Empirical evidence challenges the belief that increased restaurant dining is the cause of American obesity.

Restaurants, Regulation, and the Supersizing of America

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Obesity rates in the United States have grown rapidly in recent years, and obesity has become a leading cause of preventable death. Medical research has linked obesity to diabetes, heart disease, stroke, and certain cancers. But while obesity represents a serious and growing health issue, its underlying causes are not well understood.

One popular idea among public health advocates is that eating restaurant food causes obesity. Restaurant food is often rich and portion sizes tend to be large. Concerned policymakers are developing new regulations on restaurants in an effort to fight obesity. For example, in response to high obesity rates in low-income neighborhoods, the Los Angeles City Council unanimously approved a law in July 2008 banning the opening of new fast food restaurants in a 32 square-mile area containing 500,000 residents. "Calorie posting" laws are in effect in cities such as New York and Seattle, and the recent health care reform bill mandates calorie posting for all chain restaurants with 20 or more outlets.

If large portions and effective marketing lead people to eat more when they go to restaurants than when they eat at home, then these regulations may reduce obesity. But it is not obvious that the link between eating at restaurants and obesity is causal. The increasing prevalence of restaurants may in part reflect a greater demand for calories.

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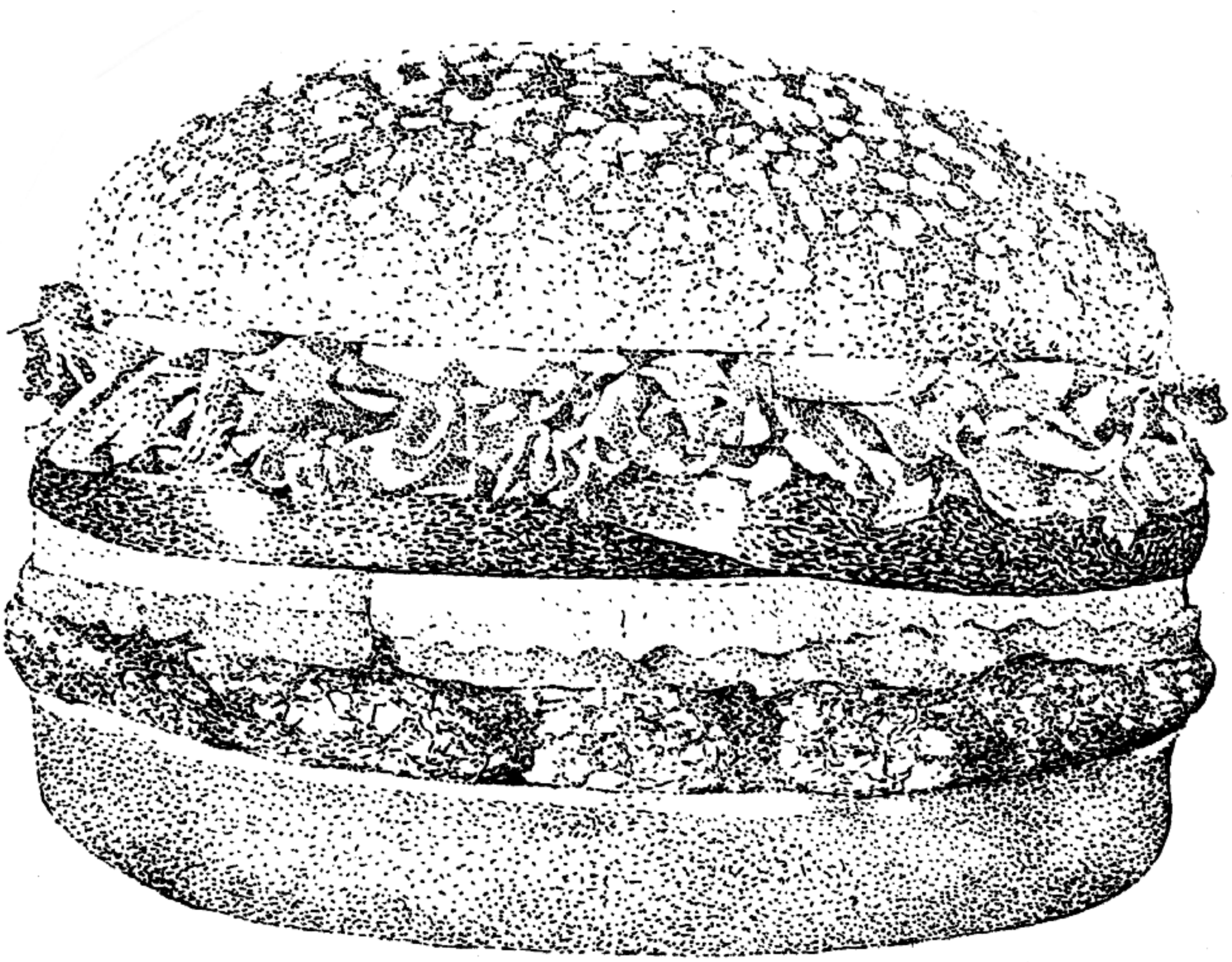
The case against restaurants centers on correlations showing that the frequency of eating out is positively associated with greater fat, sodium, and total energy intake, as well as with greater body fat. These correlations have been reproduced in a broad range of data sets and study populations. Furthermore, the number of restaurants and the prevalence of obesity have been rising for a number of decades. But simple correlations between restaurant visits and overeating may conflate the impact of changes in supply and demand. People choose where and how much to eat, leaving restaurant consumption correlated with other dietary practices associated with weight gain. A key question is whether the growth in eating out is contributing to the obesity epidemic, or whether these changes merely reflect consumer preferences. The interesting causal parameter is how much more an obese person consumes in total because he or she ate at a restaurant. If changes in preferences are leading consumers to eat out more, regulating restaurants may only lead consumers to shift consumption to other sources rather than to reduce total caloric intake.

