatory calorie labeling, a broader literature exists on the effects of quality disclosure. Dranove and Jin (2010) conclude that the empirical literature finds little evidence that sellers respond to mandatory quality disclosure by increasing quality.

Many studies find quality disclosure mandates to have their intended effect in raising quality. Jin and Leslie (2003) find that restaurant provision of hygiene quality in the form of a health card causes an increase in the average hygiene scores of restaurants. The result applies to both voluntary and mandatory disclosure. Bennear and Olmstead (2008), using a difference-in-difference approach, find that mandatory disclosure of water quality reduces water quality violations. Ippolito and Mathios (1990) examine consumers and producers' decisions in the ready-to-eat cereal market under government-provided information and advertising. They find that allowing firms to advertise about fiber contents led to an increase in development of fiber cereals. While it is desirable for policymakers that quality mandates improve quality, it is not always the case.

Several articles find that mandatory quality disclosure leads to unintended outcomes, i.e., affected firms find ways to circumvent the law to their benefit. This is true across industries: health care, education, and the environment. Dranove et al. (2003) argue that the disclosure of patient health outcomes either at the physician or hospital level may lead to selection bias, i.e., physicians/hospitals may refuse to treat severely ill patients or those more difficult to treat. Lu (2012) examines the effect of the Nursing Home Quality Initiative (NHQI) and finds that scores for reported dimensions of quality increase, while the scores for unreported dimensions deteriorate such that overall quality does not improve. Jacob (2005) examines the effect of the U.S. "No Child Left Behind" policy that requires testing of students in grades 3-8. Mathematics and reading achievements increase significantly after the implementation of the policy, strategic behaviors by teachers is also observed such as focusing on test-specific skills, substituting lower stake subjects for high stake ones, increasing special education placements, and preemptively retaining students. Powers et al. (2011) find that disclosing environmental performance of individual pulp and paper plants in India led to a significant reduction in pollution for the dirtiest plants, but not for the cleaner ones. They found that plants located in wealthier communities were more likely to reduce emissions as well as single-plant firms.

Overall, the literature on quality disclosure suggests that mandatory labeling of calorie information may lead restaurants to reduce calories. Competitive effects may be such that an increase in differentiation could be observed to soften price competition, i.e., an increase in calories for some restaurants, and decrease in calories for others. In addition, the results suggest that mandatory disclosure of calories could lead firms to alter other choice variables (nutrition characteristics or other) to their benefit.

This paper seeks to add to the literature on quality disclosure in general and fast-food restaurants' responses to the national nutrition labelling mandate in specific. As such, we analyze restaurants' strategic response to the policy from a nutrition perspective.

CHAPTER IV

DATA

This project entails a significant data collection effort to accurately represent the state of nutrition at restaurants across the United States both big (20 or more locations, directly affected by the policy) and small (less than 20 locations, not directly affected by the policy). Restaurant menu offerings and their nutrition information are collected both prior to and following the passage and implementation of the mandatory disclosure policy. Post collection, the data require digitization and formatting before analyses can begin. Below, we document the data collection and the data preparation process.