EMPIRICAL RESEARCH DESIGN

In a paper forthcoming in the *American Economic Journal: Applied Economics*, we reexamine the conventional wisdom that restaurants are making America obese. We assess the nature of the connection between restaurants and obesity by exploiting variation in the supply of restaurants and examining the impact on consumers' body mass. In rural areas, interstate highways provide variation in the supply of restaurants that is arguably uncorrelated with local consumer demand. To serve the large market of highway travelers passing through, a disproportionate number of restaurants locate



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immediately adjacent to highways. For residents of these communities, we find that the highway boosts the supply of restaurants (and reduces the travel cost associated with visiting a restaurant) in a manner that is plausibly uncorrelated with demand or general health practices. To uncover the causal effect of restaurants on obesity, we compare the prevalence of obesity in communities located immediately adjacent to interstate highways with the prevalence of obesity in communities located slightly farther away.

The estimates suggest that restaurants — both fast food and full service — have little effect on adult obesity. The differences in obesity rates between communities adjacent to highways and communities farther from highways are close to zero and precise enough to rule out any meaningful effects. These results indicate that policies focused on reducing caloric intake at restaurants are unlikely to reduce obesity substantially, at least for adults.

But given that a typical restaurant meal contains more calories than a home-cooked meal, it may seem surprising that greater restaurant availability does not increase obesity. To understand why restaurants have little impact on obesity, we examine food intake data collected by the U.S. Department of Agriculture. These micro data contain information on all food items consumed by a large panel of individuals. We find that people who eat large portions in restaurants tend to reduce their calorie consumption at other times during the day; calories eaten in the restaurant substitute (at least in part) for calories eaten at other times that day.

These food intake results have broad implications for obesity policy and general health and safety regulation. Economic theory implies that regulating specific inputs in the health production function may not improve outcomes if consumers can compensate in other ways. For example, previous research has suggested that smokers react to cigarette taxes by smoking fewer cigarettes more intensively. In the case of obesity, consumers have access to multiple sources of cheap calories. Restricting a single source — such as restaurants — is therefore unlikely to affect obesity, as our findings confirm. This mechanism may underlie the apparent failure of many interventions targeted at reducing obesity. Despite their ineffectiveness, such policies have the potential to generate considerable deadweight loss. Our results suggest that obesity reductions are unlikely in the absence of more comprehensive policies.

Data The obesity data used in this study come from a confidential extract of the Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is an ongoing, large-scale telephone survey that interviews hundreds of thousands of individuals each year regarding their health behaviors. In addition to questions about demographic characteristics and health behaviors, the survey asks each individual to report his or her weight and height.

Although national BRFSS data are publicly available from the Centers for Disease Control, the CDC does not release geographic identifiers at a finer level than the county. To complete our study, we requested confidential BRFSS extracts from states that include a much finer geographic identifier: telephone area code and exchange (i.e., the first six digits of a 10-digit telephone number). Eleven states — Arkansas, Colorado, Iowa, Kansas, Maine, Missouri, North Dakota, Nebraska, Oklahoma, Utah, and Vermont — cooperated with our requests. Sample years vary by state and overall cover 1990 to 2005.

Our measures of obesity include body mass index (BMI), defined as weight in kilograms divided by the square of height in meters. A person is considered overweight if he has a BMI of 25; he is obese if his BMI is over 30. The average BMI in our sample is 26.6, the prevalence of overweight individuals is 58 percent, and the prevalence of obese individuals is 21 percent. These figures closely match national averages over the same time period. Restaurant establishment data are from the United States Census ZIP Code Business Patterns and include separate counts of full service ("sit-down") and limited service ("fast food") restaurants for every ZIP code in the United States. Ideally we would have individual-level data on frequency of restaurant consumption to document the relationship between restaurant consumption and proximity to an interstate highway. To our knowledge, however, no existing data sets with this information have the necessary sampling rates to provide a sample of meaningful size in our study areas. Instead, we conducted our own survey on frequency of restaurant consumption, described below.

RESTAURANT PROXIMITY AND BODY MASS

Our goal is to measure the effect of restaurant consumption on body mass. In this section, we examine the effect of restaurant availability on body mass; in the next section, we confirm that restaurant availability affects restaurant consumption. An analysis that assumes restaurant placement is exogenously determined (i.e., uncorrelated with other factors that could affect obesity) is unattractive. Both restaurants and people choose where to locate, so restaurant availability is likely to be correlated with other factors that could affect weight. We address this issue by finding an instrumental variable that satisfies two essential properties: first, it affects restaurant availability, and second, it is uncorrelated with other determinants of weight.

Distance Our instrument exploits the location of interstate highways in rural areas as a source of exogenous variation in restaurant placement. We compare two groups of small towns: those directly adjacent to an interstate highway (0–5 miles away) and those slightly farther from an interstate (5–10 miles away). For convenience, we refer to these two sets of towns as "adjacent" and "nonadjacent," respectively.

The interstate highways were designed in the 1940s to connect the principal metropolitan areas and industrial centers of the United States. As an unintended consequence, the highways lowered transportation costs for rural towns that happened to lie on highway routes running between major cities. Previous work has concluded that highways may affect county-level economic outcomes, which might in turn have some impact on obesity. To avoid this potential confounding factor, our study uses a much finer level of geographic detail: ZIP codes and telephone exchange areas. This geographic detail enables us to limit our study to ZIP codes and exchanges whose centers lie within 10 miles of an interstate highway. At this level, we expect all towns to benefit from the lower long-distance transport costs that highways provide. We therefore expect — and find — no systematic differences in economic outcomes between the two groups of towns in our sample.

For a large group of individuals — through-travelers on interstate highways — adjacent towns represent a more convenient service option than nonadjacent towns. Since these individuals have many choices along their route of travel, their demand is highly elastic with respect to distance from the highway. Proximity to an interstate thereby increases the supply of restaurants in towns adjacent to interstates, relative to towns that are not immediately adjacent, for a reason that is independent of local demand (as long as residents do not sort to different areas based on the availability of restaurants, an issue that we consider below). In a comparison of the two sets of towns, ZIP codes located 0–5 miles from interstates are approximately 38 percent (19 percentage points) more likely to have restaurants than ZIP codes located 5–10 miles from interstates. This is true for both fast food and full service restaurants.

Figure 1

How Far to the Food?

Distance to the nearest resturant for residents in adjacent and nonadjacent ZIP codes

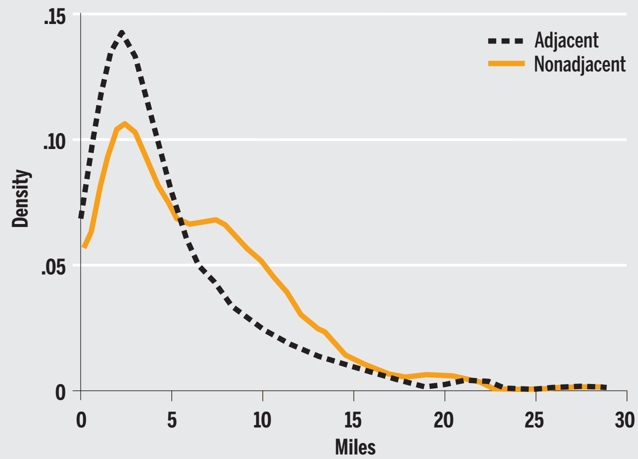


Figure 1 plots the distribution of distance to the nearest restaurant for adjacent and nonadjacent ZIP codes. For ZIP codes without restaurants, we use the distance to the nearest ZIP code with a restaurant. Of course, the average distance for residents of ZIP codes that contain restaurants is not zero. We calculate the distribution of the distance from each Census block to the nearest restaurant for a stratified random sample of 21 ZIP codes that contain restaurants. Residents of these ZIP codes live, on average, 2.5 miles from their nearest restaurant. To construct Figure 1, we sample (with replacement) from the observed distribution of restaurant distance for each sample ZIP code that contains a restaurant.

Figure 1 shows that the distance to the nearest restaurant is much lower for residents of ZIP codes that are adjacent to an interstate highway than for residents of nonadjacent ZIP codes. Most residents of adjacent ZIP codes live 0–5 miles from the nearest restaurant, whereas residents of nonadjacent ZIP codes are more likely to live 5–15 miles away. These distances correspond to additional roundtrip travel times of 10–40 minutes. Given the extensive evidence in economics and marketing that even small distances can have large effects on shopping patterns, these distances represent a sizable financial barrier to restaurant access.