Data Collection Process

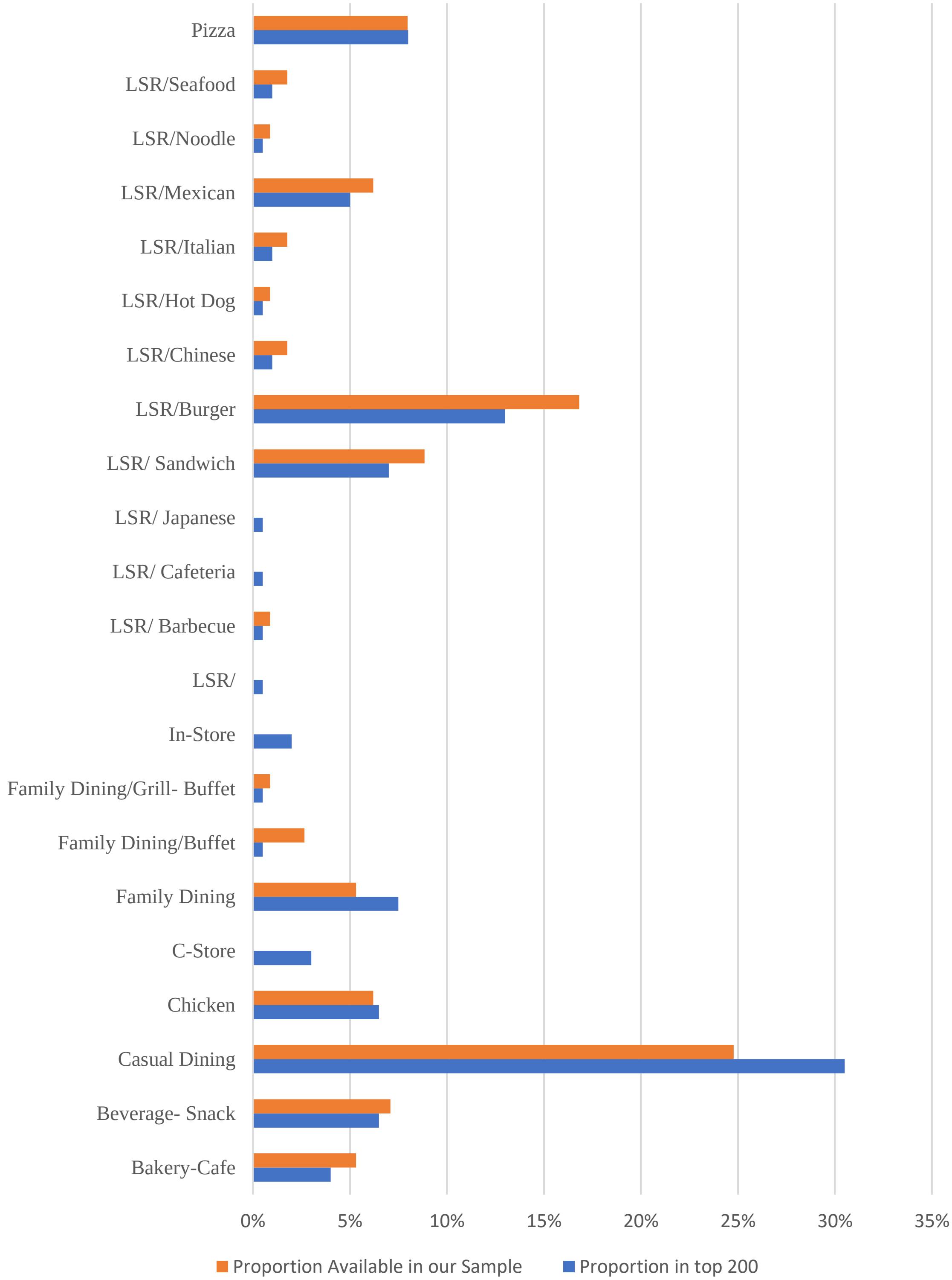
The project requires the use of a panel of detailed restaurant menu offerings and nutrition information for each of the items offered. To form the sample of our large restaurant chains, we draw restaurants from *Nation's Restaurant News*, which ranks restaurants based on their total sales. Out of the reported top 200 restaurants, we were able to successfully collect data from 113 restaurants. The remaining restaurants either did not report nutrition information before the policy took effect or reported it in a way that was not conducive to collection (e.g. requiring going through several webpages for each menu item.) Our resulting sample, as documented in Table 1 below, well represents all large restaurant chains in the United States. As shown, the distribution of restaurants in our sample matches those in the population of top restaurants reasonably well. This paper focuses specifically on fast-food restaurants, those being restaurants identified as LSR limited-service restaurants) but also pizza, chicken, beverage-snack, and bakery-café. Of which, there are 52 restaurants' nutritional information in the dataset we analyze.

Our sample also includes a diverse mix of restaurants, not only in terms of their types but also in terms of their total sales. Some restaurant chains on the top 200 list are very large, such as number 1, McDonalds with 14,482 locations and over $38 trillion in sales annually in the U.S. alone (McDonald's Newsroom, 2015 and Nation's Restaurant News, 2019). There are much smaller restaurants on the list such as number 197, Shari's Café and Pies with 96 locations and $170 million in sales annually (Marum, 2017 and Nation's Restaurant News, 2019). This feature allows us to study heterogeneous restaurant responses to the policy along several dimensions.

For the restaurants in our sample, the data documents nutritional information on macronutrients as well as serving sizes and various micronutrients. These include Total Calories, Calories from Fat, Total fat (g), Saturated fat (g), Trans fat (g), Cholesterol (mg), Sodium (mg), Total carbohydrates (g), Dietary fiber (g), Sugars (g), and Protein (g). These are collected for each menu item in each restaurant in every time-period. Collectively, this large set of longitudinal information makes it possible for detailed analysis of restaurants' strategic response to the mandatory information disclosure.

This set of data has been collected for a total 23 distinct periods between March 2016 and October 2019, encompassing both before and after policy implementation.

Table 1. Nation's Restaurant News Top 200 Proportion of Restaurants by Segment



Digitization and Preparation Process

The data collected are formatted as images, with wildly different formats. Just as restaurant menus come in all shapes and designs, so are the data in our sample. Consequently, the natural next step is digitizing and formatting the data into a clean and uniform format for analysis.

In order to deal with the heterogeneity and complexity of many restaurants' individual reporting mechanisms we have developed a multi-stage data cleaning process which uses both automation and manual processes to efficiently clean large amounts of data.

The first stage in our data preparation process is scanning, where we take the data in either HTML or PDF formats and converts it into a spreadsheet format. This step largely relies on the use of optical character recognition (OCR) software, such as ABBYY. We have been able to mostly automate this process using Python to convert the data in Excel spreadsheets.

While converting images to spreadsheets is an important step, the data still need to undergo careful and rigorous preparation before it is fit for analysis. In this next step, we focus on cleaning the data such that all observations and variables have uniform formats (e.g. all variables are listed horizontally, and observations listed vertically.) We have been able to partially automate this process using Python, which dramatically reduces cleaning time.

Finally, we move on to the most labor-intensive portion of the data cleaning process, a final manual cleaning of data. At this stage we ensure that all the variables in our dataset are properly labelled, check for errors in scanning, and manually enter serving size information that is specified in the item name.

CHAPTER V

RESULTS

Summary Statistics and Stylized Facts

Table 2. shows the average nutritional content of menu items at large American fast-food restaurant chains over our collection period. This data only includes food items and not most beverages, although it does include beverages intended wholly for dessert e.g. milkshakes. It is apparent that there are outliers in data collection when looking at some of the high maximum values present in some of the nutrients measured specifically in the measurements of saturated fat, trans fat, cholesterol, and dietary fiber. For the most part these measurement error outliers were not prevalent enough to substantially affect the average measurement of the nutritional content of menu items and we are in the process of identifying and correcting these few errors. The exception is saturated fat which appears to be measured differently across restaurants, sometimes in grams and sometimes in milligrams, and thus requires further examination before it can be used for analysis.

However, many of the high observations are reasonable. For example, the maximum value of calories, 8,880 is for a tray of 64 brownies intended for a catering event. For the most part, restaurants reported calories, total fat, sugar, sodium, and total carbohydrates consistently. For that reason and their role as nutrients American's overconsume these are the variables we consider in our analysis.

Table 3. shows how the nutritional makeup of the average menu item at U.S. restaurants changed before and after the policy went into effect. It appears that the average menu item became healthier in terms of calories, which is to say they contained about 25 fewer calories on average. That represents a reduction in calories of about one-sixth of the average can of soda or one percent of the daily reference value of calories. One interesting point of note is that the sodium content of the average menu item, which does not affect its calories has fallen where one might expect it to increase to compensate for the decrease in taste associated with a lower fat and sugar content.