Regression analysis, presented in Panel A of Table 1, confirms the statistical significance of the relationship between interstate proximity and restaurant availability. The regression estimates indicate that individuals in ZIP codes adjacent to interstate highways live 1.5 miles closer to their nearest restaurant than individuals in ZIP codes nonadjacent to interstates. Although 1.5 miles may not seem far, it is important to note that this effect primarily operates through the differential in ZIP codes containing any restaurants at all. ZIP codes adjacent to interstates are 17.5 percentage points more likely to contain a restaurant than ZIP codes nonadjacent to interstates, and when a ZIP code contains a restaurant, the distance to the nearest restaurant falls on average from 10.2 miles to 2.5 miles.

It is also possible to calculate the effect of interstate proximity on total restaurant price, which we define as the sum of meal costs and travel costs. We translate the distance measure into a price measure using conservative estimates of vehicle operating costs and travel time valuation from the transportation and economics literatures. We estimate total travel costs, including both vehicle operating costs and travel time, at 70 cents per mile. This figure implies that the average cost differential in restaurant access for ZIP codes adjacent to interstates versus ZIP codes farther from interstates is \$2.10 (1.5 miles × 2 directions (round trip) × 70 cents per mile = \$2.10). As explained above, this effect operates through the differential in ZIP codes containing any restaurants at all. Proximity to an interstate reduces the total restaurant price by an average of \$10.80 for areas that would not have a restaurant at all if not for the highway.

Table 1

Access to Restaurants And BMI

Effects of highways and restaurants

Panel A: Effect of highway proximity on:	
i) Miles to nearest ZIP with restaurant	-1.50 miles (0.39)
ii) Any restaurant in ZIP code	17.5 percentage points (0.042)
Panel B: Effect of highway proximity on:	
i) Body Mass Index	0.002 (0.127)
Panel C: Effect of being 1 mile closer to a restaurant on:	
i) Body Mass Index	0.0013 (0.085)
Observations	13,470

NOTE: *This table reports regression coefficients. Panels A and B report coefficients from regressions of the listed dependent variable on highway proximity. Panel C reports the coefficient from an instrumental variables regression of BMI on restaurant proximity (using highway proximity as the instrument). All regressions control for state-by-year fixed effects. Standard errors corrected for within-prefix correlation in the error term are reported in parentheses.*

Figure 2

Proximity to Restaurants and Obesity

BMI for people in towns adjacent to interstates and towns farther from interstates

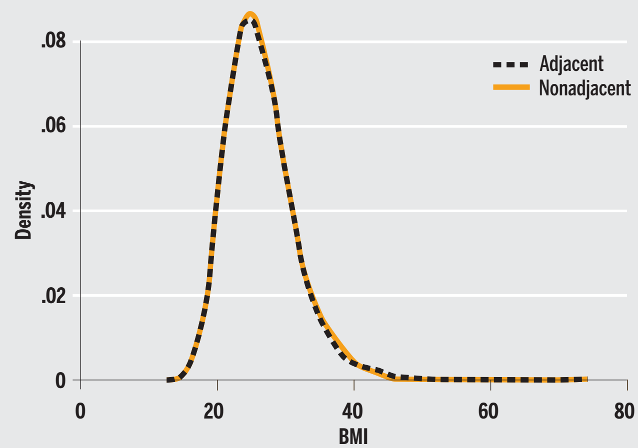


Figure 2 presents the distribution of BMI for towns adjacent to an interstate highway and towns farther from an interstate. The two distributions match up exactly, suggesting that restaurants have no discernable effect on any part of the obesity distribution. Regression analysis, presented in Panel B of Table 1, confirms the null relationship between interstate proximity and obesity; interstate proximity increases BMI by a statistically insignificant 0.002 points (from an average of 26.6 points).

We combine the results of the regressions in Panels A and B of Table 1 to estimate the effect on BMI of distance to the nearest restaurant. Specifically, we divide the estimated effect of interstate proximity on BMI (0.002) by the estimated effect of interstate proximity on distance to the nearest restaurant (–1.5). Simply stated, a 1.5-mile decrease in distance to the nearest restaurant is associated with a 0.002 point increase in BMI. We thus estimate that a 1-mile decrease in distance to the nearest restaurant increases BMI by 0.0013 points (Panel C of Table 1). This procedure is equivalent to estimating an instrumental variables model in which interstate proximity is the instrument.

We can again translate our distance measure into a total restaurant price measure by converting miles traveled into total travel costs at a rate of 70 cents per mile. We calculate: 0.0013 BMI per mile ÷ (2 directions (round trip) × 70 cents per mile) = 0.001 BMI per dollar.

Lowering restaurant access costs by $1 is thus associated with a statistically insignificant 0.001-point increase in BMI.