Table 2. Nutritional Averages by Item Category per Menu Item at U.S. Limited Service Restaurants with more than 20 locations, 2016-2019

	Count	Mean	Standard Deviation	Min	Max
Calories	143,908	440.7	406.0	0	8,880
Calories from Fat	123,400	184.7	219.0	0	5,400
Total Fat (g)	142,989	21.1	26.7	0	2,000
Saturated Fat (g)	117,434	1,194.6	10,189.7	0	710,710
Trans Fat (g)	128,411	21.8	242.4	0	7,030
Sugar (g)	133,011	20.9	33.3	0	1,230
Sodium (mg)	143,615	796.7	989.0	0	23,990
Cholesterol (mg)	142,724	80.1	237.8	0	15,900
Total Carbohydrates (g)	137,250	47.8	47.0	0	1,920
Dietary Fiber (g)	138,726	5.5	77.5	0	7,030
Protein (g)	138,768	16.4	20.8	0	472
Count indicates the number of individual items in the sample. Not every nutrient is reported for every item in every time-period					

While it is interesting to look at the average calories of a menu item it may be relevant to examine the nutrient composition by item categories, as in Table 4. That is, which portion of the meal it is intended for. For fast-food restaurants items are usually listed separately, the nutrition listed for entrées and sides separately instead of together as a whole meal as they often are at full-service restaurants. A potentially surprising revelation from this is that the average fried potato side dish contains as many calories as the entrée, burger, or sandwich portion at fast-food restaurants.

Because of the periodic nature of our data collection process, we can observe not only the changes in individual menu items but in the menu itself. That is, we can observe when new items are added, old items are taken away, and items are reformulated to have different nutritional content. For the purposes of analysis, we categorize the ways that a restaurant menu can change from the entry, exit, and reformulation of menu items. The average calories of menu items with these categorizations can be seen in Table 5. It is worth noting that overall menus become healthier on average even when these changes would appear to negatively affect healthfulness. Restaurants in general introduce new products which are more calorific and did so to a greater extent after the policy went into effect. Additionally, restaurants appear to be removing relatively less calorific items after the policy. The reformulation variable is interesting because it encompasses two effects. One is a selection effect i.e. restaurants may be choosing to reformulate relatively high calorie products. The other is the effect of reformulation i.e. restaurants may be reformulating products to have fewer calories

Table 3. Restaurant Menu Change Between Average Nutrition per Menu Item at U.S. Fast-Food Restaurants with more than 20 Locations Before and After Nutrition Labelling Policy, 2016-2019

	Pre-Policy, May 2018	**Post-Policy, May 2018**
Calories	448.7 (418.9)	423.5 (376.0)
Calories from Fat	184.3 (229.0)	185.7 (196.4)
Total Fat (g)	21.39 (28.59)	20.52 (22.04)
Saturated Fat (g)	1207.0 (9250.7)	1168.7 (11921.2)
Trans Fat (g)	28.76 (282.7)	7.563 (124.0)
Sugar (g)	22.30 (34.94)	17.89 (29.25)
Sodium (mg)	802.6 (1029.4)	783.7 (894.9)
Cholesterol (mg)	81.36 (270.8)	77.29 (142.1)
Total Carbohydrates (g)	49.12 (49.44)	44.86 (40.95)
Dietary Fiber (g)	6.365 (90.99)	3.568 (32.84)
Protein (g)	16.37 (21.40)	16.44 (19.37)

Table 4. Nutritional Averages by Item Category per Menu Item at U.S. Fast-Food Restaurants with more than 20 locations

	Calories	Total Fat (g)	Sugar (g)	Sodium (mg)
Appetizers & Sides	382.8 (356.3)	17.74 (23.73)	14.88 (26.58)	740.7 (893.9)
Baked Goods	302.9 (156.1)	13.80 (14.13)	19.72 (14.34)	313.1 (193.9)
Burgers	547.0 (276.5)	31.49 (19.74)	7.941 (6.613)	1062.1 (575.9)
Catering	1357.9 (1781.5)	78.41 (129.8)	37.65 (82.45)	2755.1 (3949.0)
Desserts	530.5 (342.6)	22.71 (20.74)	62.26 (41.75)	271.2 (266.2)
Entrées	564.9 (441.9)	27.72 (31.21)	11.27 (17.87)	1200.7 (1091.4)
Fried Potatoes	521.6 (440.8)	26.64 (28.91)	5.372 (12.17)	992.3 (969.8)
Kids	300.0 (221.9)	12.34 (15.52)	10.35 (15.00)	580.0 (565.7)
Sandwiches	609.0 (367.6)	28.18 (25.04)	7.874 (7.049)	1560.6 (1335.8)
Salads	262.0 (150.9)	12.47 (16.05)	5.855 (5.562)	1015.9 (514.5)
Soup	262.0 (150.9)	12.47 (16.05)	5.855 (5.562)	1015.9 (514.5)
Toppings & Ingredients	127.9 (181.2)	8.627 (17.13)	7.229 (18.67)	265.3 (377.2)

Table 5. Restaurant Menu Change Between Average Calories per Menu Item at U.S. Fast-Food Restaurants with more than 20 locations Before and After Nutrition Labelling Policy, 2016-2019

`	Pre-Policy, May 2018	Post-Policy, May 2018	Description
Constant Menu Item			Items which are present in both the current period and a subsequent period with no changes to their calorie content from the previous period.
Mean Calories	450	408	
SD Calories	383	361	
n	80,455	39,026	
Entry			Items which are present the current and future periods but not any previous periods.
Mean Calories	458	597	
SD Calories	570	475	
n	5,271	3,105	
Exit			Items which are present in the current period but not any subsequent period with no changes to their calorie content.
Mean Calories	461	414	
SD Calories	452	328	
n	5,148	1,528	
Entry*Exit			Items which are not present in any previous period nor any subsequent period i.e. items which are only observed once.
Mean Calories	472	558	
SD Calories	802	345	
n	2,469	166	
Reformulation			Items which are present in both a previous period and a subsequent period but with changes to their calorie content from the previous period.
Mean Calories	414	457	
SD Calories	430	471	
n	4,344	1,588	
Reformulation*Exit			Items which are present in the current period but not any subsequent period with changes to their calorie content from the previous period.
Mean Calories	288	544	
SD Calories	591	300	
n	759	49	
Total Sample Size	98,446	45,462	143,908

Note: In this table each observation is counted only once, i.e. there is no intersection between Entry, Exit, and Entry*Exit.
The first observation for a restaurant is not counted as entry and the last not counted as exit.

Reduced-Form Estimation

Overall, we are interested in the nutritional quality of menu items which can be measured not just in calories but other nutritional characteristics such as fat, sugar, carbohydrates, and sodium. Using variables described in Table 5. specifically, those related to the menu changes Entry, Exit, Reformulation, and their interactions as explanatory variables. Our main specification is:

$$Y_{ist} = \theta + \beta D_{st} + \gamma D_{it} + \alpha(D_{st} \times D_{it}) + \xi_i + \varphi_i + \tau_t + \varepsilon_{ist}$$

where the subscript *i* denotes the individual menu item. Subscript *s* denotes the subset of the data, if the observation fell into one of the categories previously discussed. Subscript *t* denotes time representing the collection period. Y_{ist} is the measure of the nutrient on question: calories, total fat, sugar, carbohydrates, or sodium. D_{st} is a dummy variable which takes the value 1 if the menu item has changed in one of the previously discussed ways in that period and 0 otherwise, and D_t a dummy which takes the value 1 if the observation is after the time that the policy went into effect and 0 otherwise. Thus, (D_s x D_t) takes the value of 1 if the menu item experienced a change after the policy went into effect and 0 otherwise. ξ, φ, and τ represent fixed effects. ξ is the restaurant segment fixed effect following the designations discussed in Table 1. φ captures item category fixed effects as discussed in Table 4. τ captures fixed effects by month including seasonality. ε_{ist}, captures any random shocks.

Table 6. shows the results of this estimation, we have controlled for month, restaurant segment, and food-category fixed effects to ensure that these results are not driven by seasonality or specialization. When firms introduced new menu items, Entry, they generally had higher calories, fat, sugar, and sodium content than other items on the

menu. This effect was even greater after the policy, Entry*Post, except for sugar content where newly introduced products had marginally lower the sugar content. In general, the elimination of products, Exit, resulted in less healthy products being eliminated. Although after the policy went into effect there were few additional effects on the elimination of products, Exit*Post shows no strong pattern. The exception once again is sugar where after the policy, controlling for fixed effects, restaurants were eliminating products with a marginally lower sugar content on average. Generally, restaurants introduced new products which were less healthful but also eliminated less healthful products.