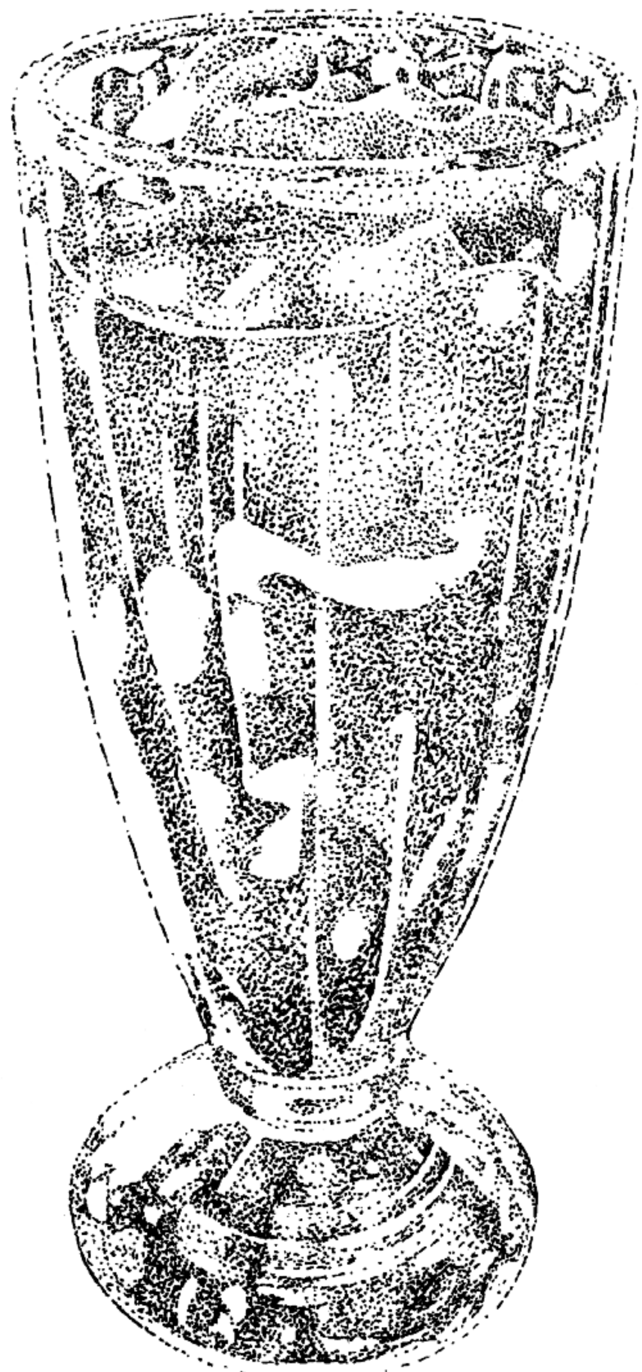
ALTERNATIVE INTERPRETATIONS

The clear null relationship between interstate proximity and body mass strongly suggests that restaurant availability does not affect obesity. However, there are two alternative explanations for the null relationship that merit consideration. First, although interstate proximity correlates with restaurant availability, it is possible that it has no effect on the frequency of restaurant consumption. Second, residents of towns adjacent to the highway may differ from residents in nonadjacent towns along dimensions that affect body mass. In that case, a positive effect of restaurants on body mass may be masked by negative effects of other factors on body mass. We consider these two possibilities in detail.

Restaurant consumption The distributions of distance to the nearest restaurant plotted in Figure 1 demonstrate that residents of nonadjacent towns live significantly farther from their nearest restaurant than residents of adjacent towns. But does this difference actually affect restaurant consumption? Restaurant demand, for example, might be highly inelastic with respect to travel distance, or savvy consumers might choose to eat in a restaurant on days when they already travel to restaurant towns for other reasons. To validate the relationship between interstate proximity and restaurant consumption, we conducted an original survey in a rural area that is representative of our study population. Specifically, we surveyed customers at every fast food restaurant lying within a 3,000 square-mile corridor of Interstate-5 in northern California. Logistical constraints compelled us to focus the survey on fast food restaurants and ignore full service restaurants; however, fast food meals comprise almost two-thirds of all meals consumed away from home and are presented in the obesity literature as being particularly unhealthy. Our survey reveals that both interstate and restaurant proximity have strong effects on frequency of restaurant consumption.

The area of northern California that we analyze is approximately two-thirds the size of Connecticut. Centered on I-5 between Dunnigan and Corning, CA, the study area is approximately 80 miles long and 40 miles wide and contains 23 fast food restaurants, including McDonald's, Burger King, Carl's Jr., Jack in the Box, Taco Bell, Kentucky Fried Chicken, Quiznos, and Subway. We chose this area because it was the only continuous interstate corridor with comparable population density to our main analytic sample located within a 200-mile radius of either Berkeley, CA, or Evanston, IL (the locations of our respective universities). Over 11 nonconsecutive days in June and July 2008, we approached 2,040 customers at all of these 23 restaurants and asked for their town and ZIP code of residence. Ninety-three percent of those approached responded to our short oral survey.