Turning now to our measure of reformulation in Table 6. this variable describes a menu item which had a change to calorie content from the previous observation. Thus, it captures two effects, first is the actual effect of reformulation, how the product changed from the previous period to the current period. However, it also captures a selection effect, that is the effect of restaurants choosing which products to reformulate. It could, therefore, be the case that fast-food restaurants were choosing high calorie products to reformulate and reformulating them to have lower calories after the policy went into effect. We further explore this hypothesis in the analysis presented in Table 7.

In Table 7. I analyze a modified dataset from that presented in Table 6. wherein we asses only data for reformulated products in the period after their reformulation and one period before their reformulation. As such, this analysis seeks to capture only the reformulation effect and not the selection effect of fast-food restaurants changing the nutritional content of their products. This analysis reveals some interesting patterns. Before the implementation of the policy fast-food restaurants focused mainly on reformulating products to be lower in sugar and fat however, these reformulations did not significantly affect the calorie content of menu items. After the implementation of the policy restaurants shifted the focus of their reformulations towards decreasing calories. While fat and sugar were decreased to a lower extent they were still generally decreased on average. Furthermore, carbohydrates were also substantially decreased.

Table 6. Effects of Limited Service Restaurant Action on Nutritional Quality of Menu Items at U.S. Fast-Food Restaurants with more than 20 locations Before and After Nutrition Labelling Policy (May 2018), 2016-2019

	(1) Calories	**(2) Total Fat (g)**	**(3) Sugar (g)**	**(4) Carbo-hydrates (g)**	**(5) Sodium (mg)**
Entry	44.03***	2.266***	1.249***	4.894***	73.09***
	(5.184)	(0.363)	(0.362)	(0.612)	(12.46)
Entry*Post	111.6***	7.186***	-1.319*	6.316***	236.7***
	(8.596)	(0.602)	(0.607)	(1.008)	(20.72)
Exit	47.82***	2.776***	1.812***	2.552***	28.59*
	(5.191)	(0.363)	(0.372)	(0.607)	(12.48)
Exit*Post	-3.203	-0.487	-2.411**	1.400	62.79*
	(10.68)	(0.746)	(0.758)	(1.250)	(25.65)
Entry*Exit	-48.92***	3.858***	0.538	-5.327***	-68.72**
	(10.33)	(0.723)	(0.730)	(1.219)	(24.83)
Entry*Exit *Post	-50.15	-9.716***	14.33***	5.119	-245.0**
	(31.76)	(2.220)	(2.213)	(3.868)	(76.32)
Reformulation	-5.124	0.384	1.325***	-3.143***	-75.44***
	(5.720)	(0.401)	(0.401)	(0.692)	(13.77)
Reformulation* Post	37.93***	1.245	-1.645*	5.263***	200.6***
	(10.79)	(0.755)	(0.759)	(1.278)	(26.05)
Reformulation* Exit	-118.6***	-8.116***	3.822***	-15.49***	-389.9***
	(15.06)	(1.053)	(1.064)	(1.788)	(36.34)
Reformulation* Exit*Post	126.6*	8.067*	-1.540	17.48**	404.8**
	(54.74)	(3.825)	(3.775)	(6.475)	(131.6)
Post	-12.44***	-0.987***	-1.025***	-2.500***	-22.30***
	(2.486)	(0.174)	(0.177)	(0.296)	(5.978)
Constant	243.3***	7.717***	6.365***	32.03***	308.1***
	(6.344)	(0.447)	(0.453)	(0.743)	(15.25)
Month, Restaurant, and Food Category Fixed Effects	yes	yes	yes	yes	yes
n	143,907	142,988	133,010	137,249	143,614