Using these data and ZIP code populations from the U.S. Census, we derived the relative frequency of fast food consumption for each ZIP code in the study area. The sampling scheme for these data is different than for the Census or BRFSS data since we sample at the point of consumption (the restaurant) rather than at the point of residence (the ZIP code or telephone exchange area). Nevertheless, because we sample from the entire universe of restaurants in the study area, both schemes should produce similar estimates of per capita fast food consumption (up to sampling error). As an example, suppose that we wish to measure the number of California residents and Nevada residents attending the 2009 Annual Meeting of the American Economic Association (AEA) in San Francisco. One alternative would be to telephone a random sample of California and Nevada residents and ask, "Did you register for and attend the 2009 AEA Annual



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Meeting?" The other alternative would be to stand at the AEA registration desk and ask each person who registers, "What state are you from?" Both alternatives are valid and would yield the same answer in a sufficiently large sample. Logistically, however, in both the AEA scenario and our actual survey, it is far less expensive to gather an equivalent number of observations using a direct customer survey than a telephone survey. For this reason, we conduct a direct customer survey.

The relationship between interstate proximity and restaurant access is roughly similar in the survey area and in our main study area. For example, interstate proximity increases the likelihood of having a restaurant by 21 percentage points in the survey area and 19 percentage points in our main analytic sample. Interstate proximity reduces the average distance to travel to the nearest restaurant by 2.1 miles in the survey area and 1.5 miles in our main analytic sample.

The survey data reveal that interstate proximity has an economically and statistically significant effect on fast food consumption. Residents of towns located 0–5 miles from I-5 visit restaurants at a rate of 128 daily visits per 1,000 residents, while residents of towns located 5–10 miles from I-5 visit restaurants at a rate of 68 daily visits per 1,000 residents. This 47 percent decrease in frequency of fast food consumption is significant at the 99.9 percent confidence level. The relationship between fast food consumption and restaurant proximity is also strong and statistically significant. Residents of towns that contain a fast food restaurant visit restaurants at a rate of 127 daily visits per 1,000 residents, while residents of towns that do not contain a fast food restaurant visit restaurants at a rate of 39 daily visits per 1,000 residents.

Overall, the results from the restaurant survey suggest that residents in ZIP codes located 5–10 miles from the highway may consume fast food at only half the rate of residents in ZIP codes located 0–5 miles from the highway. Interestingly, we estimate that the implied demand response to a $1 change in travel costs is similar to existing estimates of the demand response to a $1 change in menu prices. Even if the exact magnitudes estimated from the survey data do not generalize to our main analytic sample, the strong economic and statistical significance of the survey results verify that highway proximity indeed induces meaningful changes in fast food consumption and suggest that restaurant proximity in general is a strong determinant of restaurant consumption.

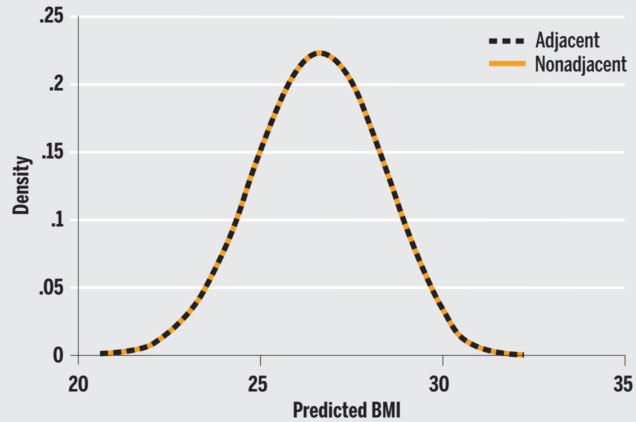
Residential sorting There is little reason to believe that proximity to interstate highways in the range we examine is correlated with the determinants of body mass. Small towns that lie directly adjacent to interstates do so only by historical accident, and all towns in our sample enjoy the lower transportation costs associated with easy access to highways. Nevertheless, people can choose where to live; in principle, individuals with a preference for eating out might choose to live in towns adjacent to interstates, and these individuals may have a pre-existing tendency to be overweight or underweight.

To confirm that unobserved factors are not offsetting a positive effect from restaurants, we analyze a wide range of observable characteristics from disaggregated Census and BRFSS data. These analyses show no evidence that people sort themselves according to proximity to an interstate. Given that all observable characteristics are uncorrelated with interstate proximity, it is likely that unobservable characteristics are uncorrelated as well. Thus our instrument (interstate proximity) is unlikely to be correlated with confounding factors that could affect BMI.