Standard errors in parentheses

* p<0.05 ** p<0.01 ***p<0.001

Table 7. Effects of Reformulation on Calories of Menu Items at U.S. Fast-Food Restaurants with more than 20 locations Before and After Nutrition Labelling Policy (May 2018), 2016-2019

	(1) Calories	(2) Total Fat (g)	(3) Sugar (g)	(4) Carbo-hydrates (g)	(5) Sodium (mg)
Reformulation	2.814 (12.94)	-9.253*** (1.247)	-3.791*** (0.796)	-1.235 (1.398)	80.94** (29.88)
Reformulation* Post	-58.98* (24.42)	6.579** (2.350)	1.356 (1.502)	-7.362** (2.553)	-169.6** (56.44)
Post	80.98*** (22.29)	-7.087*** (2.146)	-4.664*** (1.367)	6.618** (2.346)	301.8*** (51.47)
Constant	406.0*** (33.35)	20.82*** (3.222)	15.55*** (2.055)	52.46*** (3.467)	569.3*** (77.06)
Month, Restaurant, and Food Category Fixed Effects	yes	yes	yes	yes	yes
n	8,606	8,572	8,288	8,046	8,558

Standard errors in parentheses
* p<0.05 ** p<0.01 *** p<0.001

CHAPTER 6

DISCUSSION

Strategic Response of Fast-Food Restaurants

While this reduced-form analysis can hardly reveal a causal effect of the policy the patterns it shows in restaurants actions do imply some interesting strategic responses by restaurants to nutrition labelling policy. First it would appear that if the policy has had its desired effect in reducing calorie content of fast-food menu items, this effect resulted in a reduction of at most only about 25 calories per menu item, one percent of the DRV.

The three broad ways in which restaurants can alter the nutritional profile of their menus are introduction (entry), elimination (exit), and reformulation of menu items. Newly introduced products were substantially less healthful than other products and even more so after nutrition labelling in restaurants was mandated. While before the policy fast-food restaurants eliminated less healthful products this pattern did not substantially change after the introduction of the policy. Fast-food restaurants reformulated items to be healthier in general and especially so after the policy.

One potentially interesting explanation for these phenomena could be that restaurants are responding to consumers who desire healthful products but are poorly informed about nutrition. As such, restaurants strategies could entail marginally reformulating popular existing menu items to be marginally lower in calories and other overconsumed nutrients. However, at the same time introducing new products which are substantially higher in calories to serve as comparisons. Consumers who care about reducing their calorie intake will thus interpret existing menu items to be more healthful by comparison to newer items. However, this profit maximizing response could be intended solely to appeal to consumers different preferences with regards to taste and nutrition. Even if this strategic response is the case, fast-food restaurants may have still provided healthier options and potentially reduced calorie consumption so the policy could still be interpreted as successful.

<u>Limitations</u>

We see many potential limitations with this initial analysis. First, while it is generally hard to establish causal impacts of a policy change, it is particularly challenging in our case. Restaurants exist in a complex market, each selling hundreds of different products and having a diverse range of specializations.

Additionally, restaurants as well as consumer preferences constantly evolve over time, so it is important to control for time trend. Furthermore, the distinction between pre- and post-policy period becomes more subtle given that the policy was announced and later postponed (Bokamp, 2017).

Another limitation is that our data is only on nutrition of menu items, with no sales information. This makes it difficult to evaluate the policy impacts on health. To counter this limitation, we take advantage of the fact that restaurants themselves observe sales and are likely to take that into consideration when making decisions related to the nutritional content of their products. Restaurants are likely to (1) drop items in low demand, (2) add items which they think will have high demand and (3) reformulate products to have higher demand than previously. Thus, by looking at product entry, exit and reformulation, we can also infer about popularity and sales.

While there are limitations to the current analysis, we hope to counter them with more robust analyses in the future.

Extensions

We have gathered a rich panel dataset on a representative subset of U.S. restaurants' nutritional profiles. As such, the analysis presented in this paper is intended to serve as an initial exploration of this data. We intend to add more data to this analysis and expand our empirical methods to capture the causal effect of this policy more accurately.