Figure 3

Testing an Alternative Explanation

Residents of towns adjacent to interstates highways have balanced risk factors for BMI



Using BRFSS data, Figure 3 plots the distribution of an index of predicted BMI for both groups of towns. The index consists of the predicted values from a regression of BMI on a set of observed characteristics: gender, age, the square of age, indicators for educational attainment, employment, unemployment, and marital status, as well as a full set of state-by-year indicator variables. This index summarizes all of the observed characteristics for each individual, weighting them in relation to their correlation with BMI, and provides a more powerful test than examining the correlation between interstate proximity and each characteristic individually. (Statistical tests of each characteristic individually also find no significant differences, however.) The plot in Figure 3 reveals that risk factors for BMI are perfectly balanced across the adjacent and nonadjacent towns — the two distributions match up precisely. This suggests that our research design successfully approximates a randomized experiment — the instrument appears uncorrelated with potential confounding factors. Tests using Census data on gender, race, age, education, and household income also find no significant relationship between interstate proximity and any of these factors (results not shown).

WHY DO RESTAURANTS NOT AFFECT OBESITY?

Given the established correlation between eating out and obesity, as well as the simple fact that restaurant portions have grown markedly over the past several decades, it may appear surprising that restaurant consumption has no significant effect on obesity. To reconcile these facts, we analyze the causal mechanisms behind the limited effect of restaurants on obesity. Two possible reasons why access to restaurants would not affect body weight deserve particular attention. First, individuals with higher caloric demand may eat out more often. The correlation between obesity and eating out may thus reflect individual choices rather than a causal effect of restaurants on obesity. We describe this possibility as "individual selection." Second, even if people do consume more calories at restaurants, they may offset the additional restaurant consumption by eating less during the rest of the day. We describe this possibility as "compensatory behavior." To explore the relevance of the two mechanisms, we examine food intake data collected by the U.S. Department of Agriculture.

The food intake data come from the Continuing Survey of Food Intake by Individuals, conducted from 1994 to 1996, and include detailed information about all of the food items consumed by several thousand adults over two nonconsecutive days. We focus our analysis on obese and overweight individuals who live outside of metropolitan areas because they are more representative of the subjects in the preceding analysis. We also drop a small number of observations with obvious coding errors, leaving an analytic sample of 854 individuals.

We conduct two types of analyses using the food intake micro data. First, we examine how caloric intake differs for meals eaten at restaurants and meals eaten at home. Then, we examine how caloric intake changes on days in which individuals eat at a restaurant rather than exclusively at home. In particular, if individuals engage in compensatory behavior by eating less before or after a large restaurant meal, then we expect restaurants to have a larger effect on calories consumed at a given meal than they do on total calories consumed throughout the day.

Table 2

Restaurants and Calories

Relationship between restaurant meals and caloric intake

	Meals eaten in restaurant that day	Between-individual estimator	Fixed effects estimator	Sample size
	(1)	(2)	(3)	(4)
Panel A: Meal-level (mean = 697.8 calories)				
Eat at restaurant	0.163	338.8 cal (46.0)	237.6 cal (23.8)	3,920
Panel B: Daily-level (mean = 2,061.8 calories)				
Eat at restaurant	0.408	214.2 cal (53.0)	34.6 cal (41.1)	1,591

NOTE: *This table presents an analysis of caloric intake by obese and overweight rural individuals based on data collected by the USDA. The sample includes individuals aged 18 or older on days in which the person ate zero, one, or two meals at a restaurant. Column (1) shows the frequency of restaurant meals (percent of meals at restaurants in Panel A and average number of restaurant meals per day in Panel B). Columns (2) and (3) report coefficients from regressions with caloric intake as the dependent variable. In Panel A, the number of calories consumed during a given meal is regressed on an indicator for whether the food was from a restaurant and a set of controls. In Panel B, the number of calories consumed during a given day is regressed on the number of meals consumed at a restaurant that day and a set of controls. The controls include indicators for lunch and dinner (meal-level regressions only), the day of the week, and whether an individual reported eating more because of a social occasion or extreme hunger. Standard errors corrected for within-household correlation in the error term are reported in parentheses.*

Table 2 presents coefficient estimates from a regression of calories consumed by an individual during meal or day *t* on a binary indicator for whether the individual eats at a restaurant during meal or day *t* (as well as a set of control variables). Panel A reports results from the meal-level analysis. The sample ate 16.3 percent of their meals at restaurants (Column 1). Column (2) presents results from a between-individual estimator, which compares the average caloric intake per meal for individuals that eat at restaurants to the average caloric intake per meal for individuals that do not eat at restaurants. On average, individuals who eat at restaurants consume 339 more calories per meal than individuals who do not. This estimate is statistically significant and sizeable: the average restaurant meal contains 50 percent more calories than the average home-cooked meal. Many of the findings in the public health literature linking restaurants and obesity rely on this sort of between-individual variation.

But some of the observed relationship between restaurants and caloric intake across individuals may be due to selection: people who frequent restaurants may eat more than those who do not, even when they are not eating out. To address this possibility, Column (3) presents results for a model that includes a separate indicator variable for each individual in the sample (i.e., individual fixed effects). These results use within-individual variation in restaurant dining to estimate the effect of restaurants on caloric intake. On average, when a given individual eats out, he consumes 238 more calories per meal than when he eats at home (down from 339

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calories per meal in the second column).

While the within-individual estimates control for the type of selection described above, they do not capture any compensatory reductions that may occur at other meals or at snack time. Both the between- and within-individual estimates are therefore upwardly biased estimates of the effect of restaurant meals on total caloric intake — the between-individual estimate is biased because of selection and the within-individual estimate is biased because it does not capture compensatory behavior. Accurately measuring the effect of restaurants on total caloric intake requires a daily-level analysis.

Panel B of Table 2 applies the same econometric models to data measured at the daily level rather than the meal level. If calories consumed throughout the day substitute for each other, then people will compensate for larger portions at restaurants by consuming less throughout the rest of the day. Consistent with this prediction, the coefficient in the daily-level within-individual regression is substantially less than the corresponding estimate at the meal level. In fact, eating out increases intake over the entire day by only 35 calories — compared to an average daily caloric intake of 2,062 calories. Since individuals eat out on average only 0.4 times per day, the total effect of all restaurants combined only increases daily caloric intake by 14 calories on average. This effect is too small to account for more than a trivial fraction of the increase in BMI observed over the past several decades. The result implies that, although individuals tend to eat more at restaurants, they compensate to a substantial degree by eating less throughout the rest of the day.

Interestingly, this conclusion is consistent with results on calorie offsetting from controlled laboratory and field experiments in which individuals are offered meals of varying caloric content. Subjects offered more caloric meals tend to compensate by eating less later in the day, while subjects offered less caloric meals compensate by eating more later in the day.

CONCLUSION

Many policymakers and public health advocates design policies intended to reduce the impact of restaurants on obesity, even while they acknowledge that convincing evidence of such a link has proven to be elusive. For example, the Food and Drug Administration recently organized a forum in which participants proposed implementable solutions to the challenge of obesity in the context of away-from-home foods, even while the organizers cautioned that "there does not exist a conclusive body of evidence establishing a causal link between the availability or consumption of away-from-home foods and obesity."

Our findings indicate that the causal link between the consumption of restaurant foods and obesity is minimal at best. Exploiting variation in the distance to the nearest restaurant due to interstate highway proximity shows that restaurant access and restaurant consumption have no significant effects on obesity. Detailed analyses of food intake data reveal that, although restaurant meals are associated with greater caloric intake, many of these additional calories are offset by reductions in eating throughout the rest of the day. We also find evidence of selection — individuals that frequent restaurants also eat more when they eat at home. Furthermore, when eating at home, the food intake data reveal that obese individuals consume almost 30 percent of their calories in the form of "junk food" (ice cream, processed cheese, bacon, baked sweets, crackers, potato chips and fries, candies, soft drinks, and beer). Because obese individuals consume so many calories from nutritionally deficient sources at home, it may not be surprising that replacing restaurant consumption with home consumption does not improve health (as measured by BMI).

Our results contribute to a literature suggesting that regulating specific inputs into health and safety production functions can be ineffective when optimizing consumers can compensate in other ways. Although restaurants conveniently deliver calories at a low marginal cost, they are only one source among many. While taxing restaurant meals might cause obese consumers to change where they eat, our results suggest that a tax would be unlikely to affect their underlying tendency to overeat. But even if ineffective, such a tax has the potential to generate considerable deadweight loss as consumers switch to less convenient options. The same principle would apply to other targeted obesity interventions as well. Future research and policy proposals may find greater success if they are designed to account for the optimizing behavior of the targeted subjects. **R**

Readings

- "A Medium-Term Intervention Study on the Impact of High- and Low-Fat Snacks Varying in Sweetness and Fat Content: Large Shifts in Daily Fat Intake but Good Compensation for Daily Energy Intake," by Clare L. Lawton, Helen J. Delargy, Fiona C. Smith, Vikki Hamilton, and John E. Blundell. *British Journal of Nutrition*, Vol. 80, No. 2 (1998).
- "Caloric Compensation for Lunches Varying in Fat and Carbohydrate Content by Humans in a Residential Laboratory," by Richard W. Foltin, Marian W. Fischman, Timothy H. Moran, Barbara J. Rolls, and Thomas H. Kelly. *American Journal of Clinical Nutrition*, Vol. 52, No. 6 (1990).
- "Calorie Posting in Chain Restaurants," by Bryan Bollinger, Phillip Leslie, and Alan Sorensen. NBER Working Paper 15648, 2010.
- "Taxes, Cigarette Consumption, and Smoking Intensity," by Jerome Adda and Francesca Cornaglia. *American Economic Review*, Vol. 96, No. 4 (2006).