The obvious next step is to add more data to the analysis. First, we can add data for sit-down restaurants with more than 20 locations. It could be interesting to see if there is a differential effect across these two broad categories of restaurants.

Furthermore, we have collected data on restaurants with fewer than 20 locations which are not directly mandated to follow the policy. To properly identify the policy impact, we will consider and compare restaurants with 20 or more locations (subject to policy) vs. those with less than 20 locations (not subject to policy). We believe that time trend is likely to be comparable across groups within each dimension, so difference-in-differences estimates would allow us to tease out common time trend unrelated to the policy.

While a broader look at restaurants could certainly be interesting another avenue of exploration is to take a more focused look at specific groups of restaurant chains and specific menu item categories. This could reveal patterns in strategic responses across these groups.

Additionally, it may be fruitful to develop a structural model of restaurant menu decisions from a nutritional standpoint. To this end, we seek to develop a robust model of supply-side forces which influence nutrition decisions by restaurants. This will further allow us to describe the causal effects of the policy and estimate welfare effects.

Furthermore, the distinction of the policy being in effect simply after it was enacted in May 2018 (Post) is naïve. The policy was postponed multiple times (Bokamp, 2017). It is likely that restaurants strategic responses began earlier than the enaction of the policy. A more robust temporal analysis would allow us to capture the dynamic impacts over time, and properly evaluate the impact of actual policy vs. policy threat.

CHAPTER 7

CONCLUSION

Nutrition labelling in restaurants is a policy designed to inform consumers of the nutritional quality of the food they consume. As a result of this policy restaurants may choose to alter the nutritional content of their menu items. This thesis has sought to address fast-food restaurants' strategic response to the mandate to label calorie content on their menus and menu boards. Given the importance of food away from home and specifically fast-food to American diets this response could have major consequences for American public health.

Consumer responses to nutrition labelling are quite well documented in previous literature and find that consumers respond to them by reducing the number of calories they purchase but these responses vary demographically (Bollinger, Leslie, and Sorenson, 2010; Ebel, Kersh. Brescoll, and Dixon, 2009; Green, Brown, and Ohri-Vachaspati, 2015; Yamamoto et al. 2004). The limited research on the effects of nutrition labelling on restaurants food offerings is limited but generally finds that restaurants slightly reduce the calorie content of their menu items (Breummer, Krieger, Salens, and Chan, 2012; Nambla et al. 2013). The broader literature on quality disclosure finds that firms' strategic responses to quality disclosure mandates can have intended and unintended consequences (Bennear and Olmstead ,2008; Dranove et al. ,2003; Ippolito and Mathios, 1990; Jacob, 2005; Jin and Leslie ,2003; Lu ,2012; Powers et al., 2011).

This paper contributes primarily to the literature regarding firms' strategic responses to nutrition labelling policy. Specifically addressing the recent nationally mandated nutrition labelling policy for a large number of major fast-food restaurant chains. We find evidence of calorie reductions in average menu items across these restaurants, consistently with previous literature.

Holistically assessing the various patterns in the ways that restaurants can change the nutritional profile of their menus, through introduction, elimination, and reformulation of menu items suggests intended and unintended consequences of this policy. If the policy has been successful in reducing the average calorie content of menu items, it would only have resulted in at most a modest reduction of 25 calories per item on average. This may have been accomplished through the reformulation of existing menu items to be more healthful, especially since the enaction of the policy, and elimination of particularly unhealthy items. However, while restaurants have altered their menus towards a lower-calorie, fat, sugar, carbohydrate, and sodium composition they have also introduced new products which are particularly unhealthful. This introduction of unhealthful products increased in severity after the implementation of the policy. This suggests that fast-food restaurants may be appealing to consumers who care only for taste and/or magnifying the effect of their meager improvements to the existing menu with particularly unhealthy comparisons.

Further research will seek to disaggregate a causal effect of the policy from general trends. Additionally, we seek to identify patterns of response across a broader range of restaurant sizes and specialties as well as focus on specific responses of groups of restaurants. In so doing we will identify restaurants' strategic and competitive responses to the mandate to label calorie content of menu items on their menus and menu boards more accurately.

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